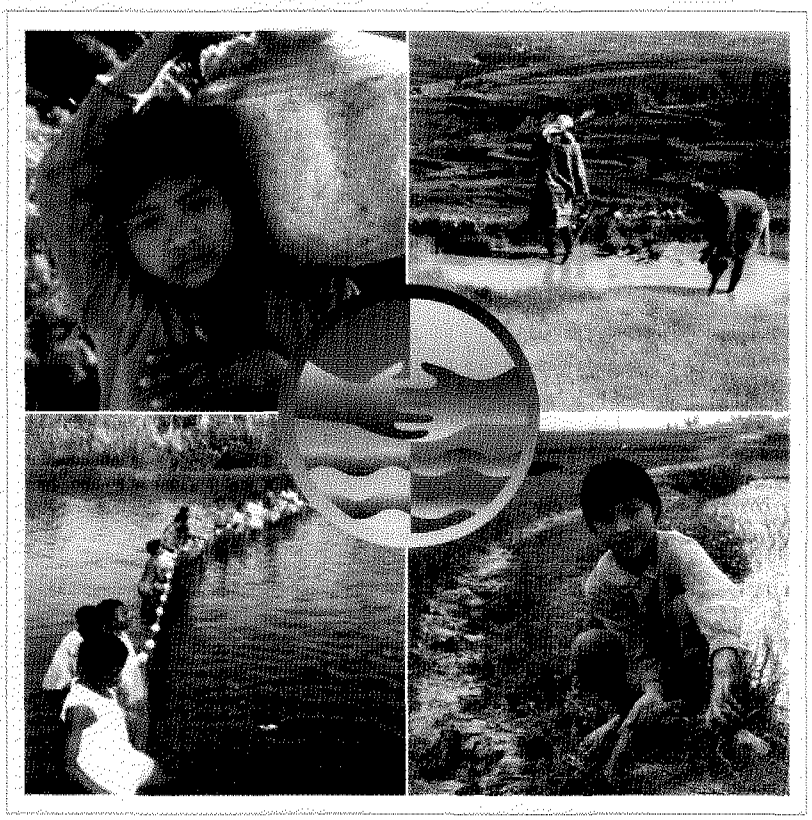
MESSAGES

TO INITIATE CONSULTATIONS FOR THE WORLD WATER VISION



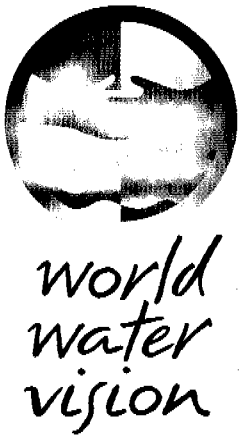
world water vision

WORLD COMMISSION ON WATER FOR THE 21ST CENTURY

WORLD WATER VISION PROJECT

MESSAGES

TO INITIATE CONSULTATIONS FOR THE WORLD WATER VISION



Second Draft, Work in Progress
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Notes:

1. Regional or national examples are given in this text to provide "a realistic feel" to the scenarios, not because they are the result of any in-depth analysis. The examples are felt to be realistic illustrations based on trends or occurrences seen today.

2. Boxes in the text are "real life" quotes, mostly from newspapers and newsletter clippings, provided as illustrations of the kinds of things the scenarios address.

3. This draft is circulated among people involved in the World Water Vision process in order to improve it to a stage where it can be used to stimulate discussions – and provide a common point of departure – in the sector, regional and network consultations for the World Water Vision. The global scenarios will evolve through the visioning process. In addition, the regional consultations are expected to lead to regionalised scenarios.

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Contents

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Gilberto Gallopin, of the Stockholm Environment Institute (SEI), drafted an initial document based on the panel discussions. Additional discussions among panel members and comments by others involved in the World Water Vision process helped flesh out the initial draft. This revised draft of the document was prepared by Gilberto Gallopin and Frank Rijsberman *(Deputy Director, World Water Vision Unit)*. The staff of the International Water and Sanitation Centre in the Hague provided many of the boxed examples.

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PREFACE

At the dawn of a new millennium, the world and its leaders are prepared to consider new ways of tackling problems that have been with us for decades. The start of the new century gives us an opportunity to rededicate ourselves to ensuring the basic human right of access to clean water.

The stakes could not be higher. Developing solutions to water-related problems would improve the quality of life for billions of people around the world—including the 4 million young children who die each year from water-related diseases. It would also ensure that water resources and the ecosystems on which life depends are protected for future generations.

We know that the future will not look like the past. Growing populations, urbanization, income growth, and the associated demand for more food and water to grow it will put more pressure on limited water supplies. Without appropriate action, water resources will become increasingly scarce, and economic growth throughout the world could decline. The need for action is thus critical.

The world water scenarios presented here represent the first step in creating a vision for the sustainable use of water resources. Feedback from regional and sector consultations will help us refine these scenarios to create a new vision for water, life, and the environment in the twenty-first century. Let us join together to think boldly about solutions that make a radical break from the past in order to ensure that the challenge of developing a viable vision is met.

Ismail Serageldin
Chair
World Commission on Water for the Twenty-First Century

1

The Need for a Vision in the Twenty-first Century

The scarcity of fresh water is one of the most pressing problems facing the developing world. Some 1.2 billion people in developing countries lack access to safe drinking water; another 2.9 billion lack adequate sanitation. Four million children die each year from water-related diseases, and women and children throughout the world spend billions of hours hauling water. Water is already a scarce resource in some parts of Africa and the Middle East, and the problem is expected to spread to other countries as population growth, urbanization, income growth, and the associated demand for more food and water to grow it put pressure on limited water supplies. Water scarcity and pollution also trigger the decline of fish and other aquatic life upon which much of the developing world depends for protein.

The challenge of improving access to water resources is daunting. But several positive changes may have positive implications for water usage. Population growth is slowing. Advances in technology may make it possible to reduce the cost of desalinization, grow food using less water, and track rainfall so that water is used more efficiently. Democratic and market forces are also likely to affect decisionmaking in a positive way in more and more parts of the world.

How will economic, social, demographic, and technological forces affect water? What policies and investments should be made to take advantage of those changes to meet future water needs and ensure the sustainable use of water? To develop a vision for water usage for 2025, the World Water Council created the World Commission on Water for the Twenty-First Century. The commission is cosponsored by all of the agencies of the United Nations (UN) that deal with water issues. It is supported by a secretariat based at UNESCO in Paris. Members of the commission, which includes distinguished scientists, economists, and policymakers from a variety of fields (see Annex A), will hold a series of meetings between September 1998 and March 2000. Over the course of that period, they will seek to:

- Develop knowledge about water and identify trends and developments in other fields that may affect the future use of water.
- Develop a vision for the year 2025 that is shared by water sector specialists, policymakers, the private sector, and civil society.
- Raise awareness of water issues among the general population and decision-makers in order to foster the political will and leadership necessary to achieve the vision.
- Use the knowledge and support generated to contribute to the Framework for Action to be developed by the Global Water Partnership and lay the ground for appropriate follow-up.

The Commission will present its vision at the Second World Water Forum and Ministerial Conference, to be held March 17-22, 2000, in The Hague.

2

Developing Alternative Global Scenarios

Developing a vision for improving access to water resources in the long term is difficult. Projections of social, economic, and demographic trends become unreliable as time horizons expand from months and years to decades and generations. Moreover, future outcomes will depend on human choices that have yet to be made. The difficulty of envisioning the future is compounded by our limited understanding of human and ecological processes and by the intrinsic difficulty of understanding complex dynamic systems.

If projections are unreliable and it is difficult to foresee future events, how can we think about the future in a meaningful way? How can we identify the requirements for a transition to sustainability in the water sector?

One way of approaching the problem is to use scenario analysis. Scenarios are not projections or forecasts. They are stories about the future that have logical plots regarding the manner in which events unfold (Schwartz 1991, Cole 1981, Miles 1981). A scenario is a hypothetical sequence of events constructed for the purpose of focusing attention on causal processes and decision points (Kahn and Wiener 1967). Considering scenarios as courses of events directs attention to the unfolding of alternatives and to branching points at which actions can significantly affect the future.

Scenario analysis challenges us to ponder critical issues and to explore the universe of possibilities for the future. Such analysis also clarifies different world views and values, challenges conventional thinking, encourages debate, and provides a common framework within which different stakeholders can address critical concerns and identify alternatives. Because scenarios embody the perspectives of their creators, either explicitly or implicitly, they are never value free. They draw on both science and imagination to conceive, articulate, and evaluate a range of socioecological pathways (Raskin, Chadwick, Jackson, and Leach 1996). Some scenarios may be more analytical (focusing on the unfolding of basic processes), while others may be more impressionistic (introducing specific vivid events for illustration). All scenarios need to be constructed with rigor, detail, and creativity, and they need to be evaluated for plausibility, consistency, and sustainability.

2.1 Global Futures Studies

Explorations of the global future have brought the problems of the environment and development to the forefront of political attention. Early work included mathematical simulation models (Meadows and others 1982, Herrera and others 1976, Mesarovic and Pestel 1974); qualitative exercises (Kahn and Wiener 1967; Kahn, Brown, and Martel 1976); input-output analysis (Leontieff 1976); and eclectic approaches (Barney 1980). Reviews and critiques of global assessments introduced fresh insights (University of Sussex 1973; Meadows, Richardson, and Bruckmann 1982) in the global modeling.

Recent global future studies have included narrative descriptions of alternative futures (Burrows, Mayne, and Newbury 1991; Milbrath 1989); optimistic (Dutch Central Planning Bureau 1992), pessimistic (Kaplan 1994), and unusual (Svedin and Aniansson 1987; Toth, Hizsnyik, and Clark 1989) analyses of the future; and the "official" United Nations Global Outlook (United Nations 1990). Recognition of the importance of climate change gave rise to numerous model-based world energy scenarios—foremost among them that of the Intergovernmental Panel on Climate Change (1992)—which generally remain within conventional notions of long-range development such as expressed in the UN Global Outlook. Recently several authors reexamined their earlier findings and—despite intense and sometimes rancorous criticism from

outsiders in the interim—confirmed the essence of their earlier conclusions (e.g. Barney, 1993).

Many global studies rely heavily on complex mathematical models. The aim is a desirable one of establishing a disciplined and internally consistent basis for understanding complex processes. But formal models can capture only those elements that are both reasonably well understood and amenable to quantification. They are not able to represent complex and open human systems. Overzealous reliance on mathematical models downgrades the importance of the underlying qualitative narrative of scenarios, so that the world behind the figures remains opaque.

Well-articulated scenarios include quantitative insight from scientific models, such as accounting frameworks (Raskin, Heaps, Sieber, and Pontius 1996) and mathematical simulation models (Hornung 1992). But they also develop a narrative and focus on key elements that are not quantifiable either in principle (cultural influences, behavior, and institutional responses to change, for example) or in practice (because of inadequate data or scientific theory). By including elements that are not quantifiable—the role of actions and choice, the effect of cultural preferences, social vision, and psychosocial factors that are not well understood—scenarios can provide a broader perspective than exercises that are heavily model-based. Quantitative analysis can provide structure, discipline, and rigor. Narrative can offer texture, richness, and insight. The art is in the balance.

The development of scenarios generally begins with a description of the current state and identification of the major driving forces. The driving forces are often associated with persistent and dominant phenomena and processes that are already ongoing or have become unavoidable consequences of events that have already happened. The major driving forces affecting the global water scenario, for example, include economic growth, demographic change, technological progress, social performance and environmental quality. The scenario may also identify critical uncertainties, resolution of which will fundamentally alter the course of events. Description of the current state, the major driving forces, and critical uncertainties are the central elements of the scenarios. In addition, all scenarios unfold according to an internal logic that links the elements into a coherent plot.

The priority global water scenario drivers used in this report are:

- **Economic growth**
- **Population pressure**
- **Technological progress**
- **Social performance**
- **Peace**
- **Environmental quality.**

The description and analysis of the mechanisms leading to alternative scenarios and the assessment of the likely efficacy of alternative actions is affected by one's world view, although that view is rarely made explicit. Only rarely are contrasting world views examined to show the effect on scenario analysis (Miles 1981). Critical reflection and explanation of the philosophical predisposition in forming a scenario is an essential aspect of scenario description and documentation.

All scenario exercises must organize the bewildering array of possible futures into some kind of taxonomy. Creators of scenarios must strike just the right balance in terms of the level of sophistication they achieve. On the one hand, the need to achieve analytical rigor and capture the full richness and texture of future possibilities suggests that a broad range of scenarios be examined. On the other hand, the desire to communicate findings to a wide audience of nonspecialists—and the need to operate within budget constraints—dictates brevity and clarity.

Weighing both considerations, the members of the Scenario Development Panel opted to explore three

scenarios—a conventional scenario, a crisis scenario, and a sustainable scenario. The scenarios are qualitative in nature, with mathematical models used to inform the scenarios where quantification is possible.

2.2 THE CONVENTIONAL WATER WORLD SCENARIO

The conventional water world scenario describes a world in which crises do not occur, but water resources are not used in a sustainable manner. Under this scenario, developments in the world are largely positive during the first 10-15 years of the next century. Later, however, the system becomes more and more vulnerable as a result of the increasing scarcity of renewable and accessible usable water resources per capita, the diminished quality of water in most of the world, and the narrower resource base of healthy ecosystems. The key water problems that are with us today— lack of access to safe drinking water and sanitation, recurrent flood and drought damage, high numbers of deaths from water-related diseases, drastic declines in species diversity, and so on— are not resolved in the conventional water world scenario. In fact, by 2025 the resilience of the natural and socioeconomic systems is being tested to the limit.

2.3 THE WATER CRISIS SCENARIO

The water crisis scenario portrays a more pessimistic future for world water resources. In this scenario institutional changes that could have supported technological improvements are not made. As a result, the vulnerability of the system increases faster than under the conventional water world scenario. The resilience of the ecosystems, including water resources, is stretched so far that it becomes a constraint on the economy. As a result, a vicious circle begins in which a weak economy and failing water resources negatively reinforce one another. Once this process begins, catastrophic events (major floods, dramatic spasms of species extinctions, terrorist attacks on major urban water systems, new viruses that are transmitted through the drinking water supply) could have devastating effects—sharply reducing consumer confidence in public water supply systems, for example, reducing international trade in food, or causing massive migration out of drought-stricken or flooded areas.

2.4 THE SUSTAINABLE WATER WORLD SCENARIO

Under the sustainable water world scenario, investment in education is made, and a strong commitment to averting a water crisis emerges. Efforts are focused on developing indicators of sustainable water use and on setting global and regional targets. Ecosystem restoration and conservation become principal objectives of water resources management. As a result of coordinated global efforts, sustainable water resources become a part of sustainable economic and social development.

3

The Conventional Water World Scenario

The conventional water world scenario describes a world in which crises do not occur, but water resources are not used in a sustainable manner. The world scenario is consistent with the recent scenario published by Shiklomanov (1997), with the efficient scenario of Seckler and others (1998), and with the conventional world scenarios of the SEI Global Scenario Group. It is more comprehensive than those scenarios, however, in that it deals more explicitly with the socioeconomic context than the Shiklomanov and Seckler scenarios and is more detailed in its treatment of water issues than the SEI Global Scenario Group scenarios.

Many factors will affect water resources over the next 25 years. The effect of these factors is described here and shown graphically in Chart 1.

3.1 Developments between 2000 and 2010

Changes outside the Water Sector

Economic Trends The conventional water world scenario assumes that following some setbacks caused by the Asian financial crisis, global economic growth resumes. Workers in industrial countries who are displaced from traditional sectors use their entrepreneurial skills to develop service businesses. Heightened appreciation for the need to rehabilitate and protect the environment increases demand for environmental services.

Governments increasingly recognize that their most important role is to provide the regulatory framework to protect citizen-consumers rather than to provide services directly. Financial institutions thus increasingly provide funding to the private sector, which is better able than the public sector to invest profitably.

Increased material and energy efficiency allows output to be produced using fewer natural resources. Nevertheless, rapid economic growth results in increasing demand for water and other natural resources and in an increase in emissions of pollutants. As a result of excessive water withdrawls, physical habitat alteration, and pollution, the precipitous decline in the abundance and diversity of aquatic life continues. This decline undermines several industries, including fisheries, recreation, cultured pearls, caviar, and others.

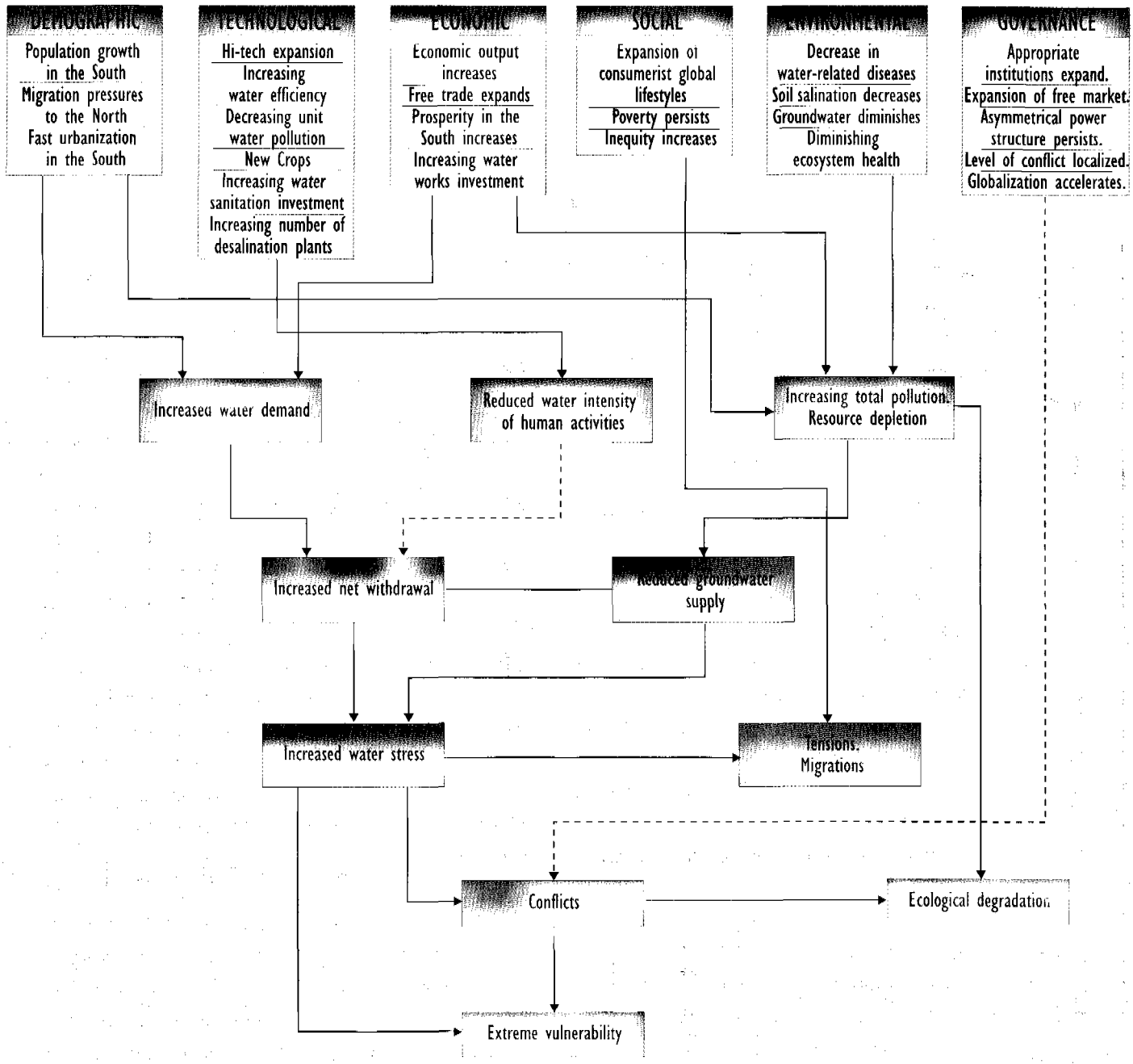
Access to market information and lower transactions costs allow developing countries to capture a larger share of the world market, and incomes in those countries rise. Much of the new income remains in the hands of a relatively small segment of the world's population, however. Within countries, income inequality increases.

Demographic Trends The global population continues to increase, reaching 8 billion people by 2025. More than 80 percent of the world's population—6.6 billion people—live in developing countries. Throughout the world, the population is older and more urban. About 84 percent of the population in industrial countries and 56 percent in developing countries live in urban areas.

Pressures for migration from the South to the North build, as a result of poverty in the South and the income differential between the two regions. Those pressures are maintained within manageable levels, however, as income continues to rise in the South and interregional migration toward more prosperous areas increases. Some industrial countries with aging populations open immigration to compensate for the loss in their economically active population, but the effect is not significant globally.

Technological Trends The introduction of crops that are resistant to drought, salt, and pests increases yields and allows expansion of potentially arable land. In 1996

Chart 1: Conventional Water World.



Dotted lines = weak influences.

some 7 million acres of land were planted with transgenic crops. The figure rose to 31 million acres in 1997 and to more than 75 million acres in 1998. Continuation of this trend makes developing rainfed agriculture the most effective way to expand food production on a global scale.

The growth of transgenic crops has different effects on different continents. In Europe lack of public acceptance of the crops reduces food imports, causing higher food prices and increasing demand for water to produce food domestically. In Africa widespread adoption of transgenic crops increases intra-African food exports from countries that adopted the new crops first.

Rapid progress takes place in the development of information technology, biotechnology, and new materials. Advances in energy technology lead to a significant decline in the cost of electricity. Global hydropower production increases initially but eventually levels off, never becoming a significant source of global energy. Hydropower development is critical to water resources policy in some regions (such as South America) and in some countries (such as Turkey). Energy requirements in South Africa and the Middle East lead to development of half of the potential of the Zaire Basin in Africa—a resource that remained unharnessed at the beginning of the century but contains 20 percent of the world's hydroelectric capacity. Alternative sources of energy, such as solar and wind energy, do not capture a significant share of the energy market.

Information technologies are widely available and lead to large improvements in production and in the efficiency of water management. Unlimited use of a global telecommunications network became widely available early in the new millenium: after paying a small fixed cost to subscribe, voice data transmission (telephone conversations) became free. Revenues of telecommunications companies became based on image transmissions.

Lower energy costs and improvements in technology sharply reduce the cost of desalination (to about $0.25-$0.5 a cubic meter for seawater by 2025). The decline makes desalinization of brackish water and seawater a realistic alternative for domestic and industrial (but not agricultural) water use in areas in which water is scarce. Most urban areas in the Middle East and Arab Peninsula that are within a few hundred kilometers of the sea depend largely on desalinization.

SOCIAL TRENDS Per capita material and energy consumption increase as lifestyles throughout the world become more like those in the North. Cultural globalization is facilitated by the growth of global satellite systems and the Internet. Income inequality between and within rich and poor countries increases tensions, but conflicts over social issues that do occur remain largely within national boundaries. International terrorism and drug cartels become ever more sophisticated and truly global enterprises.

Relative poverty decreases, and absolute poverty remains at roughly its current level. The absolute number of hungry people in low-income countries falls by about 50 percent. The purchasing power of all but a small minority of the inhabitants of large urban areas in the South, where water problems are most critical, remains very low. As a result of the trend toward privatization and globalization that began at the end of the twentieth century, transnational corporations and global corporate alliances influence national and international political decisions to a much greater extent than they did at the beginning of the century.

ENVIRONMENTAL TRENDS Emissions of total carbon and other pollutants continue to grow, although they increase less rapidly than the economy. The prospect of serious global climate change increases pressure to reduce emissions and possibly energy use itself. Global greenhouse gas emissions continue to increase, but their impact is minor. Although climatic variability increases and extreme weather events occur more frequently, no global crises occur as a result of greenhouse emissions. The impact of the few regional crises that do occur is mitigated by international relief operations.

The level of water pollution per unit of production gradually diminishes, but total water pollution rises significantly, driven by economic and population growth. In the North problems with toxic (micro-organic) pollutants and new strains of waterborne viruses in groundwater become

the main concerns. Pollutants in surface water are also a critical concern regionally and locally. In the South illness caused by untreated excreta, inadequate sewage and wastewater disposal, and reduced oxygen levels (as a result of degraded ecosystems) continue to dominate the agenda.

Changes in land use increasingly affect water resources, particularly as a result of deforestation in moist tropical areas and increased grazing in the dry lands, which accelerate soil erosion and silting of water reservoirs. On the positive side, salinization of irrigated areas is reduced through improved management. Critical watersheds are put under protected status, but conflicts still arise, particularly where rainfed agriculture expands rapidly.

The integrity and health of aquatic ecosystems, particularly in coastal areas, continues to be degraded by encroaching settlement and pollution. Improved sanitation and water management keep the incidence of water-related diseases at the levels that existed at the end of the century, however. No major epidemics of cholera or typhoid occur, but the chronic impact of poor water quality remains a major health problem in the South, with curable water-related diseases, such as diarrhea, continuing to claim the lives of millions of people, particularly young children.

Structural alterations of rivers, intended to secure dwindling water supplies and reduce flood damages, eliminate aquatic habitat and alter natural flow regimes. These changes contribute to a steady decline in the wealth of aquatic life.

The conversion of wetlands into arable land and residential areas is slowed. The process is not halted, however, let alone reversed, except in some countries in the North, where public outcry over the last remaining wetlands leads to costly actions to re-create small protected areas. In the Netherlands, for example, some reclaimed areas are turned back into wetlands to reduce the scarcity of seminatural areas for recreation and wild life purposes.

In the South the increasing market for water-based tourism activities produces mixed results. While some countries (such as Costa Rica and the Maldives) adopt policies that protect the natural capital on which their tourism is based, other countries (such as Spain, Greece, and Thailand) overexploit their resources and see their tourism revenues decline.

BOX 1.

The Living Planet Index

The living planet index is a measure of the health of global ecosystems and biodiversity, based on data showing the average change over time in the state of forest, freshwater, and marine ecosystems...The freshwater ecosystems index dropped by 50 per cent [between 1970 and 1995]...the average rate of decline was almost 6 percent per year.

Source: World Wide Fund for Nature Living Planet Report, 1998.

Changes within the Water Sector

In some areas with limited water and rapid population growth, the development of water infrastructure lags behind population growth, and the number of people without access to safe water increases. In most parts of the world, however, economic growth, combined with technological improvements, result in better living conditions, including increased access to safe drinking water.

The quantity of water used for agriculture rises because of the increase in irrigated land (requiring large volumes of water) during the last few decades of the twentieth century. Water is used more efficiently in agriculture, however, particularly in the water-stressed areas of the South. The change reflects the use of more efficient irrigation systems, such as drip irrigation, as well as the development of crops that require less water. These gains only partly offset the increase in water withdrawals for irrigated lands. A shift from irrigated to rainfed agriculture takes place because of higher yields for rainfed agriculture, reducing the level of water used in agriculture.

Large-scale groundwater withdrawals are concentrated in a relatively limited number of (large) countries (table 1). Groundwater levels in many renewable aquifers gradually decline because withdrawal exceeds the recharge. Nearly half of India's irrigated areas use groundwater for irrigation, pumped by farmers with access to heavily subsidized electricity. As a result, the water table declines 1-3 meters a year, putting millions of people at risk in the medium term. In cities such as Sana'a, Yemen, accessible renewable water supplies are exhausted because terraces and catchment schemes are abandoned by an increasingly urbanized population. Drinking water supplies for such cities are found by drilling costly wells to fossil aquifers at depths of more than 2 kilometers .

In regions in which water is scarce, food needs are increasingly met through imports rather than through an increase in irrigated areas. Increased dependency on food imports increases vulnerability to international price fluctuations.

INFRASTRUCTURE INVESTMENT Mainly because of capital flows from the private sector, investment in water infrastructure (new infrastructure and maintenance) grows at the same pace as the economy, except in some subregions. In the North investments in urban water supply infrastructure rise sharply in response to the need to rehabilitate systems, remove micro-organic pollutants from the water supply, and meet higher standards for treating sewage. The cost of urban water supply and sanitation rises to $5-$10 a cubic meter.

In the South official development assistance declines, reducing the level of investment in water infrastructure in many countries. In the wealthier countries, the private sector steps in. In most of the world, however, the lion's share of investment in water and sanitation infrastructure continues to come from national governments. Poor public sector performance in managing and maintaining this infrastructure makes it difficult to increase contributions from users or to attract private sector investment.

Many piped water supply systems supply water that does not meet drinking water quality criteria, forcing an increasing number of residents to rely on bottled water bought in the markets (as they already do in cities in Thailand, Colombia, and Venezuela). The poorer sections of many developing countries rely on water vendors, who supply water by truck. The water they supply is of unreliable quality and costs 10 times as much as piped water.

TABLE 1.

ESTIMATED GROUNDWATER ABSTRACTION RATES, 1990
(in cubic kilometers per year)

AREA	VOLUME OF WATER ABSTRACTED
China	53
India	180
Mediterranean countries	55
United States	110
World	600-700

GOVERNANCE AND INSTITUTIONS International conferences on water conservation and sustainable management continue to take place, but little consensus is reached. The water issue is perceived by many nations as a national rather than a global issue (except in the cases of shared watersheds). A Social Water Charter is adopted in 2000 (at the time of the Second World Water Forum), but it is not implemented. An increasing number of countries do work to jointly manage water-rich watersheds, increase water use efficiency, conserve water resources, and reduce the risk and level of conflict. However, in water-scarce international basins, cooperative solutions prove hard to find. Regional and river basin-level water conventions (such as those already in force for the Rhine and Danube Basins) are implemented, but no effective solution is found for dealing with conflicts of interests among countries sharing the same watercourse.

Radical policies for water management, such as rationing, are implemented only in countries or small regions facing serious water deficits during times of local drought (northern New Zealand, the southwestern United States, South Africa). Most other countries remain confident that technological progress will eventually solve the problem.

Under the influence of the World Trade Organization, most countries reduce water subsidies. In some places the reduction results in increases in the efficiency of water used for agriculture. In countries such as India, however, policymakers find it difficult to increase tariffs for energy, and large-scale pumping of groundwater for agriculture continues.

In the several countries that have privatized their water supply systems, concerns are raised about the lack of necessary investment in infrastructure and the fact that these private monopolies are poorly regulated. Community-based

BOX 2.

Maize farmers in the Alsace (France) refuse to pay for irrigation water

The maize farmers in the Alsace region in the North-East of France have never paid for their irrigation water. They are pumping 35 million cubic meters annually from Europe's largest groundwater reservoir to irrigate 50 thousand hectares of maize that have transformed a poor agricultural zone into a prosperous region over the last several decades.

Despite several court orders to pay, the farmers maintain that they have been given the right to pump water in the 1959 agreement to construct the grand Alsace canal for hydroelectric purposes. Elsewhere in Europe maize producers pay 15-20US$ per hectare for irrigation water.

Source: Le Monde, 12 March 1999

actions and new forms of public-private partnerships that mobilize water users to develop their own systems show encouraging results locally, but these efforts lack the scale and clout to tackle the water needs of larger urban or poor rural areas. Large utilities and service companies in the telecommunications and energy markets consider entering the water market, but the lack of a stable, regulated market environment in most countries keeps most companies out of the sector.

BOX 3.

Estonians Cut Water to Russian Town

Last year the Estonian town of Narva carried out its threat to cut off the water supply to its Russian neighbor, Ivangorod. The incident took place after Ivangorod failed to pay its $1.5 million (EUR 1.29 million) water bill.

Ivangorod's new partially completed water pumping station, financed with $1 million (EUR 862,000) from the Russian government, can supply about two-thirds of the town's water needs. Pressure is not sufficient to lift water beyond the first floor in some areas, however.

The Russian city received drinking water and sewage treatment from Narva for decades during the Soviet era. Today it discharges its untreated sewage (7,900 cubic meters a day) via a river into the Baltic Sea.

Source: http://www.wsscc.org/source/weekly/9839.html#estonians and Source, 16 November 1998

3.2 DEVELOPMENTS BETWEEN 2010 AND 2025

Changes outside the Water Sector

Economic growth continues, interrupted by occasional regional and national setbacks, driven largely by the same factors that spurred growth in the earlier period. By 2025 global GDP reaches more than $80,000 trillion in purchasing power parity (a real increase of 2.5 times above 1995 levels). During this period, an increasing share of growth – in absolute terms – occurs in the developing world. However, economic inequality in terms of income per capita increases, particularly within countries, and the survival of large masses of people is threatened by the incapacity or unwillingness of the international system to provide lasting relief. Fears grow that the unmet needs of sizable segments of the world's population will lead to a spiral of increasing repression, conflict, and emigration, further compromising economic recovery.

Attempts to grow food in non-arable lands lead to deforestation and environmental degradation, reducing water quality and increasing flooding. Large-scale floods, such as those in the Yangtze Basin in 1998, claim a significant share of the economic benefits generated in those floodplains and cause considerable loss of life.

Economic growth in many industrial countries causes overuse of water resources, reducing stocks below the minimum level required to maintain the integrity of aquatic ecosystems. Elsewhere in the world, economic growth is constrained by problems in the water sector. In Zimbabwe, for example, the fact that most water rights are held by a small minority is a major obstacle to national economic development.

Changes within the Water Sector

The availability of global renewable water resources falls from an average of 7,800 cubic meters a year per person

BOX 4.

Israel cuts Jordan's water share

Israel told Jordan it would be forced to cut the amount of water it supplies the desert kingdom this year under a 1994 peace treaty due to an unusually dry winter.

"The water commissioner clarified that the peace treaty with Jordan does not take into account what should be done at times of severe climatic crisis," Foreign Minister Ariel Sharon's office said in a statement.

Israel committed in the treaty to transfer to Jordan fixed quantities of water per year from shared sources in the Sea of Galilee and the Yarmouk and Jordan Rivers, and agreed to find ways to boost supply further to its neighbour. The statement said poor rains had depleted water resources to their lowest point since 1980 and that Israel had proposed reducing supply for 1999 to a percentage of a normal year.

The decision came on the heels of a report by US, Israeli, Jordanian and Palestinian water scientists that warned that unless countries in the region cooperate, there may be even drier times ahead. Water supplies in the region "are barely sufficient to maintain a quality standard of living," said Gilbert White, chairman of the group.

Source: INTERNET: IWRAnews@uwin.siu.edu, 16 March, 1999 and International Herald Tribune, 4 March, 1999

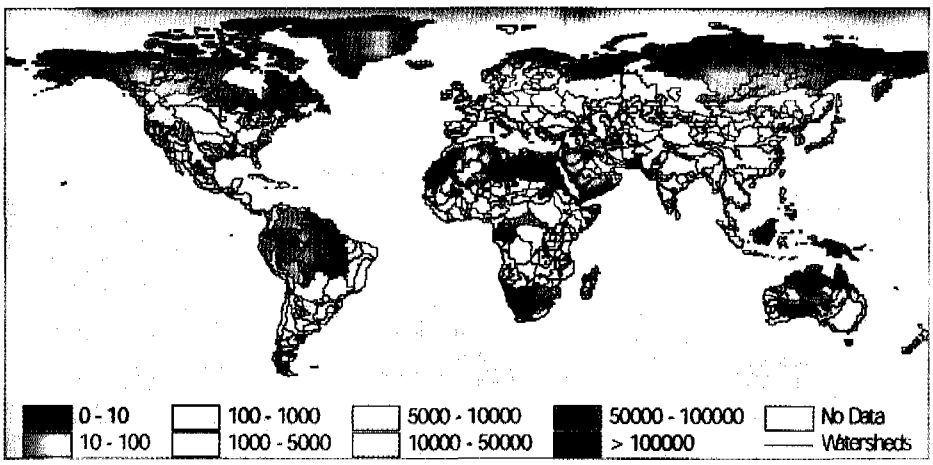
TABLE 2.

ESTIMATED AND PROJECTED VOLUMES OF AVAILABLE RENEWABLE WATER RESOURCES, BY CONTINENT, 1990 AND 2025

CONTINENT	CUBIC KILOMETERS/YEAR	CUBIC METERS PER CAPITA IN 1990	CUBIC METERS PER CAPITA IN 2025
Europe	2,900	3,990	3,920
North America	7,770	17,800	12,500
Africa	4,047	6,180	2,460
Asia	13,508	3,840	2,350
South America	12,030	40,600	24,100
Australia and Oceania	2,400	85,800	61,400
Total	42,655	7,800	4,800

SOURCE: SHIKLOMANOV 1997.

FIGURE 1

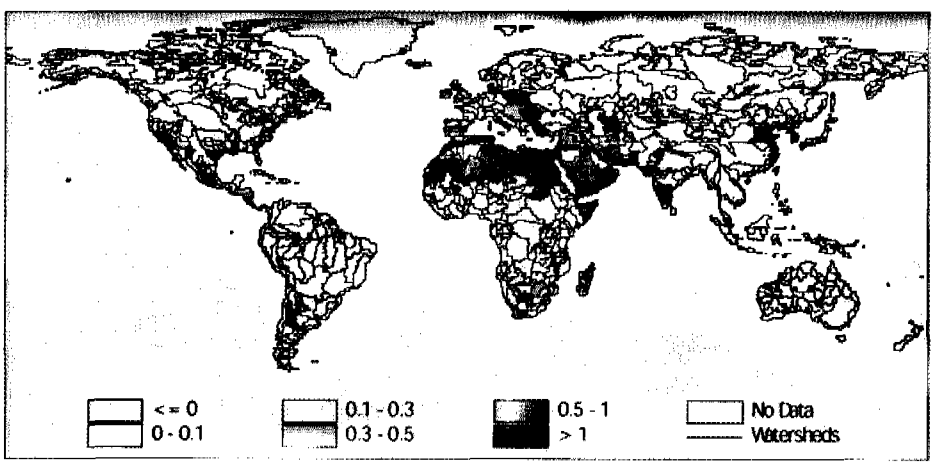


WATER AVAILABILITY IN 2025 (m^3 PER CAPITA AND YEAR)

Figure 1. This map shows a scenario for year 2025 of the amount of water available per person in individual watersheds. The redder the color, the smaller the amount of water available to the population in the watershed. These watersheds could either have large populations or be water scarce. Either way, the amount of water available is small compared to the population.

"Water availability" is the annual runoff plus shallow groundwater recharge. These calculations were carried out by the WaterGAP 1.1 model and refer to a "medium scenario" of changes in regional population, income and water intensity.

FIGURE 2



INCREASE IN WATER USE 1995 TO 2025 RELATIVE TO CURRENT WATER AVAILABILITY

This map shows the computed increase in water use in individual watersheds between 1995 and 2025, divided by the current water availability. The redder the color the greater the pressure put on available water resources by increasing water use. In the watersheds marked red, the increase in water use is large compared to the size of the water resource.

"Water use" in this case means total annual withdrawls in the domestic, industrial and agricultural sectors. "Current water availability" is the annual runoff plus shallow groundwater recharge averaged over the so-called "climate normal" period of 1961 to 1990.

BOX 5.

Water Crisis Looms in Gujarat, India

Worsening water pollution is leading to a major water crisis by the turn of the century in the Indian state of Gujarat, according to the former chairman of the Central Water Commission, V.B. Patel, and the Director of Water Management Forum, Shamji Antala. In several areas of the State, the demand for and use of water have already outstripped supply. Per capita water use is 700 cubic meters a year in some parts of the state, while only 650 cubic meters of water were available. Severe water pollution in central and south Gujarat has worsened the situation in the Saurashtra and Kutch regions, and even north andcentral Gujarat are beginning to experience problems.

Source: Indian Express, 4 January 1999.

TABLE 3.

Estimated and Projected Global Water Use, by Sector, 1950, 1990, and 2025 (in cubic kilometers per year)

ITEM	1950	1990	2025
WORLD POPULATION (MILLIONS)	**2,493**	**5,176**	**8,284**
IRRIGATED AREA (MILLIONS OF HECTARES)	**101**	**243**	**329**
AGRICULTURAL USE			
Withdrawl	1,124	2,412	3,162
Consumption	856	1,907	2,377
INDUSTRIAL USE			
Withdrawl	1,124	2,412	3,162
Consumption	14	73	146
MUNICIPAL USE			
Withdrawl	53	321	645
Consumption	14	53	81
RESERVOIRS (EVAPORATION)	6	164	275
TOTAL			
Withdrawl	1,365	3,580	5,187
Consumption	894	2,196	2,879

Source: Shiklomanov1997.

in 1990 to 4,800 cubic meters a year per person in 2025 (table 1 and Figure 1). More informative than continental or world averages are the estimated water resources in dry areas, such as the Arabian Peninsula, where only 240 cubic meters of water will be available per person by 2025 (Shiklomanov 1998).

Water withdrawals increase as a result of economic and population growth and irrigation expansion (table 2). This is a somewhat conservative (i.e. high use) scenario when compared to the forecast developed by Seckler and others (1998).The latter estimate water use for irrigation at 3,367 cubic kilometers a year, if efficiency remains at the level of 1990, but that this may go down to 2,413 cubic kilometers a year with an improved irrigation efficiency of 70 per cent in most irrigated areas. In 2025, however, it becomes clear that Shiklomanov's projected 3,163 cubic kilometers annual usage for irrigation have been more reliable, based on a more moderate increase in efficiency of water for agriculture that has actually occurred. For municipal and industrial water withdrawal Seckler's estimates were considerably lower than those of Shiklomanov (table 3) reaching 1,193 cubic kilometers per year in 2025.

As for irrigation, it turns out in 2025 that Shiklomanov's estimated increases in water withdrawals and use by continent in the period 1950–90 to 2025

TABLE 4.

Estimated and Projected Global Water Use, by Continent, 1950, 1990, and 2025 (in cubic kilometers per year)

CONTINENT	1950	1990	2025
EUROPE			
Withdrawl	94	491	619
Consumption	39	183	217
NORTH AMERICA			
Withdrawl	286	642	836
Consumption	107	225	329
AFRICA			
Withdrawl	56	199	331
Consumption	45	151	216
ASIA			
Withdrawl	859	2,067	3,104
Consumption	654	1,529	1,971
SOUTH AMERICA			
Withdrawl	60	152	257
Consumption	45	91	123
AUSTRALIA AND OCEANA			
Withdrawl	10	29	40
Consumption	5	16	23
TOTAL			
Withdrawl	1,365	3,580	5,187
Consumption	894	2,196	2,879

Source: Shiklomanov1997.

shown in Table 4 have proven to be more accurate, as countries did not change their practices enough to reach the more efficient (lower use) levels. A map of increases in withdrawals that occurred over the period 1990-2025 by watershed is given in Figure 2.

Increased technological efficiency and improved management prevent dramatic water crises. Continued water degradation, reduced groundwater levels, ever-scarcer sites for new dams, and the increasing costs of developing new water supplies increase the system's vulnerability to crises, however. Consumer confidence in technological solutions is eroded by realization of the extent of water quality problems. That this is not unrealistic follows from the example of Bangladesh, where more than 40 percent of the millions of wells drilled over the past several decades already provide drinking water that is tainted with arsenic. It is not possible to mitigate longer than average droughts because of lack of buffer water capacity. Even in industrial countries, technological progress proves insufficient to provide adequate long-term solutions to resolve water sustainability issues.

The problems apparent at the beginning of the millennium become more critical by 2025, and resolution does not appear near. In addition, the increased share of total renewable water resources used to meet the increased demand, together with deteriorating water quality, leave the system more vulnerable to events that may trigger a chain of negative consequences. Triggers could include a major drought, a flood, or the epidemic outbreak of waterborne diseases. The impact of such events would initially be felt largely at the regional level, but there is a fear that other triggers could have similar consequences in other regions, possibly setting off a global water crisis.

BOX 6.

United States and Canada Try to Resolve Disputes over Shared Water Resources

In February 1999, following a Canadian ban on water exports, the federal governments of the United States and Canada asked the International Joint Commission to examine and report on the use, diversion, and removal of waters along their common border. The governments noted that "boundary water resources continue to be the subject of ever-increasing demands in the light of expanding populations" and that "proposals to use, divert and remove greater amounts of such waters can be expected."

The request from the two governments came in the wake of Canadian private company proposals to export water overseas and litigation involving the export of water from Canada to the United States. Both governments are concerned that existing management principles and conservation measures may be inadequate to ensure future sustainable use of shared waters. "The importance of binational cooperation in addressing these critical issues cannot be overstated," said Leonard Legault, Chairman of the International Joint Commission's Canadian Section in response to the governments' request.

Contact: More information, including the full text of the letter of reference, may be found on the Commission's Web site, at http://www.ijc.org.

4

The Water Crisis Scenario

The water crisis scenario describes a world in which a weak economy reduces the quality of water resources, which then further retards economic growth. The lack of resilience of the system means that catastrophic shocks that would have been absorbed in the conventional scenario have dire consequences both regionally and globally.

4.1 Developments between 2000 and 2010

Changes outside the Water Sector

The initial assumptions on demographic changes are identical to those in the conventional scenario. In many parts of the world, material living conditions and access to drinking water improve. In some regions, however, the standard of living remains constant or declines as a result of slow economic growth, water scarcity, and rapid population growth.

As in the conventional water world scenario, the market is the major economic driving force. Global economic growth accelerates initially, raising demand for resources, including water, and increasing pollution. Growth is slower than in the conventional water world scenario, however, and capital flows away from emerging markets, which are perceived as too risky.

Commodity prices remain low. As a consequence, income inequality between poor and rich countries increases, and both relative and absolute poverty rise. Pressures for migration build, fuelled by local scarcities and income inequities.

Changes within the Water Sector

Fierce competitiveness among nations causes the efficiency of resource use to improve less than in the conventional scenario. Improvements in efficiency are more modest than in the previous scenario because such improvements are implemented only if they produce short-term profits. Long-term investments in reengineering industrial and agricultural processes are delayed unless they can be demonstrated to increase current competitiveness.

New technology increases the efficiency of water withdrawals. As a result, global withdrawals grow only slightly faster than historically, and investments in water infrastructure grow at the same pace as the economy.

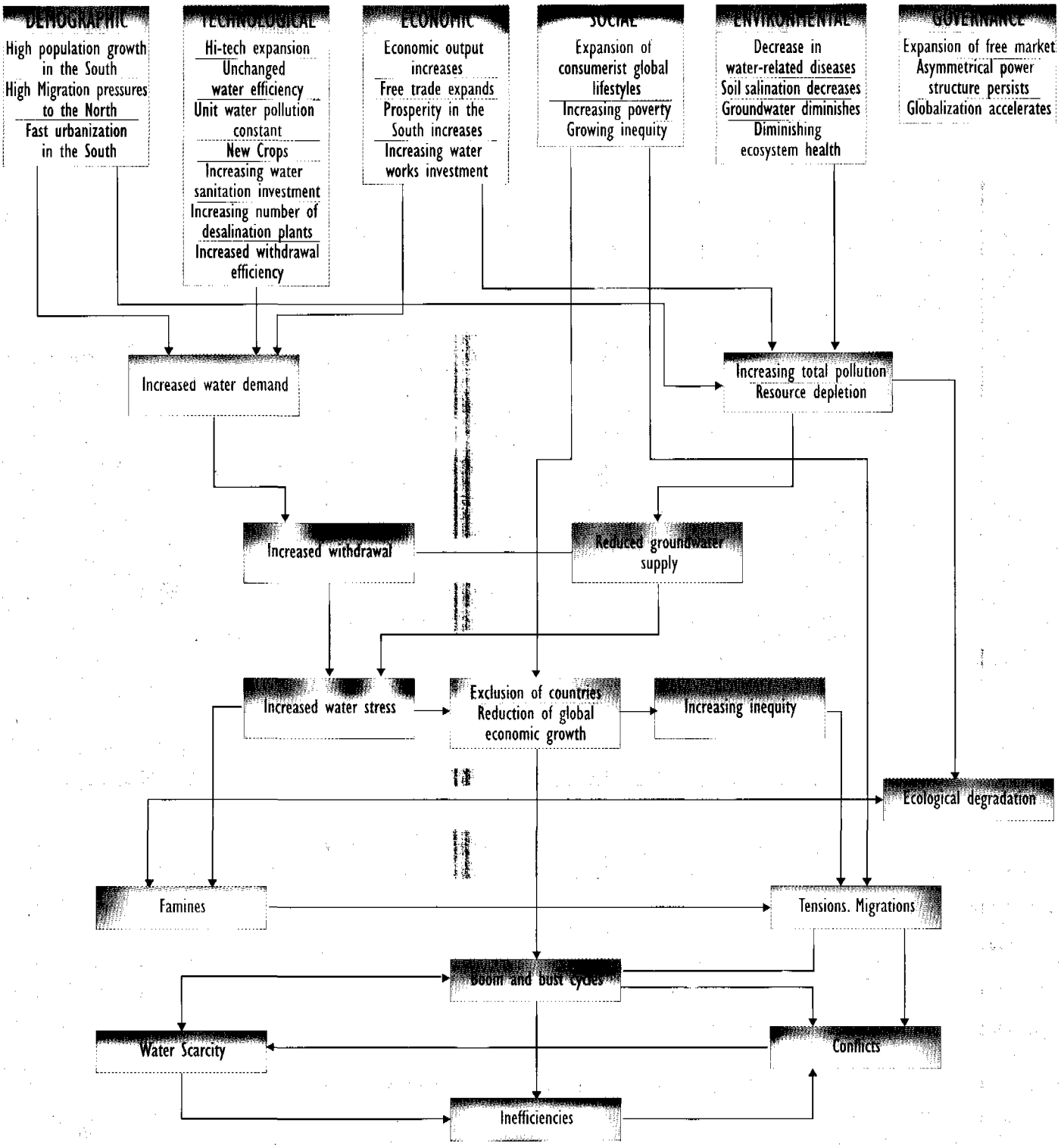
By 2010 many countries, mostly in Africa, South and East Asia, and the Middle East, are encountering a high level of water stress. With the exception of Canada and the Scandinavian countries, all countries suffer some degree of water shortage in at least some parts of their territory. The response is to continue to build more water infrastructure and increase withdrawals.

By the end of the period, events will be shaped by the following factors (shown graphically in chart 2):

- Economic globalization expands the world economy, but trade conflicts reduce the overall rate of growth.
- Technological developments, including some breakthroughs, are available and applied in some parts of the world but not in others, thereby increasing inequities.
- Global food production and trading systems become vulnerable to disruption.
- Economic disparities between and within countries grow, increasing social tensions and pressures for migration.
- Despite technological advances that improve water resources management, water withdrawals continue to grow, resulting in acute water shortages in many countries.

Little progress is made toward solving current critical water problems on a global scale.

Chart 2: Water Crisis



4.2 DEVELOPMENTS BETWEEN 2010 AND 2025

Changes Outside the Water Sector

Natural resource systems may become unstable as their resilience decreases and they are increasingly vulnerable to shocks that could once have been absorbed. Shocks can trigger reactions that result in a qualitative change in the behavior of the system. The new behavior may become stable, thus making it difficult or impossible to return to the earlier condition. Environmental degradation thus leads to natural resource and human catastrophes, which in turn slows global economic progress, creating a vicious circle of disasters.

ECONOMIC TRENDS Global cooperation is undermined by the scarcity of water, the emphasis on economic competitiveness, and the high degree of inequity. A global economic boom and bust cycle materializes, with crises at the level of regional economies, and with emerging economies exploiting their water-based comparative advantages. Water rich countries such as Brazil and other South American countries, the Nordic countries, and Canada do particularly well in this regard, both in terms of hydropower production, virtual water exports (e.g. foodstuffs) as well outright physical water exports. The system's instabilities are reinforced by environmental and social tensions, and alternative economic systems proliferate. A turbulent mixture of open and closed economies exists, sometimes successively in the same country.

BOX 7.

Struggle for water drives players in the Kurdish conflict

The recent capture of Abdullah Ocalan has focused new attention on the Kurdish conflict. Lurking behind the many reasons why Mr. Ocalan found foreign supporters and the Turkish Army fought him so fiercely, is water. Syria and Iraq have supported Mr. Ocalan's guerrillas as a way of applying pressure on Turkey to give them more water.

Turkish President Suleyman Demirel and the late president Turgut Ozal, both water engineers, vigourously supported the South Anatolia project, a vast system of dams and hydrolectric plants that Turkey has built in the region where Kurds predominate.

The strong partnership between Turkey and Israel emerged when another water engineer, Yitzhak Rabin, was in power in Israel. "If we solve every other problem in the Middle East but not water, then our region will explode", Mr. Rabin once said. The late King Hussein of Jordan asserted that water conflicts "could drive nations of the region to war".

"Water has been used as a means of pressure, for example the Syrians sponsoring Kurdish separatism because they want more water", said Ishak Alaton, a Turkish businessman who won a contract to build an undersea water pipeline to Turkish-Cyprus and is conducting a feasibility study for a pipeline to Israel. Mr. Alaton: "You can't overstate water's importance. Just as the 20th century was the century of oil, the 21st century will be the century of water".

Source: International Herald Tribune, March 2, 1999

Political instability increases, slowing economic growth and also leading to tremendous inefficiency in the use of resources and a lowering standard of living. Infrastructure built during periods of prosperity suffers from lack of maintenance during the lean phases, and long-term planning becomes sidetracked in the face of increasing economic and environmental uncertainties.

TECHNOLOGICAL TRENDS Science and technology systems suffer from lack of long-term research. As a result, technological progress slows. Innovations concentrate heavily on serving the needs of rich consumers and/or meeting security and military needs.

SOCIAL TRENDS People who have fled from areas affected by catastrophes are forced to return to their original lands, which are ecologically degraded. Immigrants are forced to return to their home countries once economic conditions in their host countries sour. Within countries people who left the countryside for large cities lose their jobs there and are forced to return to their villages.

Output of food increases, but the incidence of hunger has risen. Requirements for energy and water increase significantly. Resource use efficiency decreases, as a result of economic turbulence, slow economic growth in some regions, and a slowdown in the rate of technology transfer. Long-term cooperation is weakened and is directed primarily toward emergency and crisis relief.

Environmental Trends Higher prices and decreased global stocks of food lead many countries to combat famines by expanding rainfed agriculture into unsuitable soils, increasing deforestation, soil erosion, and environmental degradation. As a result of water scarcity caused by expanded irrigation and economic development, particularly in Africa, India, and China, the ecological thresholds required to protect ecosystems are violated. The result is widespread degradation of aquatic and terrestrial ecosystems and a series of dramatic species extinction spasms. With ecological resilience lost in those areas, some of the effects reverberate globally. Episodes of large-scale ecological collapse become more frequent. Forests that were converted to agricultural land turn into dustbowls or wastelands, inland freshwater bodies become eutrophied, marine fisheries collapse, and catastrophic floods triggered by loss of ecological regulation at the watershed level become more frequent.

BOX 8.
Declines in Aquatic Biodiversity

Twenty-five to thirty percent of freshwater fish are vulnerable, endangered or extinct. Of seven freshwater dolphins, one is vulnerable, 2 are endangered, and 1 is critically endangered. Likewise, of 23 crocodile species, 10 are threatened. Of 143 species of tortoises, turtles, and terrapines, 82 are threatened or near-threatened, most being freshwater turtles.

Source: World Bank Environment Department, April 1998.

BOX 9.
Prisoners Riot for Drinking Water and Food in Honduras

Inmates of the overcrowded national penitentiary in Honduras killed four prisoners after riots broke out over demands for more drinking water and food and the repair of the sewage system. The penitentiary population expanded from 400 to 2,500 after flooding caused by Hurricane Mitch forced the older central prison to be evacuated.

Source: C-News, 17 December 1998

INTERACTION OF DRIVING FORCES Environmental, social, and economic resilience become so fragile that the global system is unable to absorb even normal perturbations. A drought year means famine for millions; an El Niño event causes the crash of several national economies. Mortality rates increase significantly among both traditionally poor and newly impoverished countries. As a result, population growth is lower than in the conventional water world scenario and human suffering is higher. People die as the first episodes of global warming occur. A low-level equilibrium trap is established involving economic instability, technological inefficiency, social conflict, poverty, and water scarcity.

Changes within the Water Sector

Water use efficiency is decreasing, and investment in the social infrastructure falls. Poor maintenance causes the social infrastructure to erode, further reducing social resilience.

The price of water rises. Both powerful countries and corporate alliances look to water-surplus areas, such as the Congo and Amazon Basins, to grow their food in order to spare their water reservoirs for industrial and domestic use. Forests and related ecosystems in those river basins suffer as a result.

Water resource systems do not collapse globally, but triggering events affect major watersheds or socioeconomic regions. Fears rise that repeated triggers occurring over a period of years may affect the system globally. Events that could serve as triggers include the following:

- The public loses confidence in public water supply systems as a lethal new waterborne disease passes through a water treatment plant, terrorists attack an urban water supply system or a carcinogenic substance is detected in aquifers that feed the public water supply. Fierce competition develops for water considered safe, and water prices skyrocket.
- Mass migration and movement of refugees are triggered by major flooding in China, India, and Bangladesh. At the same time, health services break down and massive epidemics of cholera, typhoid, and other waterborne diseases break out.
- Armed conflicts over water resources break out in which each side bombs the other's major dams. Serious flooding occurs in the short term, and food shortages and social disruption occur for years.
- Suffering from multiyear droughts, exacerbated by climate change, cannot be relieved by safe water supply and sanitation services. The number of displaced persons increases, and the world economy becomes depressed.
- Conflicts over water between neighboring countries sharing the same water basin ignite with increasing frequency. In some regions, warlords proliferate, sometimes allying themselves with international terrorist organizations and drug cartels.

BOX 10.

No Water in Lusaka after Bomb Blasts

The Zambian capital of Lusaka, a city of 3 million people, was still without running water three days after guerrilla bombings that destroyed the main water pipeline.

Source: International Herald Tribune, 3 March 1999

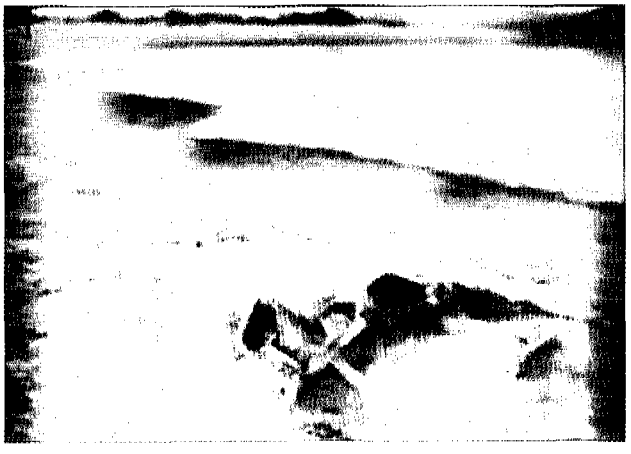
BOX 11.

Water Shortages Expected in Thailand in 1999

A tap water crisis is expected to affect about half a million residents of Bangkok and neighboring Samut Prakan between January and June 1999. According to the Metropolitan Waterworks Authority, about 500,000 people will be affected, with the hardest-hit likely to be those residing near the ends of water mains.

The problem is caused by a substantial decrease in rainfall in the north and northeast, which has reduced reservoir levels significantly. Raw water supplies from the Bhumibol and Sirikit dams are forecast to drop 10 percent during the first half of 1999.

Source: Bangkok Post, 24 December 1998



5

The Sustainable Water World Scenario

The sustainable water world scenario describes a world in which investment in education is made during the initial period of strong economic growth. Access to telecommunications increases awareness of inequities in access to water worldwide, creating pressures for action. As a result of measures taken, sustainable water resources become a part of sustainable economic and social development and there is a global sense of optimism about the future.

5.1 Developments between 2000 and 2010

Changes Outside the Water Sector

Economic Trends As in the conventional scenario, the global economy grows rapidly. Consumption of inexpensive high-technology goods increases, and private sector investment in the service, technology, and environmental sectors of the economy grows. Global economic growth is initially somewhat lower than in the conventional water world, but more resources are devoted to spurring economic growth in the South, which grows much more rapidly than the industrial countries.

Continuing trends that began in the twentieth century, official development assistance is gradually replaced by direct private investment. What assistance is provided is redirected to the poorest countries. Public-private partnerships in managing water resources become increasingly important in spreading access to new technologies and accelerating development.

Multinational and transnational corporations thrive. At the same time, the many nongovernmental organizations (NGOs) and community-based organizations established in the twentieth century start to create meaningful alliances, both among themselves and with business and other sectors.

Demographic Trends Education of women leads to a voluntary reduction in family size in countries with rapidly growing populations. As a consequence, demographers forecast that the world population may stabilize by 2070.

Technological Trends As a result of the explosive growth of information technologies and the decline in the prices of telecommunications equipment, global networks of communication allow even people in the most remote parts of the world to communicate globally. Mobile telephones become available to many individuals and to most communities. Advances in pattern recognition and artificial intelligence lead to the development and widespread use of automatic language translation engines. The developments in information and communication technology help to anticipate floods and, particularly, droughts as drought forecasting becomes a practical water resources management tool. They also improve early warning systems, which help limit the damage caused by extreme events.

Investment in science and technology—and the greater cross-fertilization across cultures and historical experiences facilitated by improved telecommunications—yields an unprecedented wave of scientific and technological innovations. Agreements are reached that protect intellectual property sufficiently to encourage development of new technology. Developing countries are able to access such technology by paying subsidies to its developers.

Developments in biotechnology and information technology allow new crops to be developed that are resistant to drought, salt, and pests. As a result, agricultural output rises without expanding cultivated areas. A new generation of crops and cropping systems that require less water reduces the quantities of water needed for irrigation; in many rainfed areas, only supplemental irrigation is needed. The new crop varieties make rainfed agriculture possible in many new areas.

New technologies are generated that incorporate high-tech developments into existing technologies. As a result, traditional technologies that are socially and eco-

logically sustainable but not economically efficient become viable. The application of ecological research to agriculture and (even) industrial production results in new eco-technologies that are used in factories, whole ecosystems, and watersheds. These technologies embody the principles of ecosystems (using the waste products from one process as raw materials in another, cascading industrial processes so that water is reused, and so forth) and are economically efficient.

BOX 12.

Andhra Pradesh Ties Water Funds to Village Performance

The government of the Indian state of Andhra Pradesh will allocate a third of its budget for ten important programs to villages on the basis of their performance in five different areas. The areas include increasing school enrollment, sterilizing eligible couples, implementing a clean and green program, constructing individual latrines, and vaccinating children. The funds will go toward improving the drinking water supply, developing watersheds, and building individual sanitary latrines.

Source: The Hindu, 30 December 1998.

SOCIAL TRENDS A variety of policy mechanisms are used to achieve a sustainable global economy. These include revised tax systems and other policies that encourage the market not to produce or consume environmental "bads" and certain types of products. Beginning at the turn of the century, corporations begin to take the long view and to link their futures with those of their host countries. The polluter pays principle is universally implemented. Discouraged by thorough public disclosure of information, antisocial corporate behavior becomes increasingly rare. Well-designed environmental, economic, and social indicators measure the effectiveness of policies, giving the public an informed basis for seeking change.

Distributed forms of governance evolve through trial and error, and mechanisms for decision-making are established from local to global scales. Within this nested structure, regions and communities have considerable control over socioeconomic decisions and approaches to environmental preservation, which are constrained only by the impacts on larger-scale environments and processes. Local energy systems, for example, vary greatly, but they must meet per capita greenhouse gas emissions guidelines, which are set by global-level agreements. Local water strategies must be compatible with allocation rules and ecosystem goals set at the river basin level. Global governance is based on a federation of regions, which, through a rejuvenated United Nations, effectively fosters cooperation, security, and environmental health.

Negotiation, collaboration, and consensus resolve conflicts. As armies are cut back and defense systems become less costly, a massive peace dividend is channeled toward the transition to sustainability and the eradication of poverty. Food is imported when water scarcity precludes local production. Through the rejuvenated UN system, economic aid is provided to poor countries to satisfy basic food requirements.

Environmental Trends Many environmental problems initially worsen and new ones arise. Widespread awareness of water problems is reinforced by scientific evidence showing that large-scale global changes in the man-environment system are increasingly likely. They are already building up in climate, life-support systems, and public health. New water-triggered ecological collapses provide strong warning signals about global economic instability and add to the sense of urgency over finding lasting solutions. Agreements are reached on international mechanisms that tie redistribution of wealth to meeting globally agreed-upon environmental targets.

BOX 13.

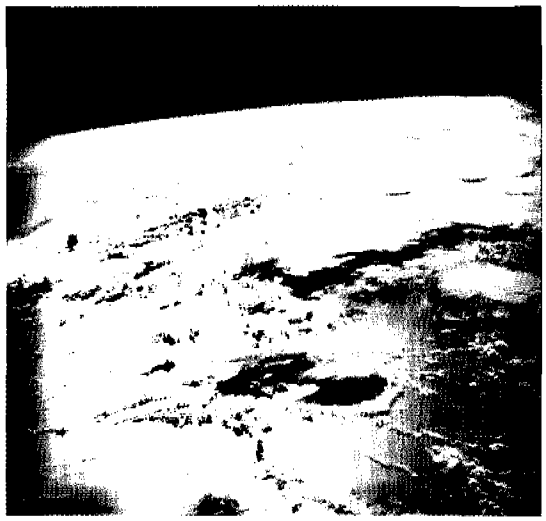
Wine Growers Help Wetlands in Australia

A particularly fertile pocket of South Australia's Riverland Region is the intersection of Banrock Creek and the River Murray. Banrock Station wines reflect the richness of this region. Banrock Station owns 12.5 kilometers of river frontage that is mainly wetland, which it is restoring and protecting in cooperation with the conservation group Australian Wetland Care. Part of the proceeds from the sales of wine are applied to reestablishing native fish, birds, and plants. The project has also assisted with employment in the region.

Source: http://ramsar.org/w.n.banrock.htm

Changes within the Water Sector

The Second World Water Forum, held in the Hague in 2000, attracts the attention of a global public. Already sensitized by previous discussions and initiatives on environmental issues— particularly the 1992 Earth Summit in Rio de Janeiro and the Intergovernmental Panel of Climate Change—the public begins to recognize the importance of water in terms of immediate human needs and everyday life. Successive World Water Forums increasingly link the water issue to prospects for development. Gradually, a global agenda emerges that joins environmental concerns with equity and development issues under the umbrella "Water for Life, Water for All."



A major effort is made to make the best existing technologies widely available. As a result, water use efficiency increases dramatically, particularly in the developing world. Desalinization becomes affordable for all countries in which water is scarce through strong international cooperation.

At the Second World Water Forum delegates set targets for action based on indicators of water and sustainability. These targets include the following:

1. All people will have access to 25 liters of safe and affordable water for drinking and sanitation by 2015.
2. Men and women must have equal access to and control over water resources.
3. Individuals, communities, and governments should adopt a Social Charter for Water as a basis for managing water at the lowest appropriate level.
4. All countries should ratify a Water Convention, which codifies water management principles and is recognized by sovereign governments. Where necessary the convention should be used as a basis for rulings by the International Court of Justice.
5. Renewable water resources should be protected to ensure their renewal and sustainability.
6. Quantitative and qualitative water requirements for aquatic and terrestrial ecosystems should be met.

UN agencies include progress toward these goals as part of their human development and human poverty indexes. Access to this information via the media and the Internet make people everywhere aware of their countries' progress.

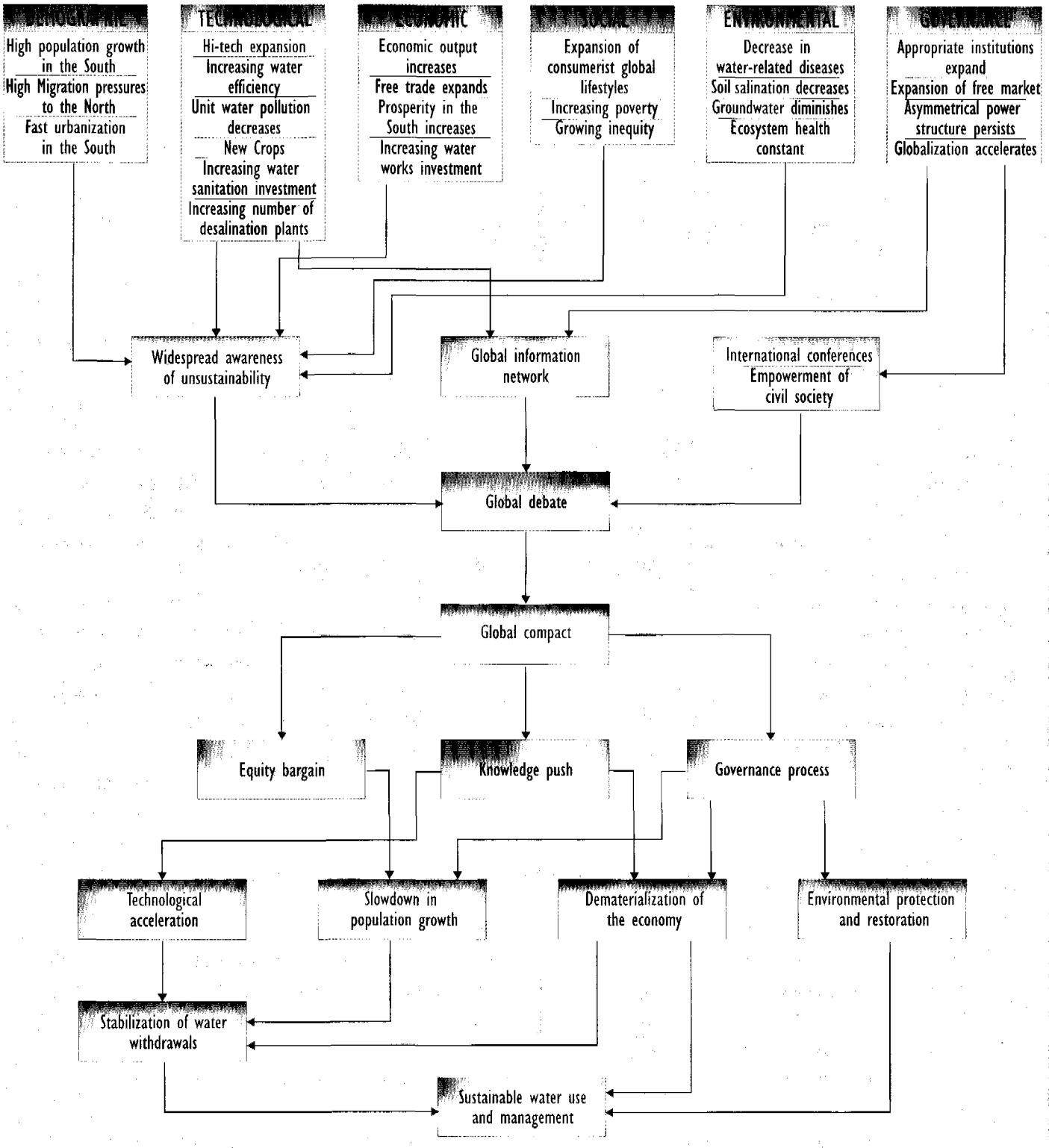
Meeting these goals represents an enormous challenge, and unprecedented measures and cooperation are required to succeed. Fundamental changes in societal values (away from consumerism and toward a global sense of solidarity) and in technologies (that allow production to use fewer resources) are required to meet the targets.

A global network of scientific research cooperation, called Water Science for Sustainability, is established. The network is funded by voluntary contributions (following the model of the old CGIAR structure), but it includes a sizable endowment fund, which ensures that its agenda is not determined by short-term donor priorities. The network establishes resource centers in different countries and works in close collaboration with national research systems and the business community.

By the end of the period, events will be shaped by the following factors (shown graphically in Chart 3):

- Global economic growth is strong, particularly in the developing world.
- Literacy levels are raised throughout the world, as education is made a priority.
- A global communication network connects the people of the world.
- Crops that require less water and are resistant to disease and pests are developed.
- The public comes to recognize that consumerism is not sustainable and that it can lead to a water crisis.
- Absolute poverty is reduced by 50 percent; relative poverty declines by 60 percent.

Chart 3: Sustainable Water World



BOX 14.

Sanitation Services for All in Kerala, India

Sanitation services will be expanded to cover 100 percent of the population in the Indian state of Kerala within the next three years, according to the State Minister for Rural Development. Currently, about 2.9 of Kerala's 5.5 million households (53 percent) are without safe sanitation facility.

The project will construct household latrines and improve solid and liquid waste management, home sanitation, personal hygiene, community environmental sanitation, and the handling of drinking water. The strategy aims to build local capacity and to focus on self-reliance, local resource mobilization, and sustainability.

The ministry will use a multidisciplinary approach that focuses on information, education, and communication disseminated by community-based programs. The campaign will be launched on a pilot basis in 15 panchayats (districts). It will be extended to 150-200 panchayats in 1999 and to 800-900 panchayats and municipalities in 2000-01.

Source: The Hindu, 24 December 1998.

- Aquatic (and terrestrial) ecosystems are no longer deteriorating. In many places, they are beginning to recover.
- International cooperation is strong and increasing.
- Public-private partnerships proliferate.
- NGO and community-based organizations begin to go global.
- A few high-visibility water-related catastrophic events occur.
- Water withdrawals stabilize.
- Targets are set and action plans established to ensure access to water and sanitation for all.

5.2 DEVELOPMENTS BETWEEN 2010 AND 2025

Changes outside the Water Sector

Trends toward institutional change and social solidarity consolidate, and deeper changes develop. More efficient production processes create lean productive systems that use fewer resources. Large economic resources are devoted to culture, education, science, and entertainment. Demographic growth has reached the point where population stabilizes in many countries, and the global population shows clear signs of stabilizing.

Technological innovation increasingly concentrates on biosystems that efficiently produce the resources necessary for life. Increasingly, biosystems are used to capture water and produce food, medicines, molecules with specific properties, and water-efficient ecosystems. Toward the end of the period, carbon-based biological information-processing systems compete with silicon-based computers and information devices. Ecological engineering is applied to large-scale ecosystems, and management of watersheds through biological and ecological entry points becomes widespread.

Ecosystem restoration and rehabilitation becomes a leading sector of the economy. As a result, environmental quality improves significantly. The rate of species loss stabilizes at a pre-industrial revolution level. While not all ecosystems can be recuperated, many new, large-scale sustainable ecosystems evolve. People have learned to live with the ecological cycles rather than trying to control them.

Developments within the Water Sector

As the network of communities evolves and organizes itself at different levels (local, subnational, national), new ways of managing water and other resources—involving technological solutions combined with structural changes—become possible. Non-waterborne sewage systems are implemented within the redesign of human settlements. New forms of community-based water management are introduced as pilot schemes. The traditional culture of desert people is studied to learn more about efficient water harvesting and patterns of social and individual use of water.

Total water withdrawals decrease to a sustainable level, as a result of cultural, economic, and technological changes. Water intensity (water use per unit of "production," generally speaking) reaches an historical minimum.

6

Disseminating the Messages of the World Water Commission

Despite the critical importance of water, water-related issues currently rank low on most policymakers' list of priorities. One of the most important goals of the Commission will be to convince policymakers that business as usual will produce outcomes that are highly undesirable. To do so, the Commission will need to raise public awareness of water issues by communicating clear and concise messages that relate to people's immediate concerns. The proposal from the Commission's chairman is put forth in Box 12.

BOX 12.

Solutions for a Thirsty World?

Ismail Serageldin

Everyday, 230,000 people join the human race. Each and every one of them will depend on water to live. But fresh water is becoming increasingly difficult to access and dirtier. The competition for water is becoming more intense, and millions of people may go hungry as individuals, industry and farmers compete for limited resources.

But it doesn't have to be this way. Our children and the health of the planet itself will depend on our willingness to make a set of choices about managing this most precious resource that are different than the ones we are making today, and to make them soon. Ninety-seven-and-a-half percent of the world's water is unusable because it is full of salt. Most of the remaining 2.5 percent is locked up in the polar ice caps or lost to evaporation. All told, less than one tenth of one percent of all the water on the planet is available for the use of humans, plants and animals.

Already, a good part of humanity is sick and dying because of the shortage of clean, fresh water; 1.4 billion people don't have safe drinking water; 2.3 billion lack adequate sanitation. A fifth of the world's population, mostly children, suffers from illnesses related to water; 7 million a year die from water-borne diseases.

Natural ecosystems on which all life depends are also suffering. Half the rivers and lakes in Europe and North America are seriously polluted. And the draining of large bodies of water like the Aral Sea and Florida Everglades has caused massive environmental damage, economic disaster or both. Already, California has lost 90 percent of its wetlands.

If this appears bad, we know that with present trends things are likely to get much worse before they get better. Right now, 31 countries are facing water shortages. In 25 years, as the world's population grows by another 3 billion people, that number will increase to 48 countries, and by 2050, 55 countries will be in serious trouble. All but a few of those countries are found in the developing world, in precisely the same regions where population growth will be most

pronounced. But the problems will not be limited to poor countries. Parts of southern Europe and the western United States will face severe water shortages.

Many experts believe that the shortage of fresh water is looming as the most serious obstacle to global food security. Food production consumes over 70% of all water used by humans. Even if we increase the efficiency by which agriculture uses water from the current 45 percent to 70 percent, the world will still need a fifth more water to feed the growing number of mouths and meet its other development needs. One of the consequences of failing to better manage water resources may be higher food prices and expensive food imports to poor, water scarce countries. Already, 800 million people are going hungry because they cannot afford to buy food.

This crisis will not only affect food production. Water availability in urban areas will also be seriously threatened. Some of the world's largest cities, including Beijing, Buenos Aires, Dhaka, Lima and Mexico City, depend heavily on groundwater for their water supply. But dependence on aquifers, which take many years to fill, may not be sustainable. As a whole, India is using twice as much water from its aquifers as is being replenished naturally. Most countries in North Africa and the Middle East are mining their aquifers, as do inhabitants of the Colorado basin in the USA. Libya consumes 3.7 times its renewable water resources.

This year, the international community has joined forces to seriously address the coming crisis. The World Water Council (WWC), with the support of all the United Nations Organizations, the World Bank and the governments of one dozen donor countries has created the World Commission on Water for the 21st Century. The Commission will recommend both basic and outside-the-box solutions to our water problems and convince policy makers to act on them. The Global Water Partnership (GWP) is preparing a framework for Action to implement the Commission's recommendations. All this work is already starting and will be involving thousands of professionals and stakeholders around the world in the months ahead. Special regional consultations are planned, and special outreach programs to involve women and youth in the design of solutions are being organized. While my colleagues and I on the Commission are alarmed by the current forecasts, we are also optimistic that the world can provide for its growing water needs. What can we do?

One basic problem is that many of us have shown a reluctance to treat water as an economic as well as a public good. Another is that management of water resources and the environment in every country is fragmented among many institutions, most with little regard for conflicts between social, economic and environmental objectives. In general, there is little recognition that health and environmental problems are associated with bad water management. That has to change.

Radical and innovative plans can be devised to avert the coming disaster. Creating more freshwater is not an obvious solution. Taking the salt out of seawater is still an expensive process. While it is likely to get cheaper as energy becomes less expensive, the costs of desalinated water will still be beyond the means of most people. We can explore other technological solutions such as rainwater harvesting, dry toilets, water transport, reuse of waster water, and engineering less thirsty and more drought-resistant crops. We can integrate water management organizations, we can think of innovative ways of partnering the private sector, local communities and NGOs to ensure the effective and efficient use of water for all the world's economic and social needs.

But technology developments and restructuring of organizations will not be enough. Acting to meet the challenges will require much more. We will need nothing less than changed values and behavior on a global scale coupled with informed and enlightened leadership. The World Commission will present a vision of that future, accompanied by a framework of action to implement the vision, to world leaders and many others meeting at The Hague in March 2000. Will we be able to seize this millennial moment to change our ways and by wise actions today lay the foundations for better tomorrows for our children?

7

Using the Water Scenarios to Develop the Water Vision

The scenarios presented here represent an initial attempt to develop a vision for water in the next century. They are intended to be used by groups involved in the regional and sector consultations as a common starting point from which to develop their own scenarios. The members of the Scenario Development Panel have expressed willingness and interest to facilitate the use of the scenario approach in the regions.

7.1 Regional Consultations

The scenarios presented here are global, not regional, scenarios. Regional groups are asked to develop their own regional scenarios. Such scenarios should take into account specific issues affecting the region that have not been covered or emphasized adequately in the global scenarios. Regional consultations may also be able to develop more specific types of actions that could be taken to realize a sustainable water world.

7.2 Sector Consultations

The sector consultations are expected to enrich—and possibly change the direction of—sector issues in the global scenarios. Sector consultations should review the global scenarios critically and provide comments that will help enrich the scenarios. The sector scenarios will generate ideas that are relevant to the regional groups. Their drafts should therefore be passed on to the regional groups as soon as possible.

7.3 Refining the Global Scenarios

The scenarios described here represent a first draft. They will be refined after the thematic panels, regional groups, and sector experts provide their input. The results of special studies, panels, and workshops will also be used to help refine these scenarios. Drafts of the scenarios will be posted on the Vision website at each stage of development.

7.4 From Scenario Development to Creation of a Vision

Scenarios are possible courses of events that lead to a particular state of the world. They are ways of exploring possible futures. The World Water Vision that is the end-product of the vision exercise differs from the scenarios in that it represents not just a possible future but a desirable future.

But desirable for whom? For a vision to be meaningful, it must state explicitly whose vision it represents. The global vision will represent the values and ideas of the World Commission for Water. The regional visions will represent the values and ideas of the regional stakeholders who develop them. Those visions, which will be published as separate monographs, will not necessarily reflect the views of the World Commission on Water. Because differences exist between global and regional priorities, the regional visions and the global visions need not be completely compatible.

It is also recognized that all visions depend on the perspective of the stakeholders that subscribe to them and that there is no automatic or easy consensus over what the vision ought to be. To develop a widely supported vision—both at the global and at the regional level—is, however, the goal of the World Water Vision exercise.

TABLE 1 Overview of drivers and their value in the three World Water Vision global scenarios

	CONVENTIONAL WATER WORLD	WATER CRISIS (as compared to CWW)	SUSTAINABLE WATER WORLD (as compared to CWW)
DRIVERS:			
DEMOGRAPHIC			
Total population size 2025	Total 8 billion; 6.6 in the South (S)	About the same	Total 7.5 billion (6.2 in the S)
Population growth rate	1.2 percent/year (1.4 in the S)	About the same or slightly lower (because of higher mortality)	1.05 percent/year (1.1 in the S)
Urbanization	61 percent Urbanized (56 percent in the S)	About the same or slightly lower	About the same as CWW
Migration patterns	High pressures for migration S to North (N)	Higher pressures (and stronger barriers)	Low pressures for migration S to N
TECHNOLOGICAL			
Information technologies	Widely available and used for increasing water management efficiency	Widely available, but application to enhance water efficiency not effective due to other constraints.	Widely available and used for increasing management efficiency and effectiveness (including water management) and social participation.
Biotechnology	Widely available and used for new varieties	Privately appropriated and not widely available	Widely available and used for new sustainable crop systems and water purification
Water use efficiency	Increases overall, and particularly in arid areas	Increases but much less	Increases overall, faster than in CWW
Water pollution	Pollution per unit gradually decreases	Decreases but only marginally, due to lack of access to technology	Pollution per unit decrease much faster than in CWW
New drought-, pest -and salt-resistant crops	Massive development and dissemination of new varieties leading to expansion of potentially arable land and yield increases in marginal lands	Development of resistant varieties ; dissemination curtailed in countries unable to pay the royalties	Same as CWW, but combined with ecotechnologies and integrated in new agricultural systems
Water sanitation	Investment in S grows as fast as the economy	Investment in S falls down due to economic crisis	Investment in S grows faster than overall economy; ecotechnologies used
Desalinization processes	Widely available	Expensive; only adopted in rich, arid, zones	Widely available
ECONOMIC			
Total volume of production	To 83.1 trillion (40.8 in S)	50 percent lower?	To 90 trillion (60 in S)
Structure of production	Gradual dematerialization; agriculture growths in absolute terms	Little dematerialization in the S; agriculture growths in absolute and relative terms in the S	Fast increase of the non-material economy
Water- infrastructure (availability and condition)	Grows at same rate as the economy	Deteriorated gradually in S, or behaves erratically	Grows faster than overall economy
Trade	Universal	Some countries or regions become excluded from the global markets	Universal and strategically regulated
SOCIAL			
Lifestyles and cultural preferences	Converge to current level in the N	Preferences are the same, but real lifestyles in S and N gradually diverge	Convergence in S and N to lifestyles less material-intensive than current in the N
Poverty	Absolute poverty remains constant; relative poverty decreases	Relative and absolute poverty increases	Absolute poverty eradicated
ENVIRONMENTAL			
Committed Climate change	Increased variability, agro-ecologic shifting	Very dramatic shifting, variability and global warming	Less dramatic than in CWW because of strong emission policies
Water-related diseases	Gradually diminishing	Gradually increasing due to low investment and climate change	Remaining only in small pockets
Salinization	Gradually reduced	Increasing	Stopped
Exhaustion and/or Pollution of surface and ground water	Gradual increase	Faster increase	Stopped; water withdrawals reduced to sustainable levels
Integrity of aquatic ecosystems	Gradual decrease	Generalized decrease including dramatic ecological collapses	Recovering
GOVERNANCE			
Institutions	Appropriate; new arrangements made	Institutional breakdown; arrangements increasingly dysfunctional	Strong and adequate institutions created; new shared goals; wide participation
Market dominance	Universal	Free market only in some rich regions	Universal, but internationally regulated
Power structure (international, national)	Asymmetrical but becoming more pluralistic	Asymmetrical and authoritarian; militarization of water and other scarce natural resources	Much more pluralistic than in CWW
Conflicts	Localized and manageable	Ubiquitous and increasing, particularly over natural resources.	Practically absent
Globalization	Accelerating	Spasmodic but widening	Accelerating

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