14 Ensuring the Knowledge Base: A Collective Responsibility

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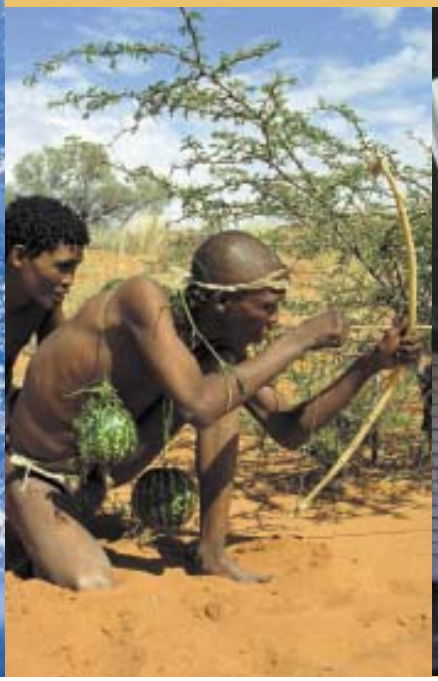
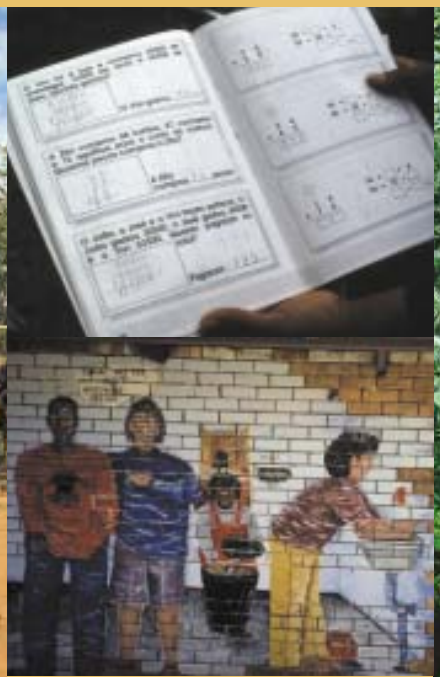
Tell me and I forget. Show me and I remember.
Involve me and I learn.

Anonymous

KNOWLEDGE DOES NOT EXIST IN ISOLATION, and understanding even less so. This chapter investigates some of the subtle but powerful ways in which education, training, public information, cultural traditions, the media and modern telecommunications interact with each other to influence the way we behave and respond to change in the world around us. Our attitudes begin forming at a very early age, and those in a position to affect the way we perceive and manage our water resources must pay as much attention to non-formal communication as to formal education. Public awareness, community involvement and the inclusion of all actors – but especially women – in decision-making are keys to success. In this context, such high-tech tools as computers, geographic information systems (GIS) and electronic databases are almost irrelevant as long as millions of people are deprived of basic education, health and food.





KNOWLEDGE IS CRUCIAL to improved livelihoods, environmental conservation, broader participation and stronger democracies – in short, to development. The unprecedented revolution ushered in by the new information and communication technologies (ICTs) has placed an ever higher premium on knowledge as having a potential to not only generate wealth, but also contribute to sustainable development for the benefit of present and future generations. Generating and disseminating this knowledge requires political will, investment and international cooperation: towards expanding education, facilitating scientific research, building capacities at all levels and bridging the gap between rich and poor.

In the complex domain of water, a narrow definition would describe the knowledge base as all aspects of data gathering, information, experience and knowledge enabling countries and regions to produce a well-documented assessment of their water resources. However, because water affects every facet of life, from health to agriculture, to industry and the ecosystem at large, the knowledge and skills required to improve stewardship of this finite resource stretch across an extremely broad spectrum encompassing education, health, law, economics, communications, and science and technology. In particular, the constituencies required to govern water wisely cut across all socio-economic categories and generations to include grass roots communities, industry and business leaders, health specialists, educators, lawyers, scientists, engineers and government agencies.

Since the United Nations Conference on Environment and Development (UNCED) in 1992, the international community has made considerable efforts to raise awareness about water resources, building upon the goals of equity and sustainability elaborated during previous conferences, such as the 1990 New Delhi Global Consultation on Safe Water and Sanitation and the 1992 Dublin International Conference on Water. Following along the same lines, the 2000 World Water Vision reiterates that integrated management is the bottom line for addressing the current crisis. It relies *inter alia* on empowering women, men and communities, increasing public funding for research and innovation in the public interest and improving cooperation in international water basins. At the Second World Water Forum in The Hague in 2000, the Global Water Partnership (GWP) spelt out targets related to strengthening the knowledge base: water awareness initiatives instigated in all countries by August 2001, capacity for informed decision-making at all levels and across all stakeholders increased by 2005, investment in research on water issues increased by August 2001, hygiene education in 80 percent of all schools by 2010. These targets highlight the significance of awareness-raising, training and research, and sound data, and also underscore the evident links between better health and safer water practices.

Formidable barriers still stand in the way of progress. Driven by the revolution in information technology and increasing mobility of capital, globalization is generating new wealth and greater interconnectedness and interdependence. It has the potential to reduce inequality and poverty, but also holds the danger of creating a market place in knowledge that excludes the poor and the disadvantaged. Population growth, HIV/AIDS (Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome) and armed conflict have all contributed to increasing poverty and social inequalities in recent years. Climate change, environmental degradation and rapid urbanization make societies more vulnerable to disasters. The rise of market-oriented research risks undermining science as a public good, capable of responding to pressing environmental and social problems.

The media, both print and electronic, play a pivotal role in raising awareness of water's value, promoting safe health practices and facilitating dialogue between stakeholders. Furthermore, because water and climate know no national boundaries, initiatives in sharing knowledge require a high degree of international collaboration. The rise in information technology has made it easier to spread knowledge and pave new avenues for learning. However, the digital divide leaves large swathes of the globe isolated from accessing and contributing to this exchange.

Although no formal monitoring process has been established to track progress, trends in knowledge can be identified on several fronts, in more participatory approaches to managing water, in collaborative ventures to improve assessment of water resources, in the strengthening of global networks for sharing knowledge and advancing pro-poor policies to ensure water security. Adopting a broad approach that reflects the aspiration towards more integrated management of water resources, this chapter paints a picture of trends and progress by placing knowledge about water in the wider context of education, science and communication worldwide, while drawing more specific attention to community participation, data collection, basic and applied research and international cooperation.

Holistic Thinking: Making the Knowledge Base Everyone's Business

The notion of integrated management mirrors a progressive shift in our approach to development towards an all-inclusive endeavour that takes stock of the intricate connections between society, culture, science and the environment. It relies upon greater participation at all levels and profound changes in the relationship between state and society, with implications for the ways in which knowledge is created, acquired and shared.

In 1977, the Mar del Plata Conference underscored the importance of water resources management as a global issue; one that required the capacities of engineers, economists and environmentalists. Since then, the circle of stakeholders has grown steadily, spanning the natural and social sciences. Since UNCED, economic expansion, demographics and climate instability have raised water resource development and management to the status of a global social, economic and environmental issue. Rio was but one in a series of major international United Nations (UN) conferences spanning the 1990s which, working along the same lines, reaffirmed that people are at the centre of development, with education playing a determining role in alleviating poverty and building a more sustainable future. A clear understanding has emerged that knowledge is critical to achieving the goals of global security, poverty alleviation and water resource stewardship expressed in Agenda 21 (see box 14.1).

In the words of former World Bank Vice President Joseph Stiglitz:

> *Today, we recognize that knowledge is not only a public good, but a global or international good. We have also come to recognize that knowledge is central to successful development. The international community ... has a collective responsibility for the creation and dissemination of one global public good – knowledge for development* (World Bank, 1998).

Ensuring basic education, creating opportunities for lifelong learning and supporting tertiary education, especially in science and engineering, is one of the critical steps that must be taken to narrow knowledge gaps.

Education: The Base of the Knowledge Pyramid

Education – whether in the formal school setting, through a community-led initiative or in the context of an adult literacy class – is a fundamental pillar of human rights and a key to achieving sustainable development. It plays a critical role in empowering individuals with the knowledge and skills to reflect, make choices and enjoy a better life – in short, to become agents of change.

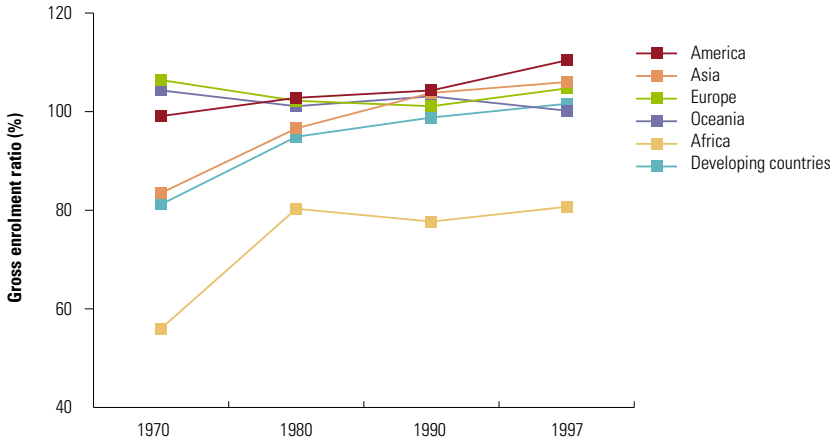
Every UN Conference in the 1990s, whether focusing on children, social development, women, cities, environment, science, human rights or population, made significant recommendations

Box 14.1: Pointers from the 1992 Earth Summit

UNCED's Agenda 21 called for national comprehensive policies for water resources management that were holistic, integrated and environmentally sound. It advised that improved water use policies and legal frameworks should embrace human health, service coverage, food, disaster mitigation and environmental protection. Chapter 18 of Agenda 21 dealing with freshwater resources pointed to several objectives and activities aiming to ensure the knowledge base. The importance of the following elements was particularly emphasized:

- inventory of water resources;
- dissemination of operational guidelines, and education for water users;
- development of interactive databases;
- public awareness-raising educational programmes;
- use of GIS and expert systems;
- training of water managers at all levels;
- strengthening training capacities in developing countries;
- training of professionals, and improving career structures;
- sharing of appropriate knowledge and technology, including knowledge needed to extract the best performance from the existing investment system; and
- establishing or strengthening research and development programmes.

Figure 14.1: Gross enrolment ratio in primary education



Gross enrolment ratio in primary education is defined as the total enrolment in primary education, regardless of age, expressed as a percentage of the population of the age group which officially corresponds to primary schooling. In the past thirty years, developing countries have made enormous strides in expanding enrolments at all levels. There has been a global increase in enrolment rates worldwide. However, the regional disparities are striking, with a much higher rate of enrolment in developed countries than in Africa, which lags far behind the rest of the world.

Source: UNESCO, 1999b.

concerning education. All reaffirmed that education was first and foremost a right, stipulated in Article 26 of the Universal Declaration of Human Rights. All underlined the positive correlations between better education – particularly of girls and women – and improved health practices. The Programme of the UNCED underscored that both 'formal and non-formal education are indispensable to changing people's attitudes so that they have the capacity to assess and address their sustainable development concerns'. Understanding why it is necessary to conserve our finite water resources is a starting point for protection and better management.

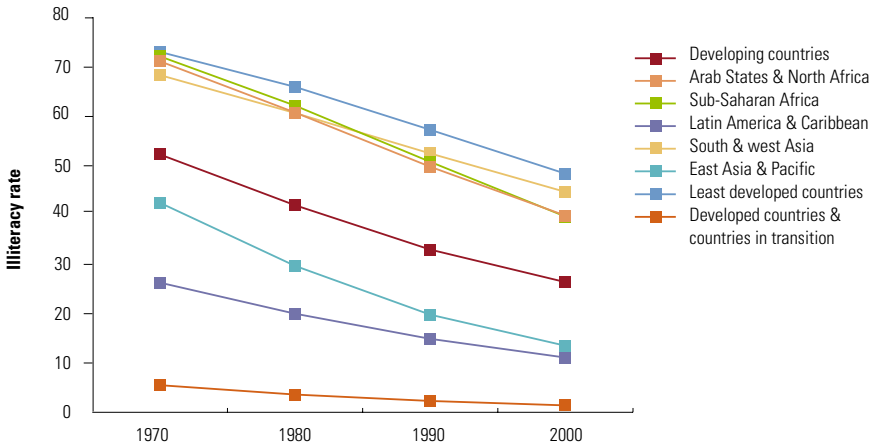
Basic education for all

As well as providing an understanding of the issues surrounding water resources, a good educational base is essential if suitable professionals capable of monitoring and managing water resources are to emerge. In the past thirty years, developing countries have made enormous strides in expanding enrolments at all levels: in 1960, fewer than half of the developing world's children aged six to eleven were enrolled in primary school, compared with 79 percent today (see figure 14.1). At the other end of the education spectrum, higher education witnessed a six-fold increase in enrolments worldwide, between 1960 and 1995. But as the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Conference on Higher Education noted in 1998, the gap between industrially developed, developing and least developed countries with regards to access to and resources for learning and research has widened in this period. Africa's gross enrolment at the tertiary level stands at 5.2 percent, compared to 51.6 percent for developed countries (UNESCO, 1999c). Without adequate higher education and research institutions providing a critical mass of skilled and educated people, no country can ensure genuine, endogenous and sustainable development.

Despite the increase in enrolment rates, many countries, mostly concentrated in sub-Saharan Africa and south Asia, remain impoverished by poor educational achievement. Today, some 113 million children of primary school age, 60 percent of whom are girls, do not have access to education. Four out of every ten primary-age children in sub-Saharan Africa do not go to school (UNESCO, 2001b). Figure 14.2 shows the illiteracy rates, an indication of the general level of basic education. It is clear that while improvements have been made, there is still far to go.

Water factors, such as the need to collect domestic water, play a large part in school attendance. Many girls are prevented from attending school because of the lack of separate toilet facilities. In addition, many school days are lost due to illness as a result of water-related factors: improved environmental health is essential to allow more children to attend school. To this end, a UN interagency flagship launched in 2000 aims to assist governments in implementing school-based health programmes, including promotion of health skills and provision of safe water and sanitation. Basic

Figure 14.2: Estimated illiteracy rates – totals for males and females aged 15 years and older



Illiteracy rates are decreasing rapidly throughout the world, but there is a vast difference between developed countries, which in 2000 had an illiteracy rate of close to 0, and the least developed countries, with a rate of nearly 50 percent. While improvements have been made, there is still far to go.

Source: UIS, 2002.

hygiene education is essential if children are to realize the benefits of water. Simple hand and face washing can prevent many water-related diseases. At the Second World Water Forum, a target was agreed to provide hygiene education in 80 percent of primary schools by 2040.

There is an emerging consensus that wise water management cannot be accomplished by technical or regulatory measures alone, but must encompass education and awareness-raising initiatives. This suggests the need for much more pronounced efforts to make curricula more practical, to train teachers in water education courses and to foster stronger linkages between schools, water companies, city managers, relevant government ministries and non-governmental organizations (NGOs). To monitor progress, an in-depth global assessment of water within formal school curricula worldwide would be a valuable tool for promoting broader individual and societal responsibility. A monitoring mechanism is also urgently required to track progress towards attaining hygiene education targets.

In light of the irrefutable links between education and poverty alleviation, the number of out-of-school children casts a pall over the ambition to foster better understanding of water's value and to teach basic health skills in the regions of the world where needs are greatest. The prospect is all the more disquieting given the disproportionate number of girls not receiving any education: as future mothers, they are more than likely to perpetuate unsound practices.

Education for sustainable development

Beyond the overarching priority of providing all children with universal primary education, attention has focused in recent years on fostering an environmental ethic. Agenda 21 noted that education is 'critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making'. This suggests gearing curricula to address a range of health and environmental issues, while involving parents and communities at large in a wide range of awareness-raising and self-reliance initiatives.

Why is water valuable and how can it be managed in a sustainable manner? How is drinking water produced? How can we avoid conflicts over water? By answering these questions, water-related environmental education has gained ground in both industrialized and developing countries. An expert group meeting on Water Education in African Cities held in Johannesburg, South Africa (2001) provided valuable insight into initiatives underway on a continent faced with water scarcity. Water education was described as a 'strategic entry point to developing a new ethic for water governance in African cities ... an important agent for behavioural and attitude changes of key actors in the urban scene'. In particular, participants emphasized the richness of indigenous knowledge and experience in environmental education, both for enhancing cultural diversity and promoting ecological integrity.

In many countries, the broader concept of education for sustainable development is making headway. It aims to shape values, promote responsible behaviour and make children aware of their role in preserving the environment. In India, the Centre for Science and Environment produces quality resource materials and programmes to foster more ecologically conscious lifestyles. The Centre organizes workshops around the country to introduce students to the value and wise use of water as well as technologies such as water harvesting. The British NGO WaterAid has developed games and study materials aimed at children of all ages.

Introducing water education in schools is a complex, long-term endeavour: curricula are all too often overloaded and plagued by an academic, exam-oriented focus. Water-related contents are often scattered across several disciplines, failing to give a holistic view of water. The task of mainstreaming water education calls for revising curricula and textbooks, producing teachers' guides and providing adapted in-service training, particularly to promote a more hands-on, active pedagogy based on problem solving. A number of countries have introduced reforms in this spirit: in Mexico, the natural science curriculum for primary school was revised to broach topics such as the importance of water, different types of pollution and how technologies affect ecosystems. In Ethiopia as well, the school curriculum includes water-related topics in all grades, from understanding the sources and uses of water to conservation methods, hygiene and sanitation, and the effects of pollution.

Formal schooling is not the only channel for conveying such information. On the contrary: an expanded vision of education advocated since the World Conference on Education for All in 1990 and reinforced by the Delors Commission on Education for the twenty-first century, recognizes learning as a seamless process starting from early childhood and continuing through adult life. It necessarily entails a variety of learning methods and settings, both formal and non-formal: school equivalency programmes, adolescent and teenage literacy classes, skills training by local cooperatives and associations. Community-oriented environmental education has the potential to change behaviour and attitudes towards the environment and water management, provided it is geared to needs, for example, of the urban poor. Such initiatives are a stepping-stone for empowering users and promoting more effective participation. Water agencies also have their role to play: a good example is that of the Seine-Normandy Water Agency, which has been developing a programme for educating the general public by providing a range of teaching materials for the past fifteen years. The Agency's 'Water classes' can be adapted to all scholastic levels and to groups of adults, enabling the public to become more aware of water's importance and the active role that everyone can play in its preservation. These training courses also allow the public to discover various aspects of water management and how roles are shared out in this sector, as well as in other contexts worldwide. The water classes, of which there are presently more than 1,000 each year throughout the Seine-Normandy basin, are organized by teachers based on meetings with stakeholders of the water sector, visits to typical installations and workshops on water. They lead to a joint production such as an exhibition, a video or a magazine (for more details on the Seine-Normandy basin, see chapter 19).

Very often, these settings are testing grounds for educational innovation that adopt more creative approaches to learning. Programmes are often created and fine-tuned through a participatory approach so that materials are carefully targeted and understood. In Mexico, for example, a health and hygiene programme (PIACT – International Programme for the Improvement of Working Conditions and Environment) visited homes, learnt about healthcare habits and consulted experts about local customs to design materials on promoting sanitation and oral rehydration. Clearly, participation on all scales by all parties is essential in building a more sustained, equitable knowledge base.

Knowledge from the bottom up

Civil society mobilization in favour of fairer development has been a hallmark of the past decade. NGOs representing a vast range of interests have stepped into the global arena, determined to share their knowledge and influence the development agenda. International gatherings on key challenges of the twenty-first century have all reiterated that participation – making development everybody's business – is the *sine qua non* to reducing poverty and improving the welfare of people everywhere.

The Dublin principles (1992) stated that water development and management should be participatory, involving users, planners and policy-makers at all levels. The major groups involved include farmers, NGOs, local authorities, the scientific and technological community, trade unions, business and industry, indigenous people, children, youth and women. The principles reflect a shift in conventional water governance from a top-down towards a bottom-up approach. Participation opens up the way for more informed decision-making, and offers people opportunities to claim their rights as well as to meet their responsibilities. In principle, it gives a voice to relatively powerless groups, such as women – central to providing, managing and safeguarding water – and indigenous people, custodians of sound, ancestral water management practices.

Local people have a direct interest in improving the quality of life in their village. For projects to succeed, for a sense of ownership to exist, their input into decision-making is critical. Consulting with communities is important for determining the most appropriate intervention. In the Indian city of Pune, for example, a partnership between the municipal government, NGOs and community-based organizations has greatly improved sanitation for

Box 14.2: Guinea-Bissau – with training, women 'man' the pumps

Since 1987, the government of Guinea-Bissau has focused on developing a decentralized maintenance system and standardizing hand pumps. This has improved pump performance, supported the introduction of cost-recovery strategies and promoted the principle of user involvement. In 1993, these efforts began to yield results: users financed 5 to 10 percent of maintenance costs. Early in 1994, forty-six villages were surveyed to review the management performance of the water point committees. In almost all cases, the committees were functioning well. Some 53 percent of their members were female, with 20 percent of the women fulfilling management functions beyond their traditional task of cleaning pump surroundings.

Candidates for the position of area mechanic were selected at village meetings. The villagers preferred male mechanics because of the need to visit villages by bicycle and the physical labour involved in pump repair. However, though the job was popular, it did not pay enough to maintain the bicycles. The provincial promotion team encouraged the villagers to select women for this job, as they had a more direct interest in the maintenance of the pumps and were less likely to be absent or to leave the village in search of work. By mid-1993, a total of 177 village mechanics, including ninety-eight females, had been trained and were maintaining their hand pumps.

Source: Based on Visscher and Van de Werff, 1995.

more than half a million people (see box 7.5 in chapter 7 on water and cities). The city government recognized the capacity of community organizations to develop their own solutions, supported by local NGOs. In the process, water users generate their own knowledge as a springboard for action. Participatory rural appraisals now represent a key planning tool in rural development. They involve engaging with communities to determine outcomes and activities, replacing what was largely a central planning exercise.

In seeking to overcome their own water management problems, communities generate precious knowledge. The adoption of participatory approaches in water management, greater public consultation on proposed schemes and devolved responsibilities to water user groups have stimulated knowledge amongst wide numbers of people on specific issues. It has also contributed to challenging assumptions about gender division of labour, a first step towards giving women a greater say in planning water schemes. In Niger, research in several villages on the respective roles of men and women in handling water supply, sanitation and hygiene was a starting point for fostering discussion about gender divisions of work. In Guinea-Bissau (see box 14.2), women have successfully demonstrated their skills at maintaining pumps. The fact that thinking and experience have moved beyond women and development to gender and development is an important step forward. Capacity-building that pays attention to gender and opportunities for women in water resources management must be systematically reinforced, and indigenous knowledge more diligently explored.

Traditional local knowledge

Local communities are often custodians of knowledge with the potential to reverse water waste and shortages in hostile environments. Indigenous knowledge generally reflects a profound understanding of the water cycle. In Fiji for example, the indigenous population has long blended birth and death rituals with sound water management, allowing fish stocks to replenish after ceremonies. In southern Africa, the bushmen of the Kalahari desert had an inventive technology for extracting water (see box 14.3).

Today, through community initiatives, some of these ancient techniques are being revived. Water harvesting provides a rich example. An ancient technique, which comprises a range of methods of collecting and concentrating runoff from various precipitation sources (rain, dew, fog), has enabled villagers in several parts of India (western Rajasthan for example) to overcome perennial water shortages and ensure more reliable water supplies. These initiatives, now gaining ground across the country, highlight the benefits to be gained from a combination of public awareness, traditional knowledge and community-based approaches to self-reliance. More effort must be devoted to sharing and promoting these practices both at a national and regional level, and combining this knowledge with modern materials and techniques.

Community mobilization

The trend towards decentralization in many countries has placed more decision-making power into the hands of civil society and local government, particularly in countries where trimming the central

Box 14.3: The bushmen's loss is everyone's loss

Several centuries ago, the San, a semi-nomadic population of the Kalahari desert in southern Africa, invented an innovative technology for pumping water: at selected sip-wells (places where water was sucked up through a straw) holes were prepared, into which the San inserted a straw with grass filters at either end. They then compacted the sand around the straw, letting it accumulate moisture, after which they sucked the water out of the sand and stored it in ostrich eggs, sealed and buried for later use.

The San also knew of rare springs that provided freshwater throughout the year. Other water sources included pan-like areas that stored rainwater for long periods of time, but these were generally only used in cooler seasons when the threat of malaria decreased, and the San often discarded this water for drinking because of its brackish taste. In addition, certain tree species have holes out of which the San sucked collected rainwater and dew.

However, the San's methods of water management were drastically altered in the seventeenth century when their territories were invaded by Bantu and European settlers. New technologies such as boreholes were introduced, pumping vast quantities of groundwater that eventually dried up the San's sip-wells. The settlers' livestock ravaged the food supplies and the water-collecting trees. Now thoroughly dispossessed, the San are fighting to regain their territories, and their way of life and water management.

Source: UNESCO, 2002. Prepared for the World Water Assessment Programme (WWAP).

Civil Service was a main condition of the economic and structural adjustment programmes of recent decades. This has charged many local government agencies with new functions, for which they require adequate training. In many instances, responsibility for operating and maintaining systems has been transferred to local water user associations. While the local users have sound knowledge about the local context, all too often the associations are understaffed, rely on voluntary workers and experience difficulties in scaling up operations (for an example, see chapter 16, the Chao Phraya River basin case study).

New water laws (see box 14.4 on Brazil and Sri Lanka) have been enacted in many countries. They are changing the rules of water governance, empowering communities to manage their resources and develop sustainable water management policies. The new Water Law of Zimbabwe, for example, delegates catchment management responsibilities and day-to-day duties of water rights allocation to stakeholder-elected Catchment Councils.

If delegation is to be effective, it must address local human, financial and institutional capacities. Many governments maintain an overly instrumental view of local communities, and their active involvement is normally sought only for implementing water projects, whereas true participation would entail involvement throughout the whole policy or project cycle. New mechanisms are required to enhance links between government agencies, private sector and civil society organizations, particularly in many cities of Africa, Asia and Latin America, where governance structures are often inadequate to address issues of provision and revenue-raising. An open, transparent and continuous process of consultation and

Box 14.4: Power to society – water laws in Brazil and Sri Lanka

In 1997, Brazil adopted a new water law, based on the principle set out in the 1988 Constitution describing water as a public good. The law reflects a shift in thinking on water management towards a more democratic and decentralized exercise. It underlines the importance of giving society more decision-making power in water matters, specifically national state councils for water resources and river basin committees. The latter are seen as belonging to everyone, and become a conciliating element between the interests of the state and those of consumers.

In Sri Lanka, heated debate surrounds a draft water act aimed at fostering decentralized management of water through river basin organizations. The latter will become responsible for planning, implementing and regulating water allocations between water use sections in each basin. However, introduction of the water resource management concepts that underpin the act, including water rights, have proved contentious, largely due to fears over loss of rights for traditional water usage and apprehension over the possible introduction of new water charges. These fears are delaying presentation of the act to Parliament.

Source: Based on P. Alfonso Romano, former Secretary of Water Resources of Brazil, and the Ministry of Irrigation and Water Management of Sri Lanka.

Box 14.5: CapNet – the virtues of networking

CapNet works towards strengthening or establishing regional networks delivering education and training support for improved management of water resources. This objective is achieved through networking, awareness creation, training and education, and development of relevant materials and tools. Target groups include water professionals and decision-makers, with a strong emphasis on the inclusion of women. Partners include particular regional and national capacity-building institutions in both the north and the south (http://www.cap-net.org/).

participation is essential if national water resources are to be managed in an equitable and sustainable way.

Growing mobilization at the community level is also witnessed by the surge of river basin groups, usually staffed by volunteers interested in protecting the integrity of their river basin. The United States Environmental Protection Agency (US EPA) has identified more than 3,000 such groups, each composed primarily of individuals, identifying and using local knowledge relevant to their river basin. Some have discussion forums that encourage sharing of information and knowledge. South Africa and Australia have Internet sites with a wealth of knowledge and experience covering the full spectrum of river basin activities. Mirroring a worldwide trend, river basin organizations have established a worldwide network, the International Network of Basin Organizations (INBO), to exchange information and experience on a wide range of issues such as mechanisms for cooperative action, conflict mitigation, public-private partnerships and practices of water pricing and allocation of resources.

Buttressing this burgeoning of local initiatives, a number of national and international NGOs as well as civil society groups are working to consolidate this emerging knowledge base through building community awareness and local capacity. These organizations offer learning tools, collect cases of best practice and draw on a wealth of experiences through community networks. They are devoting significant resources to partnering and networking activities to more effectively carry out their mission. The rapid development of information technologies has further spurred the creation of planetary networks allowing communities of interest to share information and learn from each other. These knowledge bases range from simple bulletin-board-style communications systems to complex and information-rich compilations with well developed navigation and query systems. Some, such as CapNet, specifically aim to bolster capacities (see box 14.5).

Many networks are devoted to specific aspects of water, such as LakeNet, a global network of people and organizations dedicated to the conservation and sustainable management of lakes. The Oneworld Water and Sanitation Think Tank aims to promote sharing of experiences on a south-south basis and to enable water practitioners in developing countries to integrate these lessons into policy-making. Others adopt an integrated vision to improve water management. GWP works through a network of partners to identify critical knowledge needs, assists in designing programmes to meet them and serves as a broker between providers and donors. GWP stresses the need for innovative solutions and for all users of water to share information, understand data and work together to solve problems.

The Challenges

Shifts in the water industry

The participatory approach is also taking hold in the water industry as companies expand their operations and adopt more flexible management practices. Less than half a century ago, the knowledge base for a water supply company consisted primarily of design drawings, operation and maintenance manuals and inherent understanding of the system through the skills and experience of staff. Today, assessment of demand by customers, higher standards of treatment, improved concern for public health, metering and better operations and maintenance have all required a wider consultation with other professionals. Bridges are being built between consumers, water companies and government, requiring more accessible and comprehensive knowledge. They include Public Service Agreements detailing dates and terms of government delivery, Service Level Agreements by companies to meet consumer-consulted supply reliabilities and public consultations on government white papers or technical applications with a public impact. Further examples of these emerging connections between stakeholders include public consultations on particular water schemes and consumer association involvement in water.

Across the water sector, the number of generic guidelines on best practice relating to specific issues numbers into the tens of thousands. Against the backdrop of mergers and public-private partnerships, the water consultancy business has soared as organizations seek advice on ever-wider missions and responsibilities in the aim of integrating new knowledge into their operational

practices. Development partners are increasingly stimulating growth in the local consultancy sector rather than turning to international expertise. Patterns in the supply of bilateral support are also beginning to change, with the untying of development assistance. As a result, national funds from a donor country are not necessarily tied to technical assistance from the same country.

As noted, the water industry relies on a very broad body of knowledge to operate: codes of practice, operating and training manuals for systems, plants and equipment, databases, government guidelines, research journals, reports of professional and trade associations, manufacturers and suppliers. Much of this operating knowledge, however, still tends to be based on the needs of advanced countries. All too often, low-income countries adopt laws, regulations and working practices from advanced countries, when in many cases they lack the capacity to enforce and apply them. While several low-income countries have developed local expertise to deal with challenges in their water sectors – examples include Mexican wastewater and irrigation reform practices and Brazilian expertise in water and sanitation in poor communities – these experiences are not systematically shared with other developing countries. Language, financial and cultural barriers impede the transfer of knowledge. Channels must be facilitated to boost this south-south collaboration and, in the process, place higher value on local expertise, which is more inclined to view water knowledge in context.

Overcoming poor data availability

Empowering stakeholders at all levels is one facet of creating a sound knowledge base. Another vital facet is the production of high-quality data. Agenda 21 warned that a lack of data is 'seriously impairing the capacities of countries to make informed decisions concerning environment and development'.

National water databases are the backbone of international data management. However, in many parts of the world hydrometric and water quality monitoring networks are deficient. Table 14.1 shows the regional variation in the total number and density of various monitoring stations. Data from many of the stations measuring river discharge are not available and only a relatively small number have data series of sufficient length and quality for use in analyses. Similarly, there is a dearth of quality data on groundwater in spite of its potential for future water supply. Studies have additionally shown that the density of these stations is much lower in Africa than elsewhere.

In addition to the problems in collecting data – often due to a lack of resources for maintaining observation stations – the ability to use available data to describe the status and trends of global water resources is hampered by divergent procedures for collecting data, different quality assurance procedures and unreliable telecommunications. The fragmentation of national organizations dealing with water resources assessment has meant that networks

Table 14.1. Increases and decreases in the number of hydrological observing stations in the world between 1974 and 1997

	World Meteorological Organization Regions						
Type of stations	**I Africa**	**II Asia**	**III South America**	**IV North and Central America**	**V South-west Pacific**	**VI Europe**	**Total (global)**
METEOROLOGICAL							
Precipitation	10,074 <>	9,445 ++	22,975 +++	20,174 <>	16,367 <>	35,091 -	114,126 <>
Evaporation (pans)	682 +++	1,011 +++	1,945 +++	871 <>	1,296 +++	1,129 +	6,934 ++
SURFACE WATER							
Discharge	1,748 +++	3,163 ++	7,568 +++	11,958 -	5,935 +	18,796 ++	49,168 +
Stage	1,798 +++	8,186 +++	7,022 +++	10,819 -	852 –	10,427 -	39,104 +
Suspended solids	560 +++	440 ++	1,187 +++	1,008 +	514 –	3,590 +++	7,299 ++
Bed load	6 +++	27 ++	339 +++	0 n.a.	0 —	1,423 +++	1,795 +++
Water quality	310 -	2,057 ++	3,076 +++	14,218 +++	1,415 —	14,974 +++	36,050 +++
GROUNDWATER							
Groundwater level	1,450 ++	3,776 <>	1,133 +++	4,344 ++	1,999 +++	45,782 –	58,484 -

Key: — = < -2% – = < -1% - = < -0.5% <> = no significant change + = > +0.5% ++ = > +1% +++ = > +2% n.a. = data not available

This table shows the regional variation in the total number and density of various monitoring stations. Data from many of the stations measuring river discharge are not available and only a relatively small number have data series of sufficient length and quality for use in analyses.

Source: WMO, the World's Hydrological Networks, 1997.

Box 14.6: New tools for the Mekong

The Lower Mekong suffered serious damages resulting in heavy loss of life during six floods in the last decade. Decision-making needs to be supported by scientific assessment of the causes of increased flood damage – change in climate or land use, population growth – but poor data availability has prevented this.

In response, the International Association of Hydrologic Sciences has developed its Prediction of Ungauged Basins (PUB), an international research initiative to assess water resources in basins with no records. One possible application is the Mekong River basin.

Using a downscaling technique that requires a sophisticated integrated hydrometeorological model, experts from the Public Works Research Institute of Japan conducted a blind test on Greater Tokyo to reconstruct historic rainfall over the area. The approach offers several advantages: it can be applied to any basin in the world including ungauged ones, in contrast to remote sensing that requires some ground rainfall data. This technique will be used to reconstruct rainfall over the Lower Mekong River basin in the last two decades and scientifically assess flood frequency.

Source: Prepared for the World Water Assessment Programme (WWAP) by the Ministry of Land, Infrastructure and Transport (MLIT) of Japan, 2002.

specialized in different hydrological observations (e.g. surface water, groundwater, management of reservoirs) are often poorly integrated. Coordination is similarly lacking between databases on water and similar ones on geology, land use, demographic data, health, economics and other fields that tie into a vision of integrated management. Climate change is also introducing elements of data uncertainty concerning the variability in the distribution of water resources.

New technologies such as remote sensing and GIS have improved water data collection and contributed to advancing scientific knowledge. Remote sensing enables a continuous monitoring of the globe at all scales. It has found important application in the mapping of snow and ice covers, glacier movement, currents in lakes and seas, biomass and algal growth, particles in water, water temperature and other variables. GIS technology has been instrumental in mapping Africa's water resources while the European environmental satellite, Envisat, launched in March 2002, will provide valuable input to the study of global climate change and the world's waters. New computing tools (see box 14.6 for an example from the Mekong River) promise to advance knowledge of flooding and strategies for risk mitigation.

Several international programmes are seeking to improve national capacity to assess water resources. The World Meteorological Organization (WMO), supported by the World Bank, has developed the World Hydrological Cycle Observing System (WHYCOS), establishing a global network of hydrological observatories, supplementing national networks. The International Atomic Energy Agency (IAEA), with WMO, contributes to building capacity for improved water resource understanding and management through the Global Network of Isotopes in Precipitation. The United Nations Environment Programme's (UNEP) Global Environmental Monitoring System gathers data from sixty-nine countries on variables such as organic matter, heavy metals, salinity and acidifying atmospheric emissions. An international groundwater resources assessment centre, under the auspices of UNESCO and WMO, is planned, and will focus on the development of procedures for collecting and processing data on the world's aquifers, promoting adequate monitoring systems and increasing awareness.

Sharing and harmonizing knowledge

In addition to the gathering of data, sharing knowledge and making knowledge and data available are aims that have been pursued by UN organizations and their partners, boosted by the opportunities offered by information technology. Many knowledge bases relating to agriculture, health and indigenous knowledge are now made freely available to decision-makers, stakeholders and the public at large. The Global Terrestrial Network provides an Internet-based mechanism to access data and meta-data information from independent centres on such variables as surface water discharge, groundwater fluxes, precipitation and soil moisture. The WMO's Global Runoff Data Centre (GRDC) collects and disseminates data on river discharge on a global scale, and provides data products and specialized services for the research community, water managers and water-related programmes.

Regional databases also exist but data characterization remains a major problem, rendering comparisons from different sources hazardous. Joint monitoring projects underway at Lake Peipsi and cooperation in drawing up a management plan for the Senegal River basin, shared between four countries (see boxes 14.7 and 14.8), are vital steps to enhancing the knowledge base. International cooperation is also urgently required to ensure a reliable, comparable global database.

Box 14.7: Senegal River basin – information for sustainable management

Reliable, comprehensive information is the foundation of better management. In Senegal, for example, OMVS (Organisation pour la Mise en Valeur du Fleuve du Sénégal, or Organization for the Development of the Senegal River) is preparing a development and management plan for the Senegal River basin, which is shared amongst Guinea, Mali, Mauritania and Senegal. For this task, authorities are relying on several tools developed over recent years, namely a flow rate monitoring network with statistics kept since 1904, a computer program designed to evaluate the effects of different management rules applying to the Manatali dam and two dam management manuals. The latter provide managers with guidelines on keeping the upstream storage lakes at high levels during periods of flooding, security guidelines and flow rates required to best meet the aims of regular output and electricity production.

Source: Based on a text by the Organization for the Development of the Senegal River (OMVS), 2002. Prepared for the World Water Assessment Programme (WWAP).

Box 14.8: Joint monitoring on Lake Peipsi

Sharing water is one of the major challenges to achieving water security in the twenty-first century. A joint project on Lake Peipsi, now divided between the Russian Federation and the Republic of Estonia, has resulted in coordinating sampling programmes and comparing water quality norms. The Narva Watershed Research Programme originated in 1998, supported by the Swedish Water Management Research Programme (VASTRA), to develop catchment-based strategies for sustainable water use. A separate three-year European Union project will result in extensive research papers and databases, including numerous GIS layers covering the whole basin. This project stands to benefit environmental authorities in both countries.

Source: Prepared for the World Water Assessment Programme (WWAP) by the Ministry of Natural Resources of the Russian Federation, and the Ministry of the Environment of Estonia, 2002.

A more holistic approach to water management can equally be gleaned from initiatives such as the UN Earthwatch system, which utilizes the combined resources of UN partners and others in producing major environmental assessments. A *World Water and Climate Atlas* was produced in 1999 by the International Water Management Institute (IWMI), while 'Our Fragile World', a forerunner to the *Encyclopaedia of Life Support Systems*, supported by UNESCO (2001c), presents an integrated vision of knowledge essential for global stability by connecting issues relating to water, energy, environment, food and agriculture.

While many organizations provide valuable data and information on trends in the arena of water management, the absence of a coordinated monitoring process is hampering appraisal of progress. The failure to measure progress against targets set out at major international meetings runs the risk, over time, of undermining the effectiveness of policies and of basing investments on poorly identified priorities.

Efforts are being made towards improving the coverage and effectiveness of the global statistical systems through establishment of large datasets. In certain instances, agencies within the UN are tasked by member states with particular monitoring and evaluation roles, such as that of the UN Economic and Social Council and the Commission on Sustainable Development (CSD) in tracking progress against Agenda 21.

The UN's data holdings permit the publication of authoritative reports, such as the recently introduced *World Development Indicators*, the World Bank's premier annual compilation of development data, with some 800 indicators. It is one of WWAP's major priorities to further harmonize data within the UN family. At present, there are at least three UN system-wide meta-data-gathering initiatives taking place:

- the UN Geographic Information Working Group (UNGIWG), which is looking at the coordinated development of GIS within the UN system;
- the UN statistics division initiative, which concentrates on the development of a standard set of statistics that are collected to support the UN as a whole; and
- Earthwatch, a mechanism for coordinating UN agency initiatives in the field of environmental management. Furthermore, the UN Department of Economic and Social Affairs (DESA) has compiled a survey of water-related databases.

However, UN efforts at creating these global datasets are only as good as a country's ability to assemble its own water information. The global statistical system is built up from the national level, where data are obtained from a number of different sources: central statistical offices, ministries and national banks. Efforts are being focused on improving collection of water-related data from censuses, surveys, consumer information and statutory data collection requirements. Reinforcing the capacity of countries to obtain and store data is an overriding priority for ensuring our ability to describe and assess the global water situation. Financial constraints have reduced the ability of public service institutions in charge of water resources to collect data at the field level in many developing countries. As noted earlier, there has been in many cases a decline in the quantity and quality of information on water resources and their uses. GIS and computerized databases of water resources and related socio-economic information still have to be made available on a much larger scale in developing countries, combined with capacity-building. Despite progress made in the Joint Monitoring Programme's 2000 Assessment (WHO/UNICEF, 2000), there is little detailed data available on the quality of provision for water and sanitation in most of the world's cities. More detailed data would mean significant changes in the questions asked within censuses – an evident strain on the resources of poor countries.

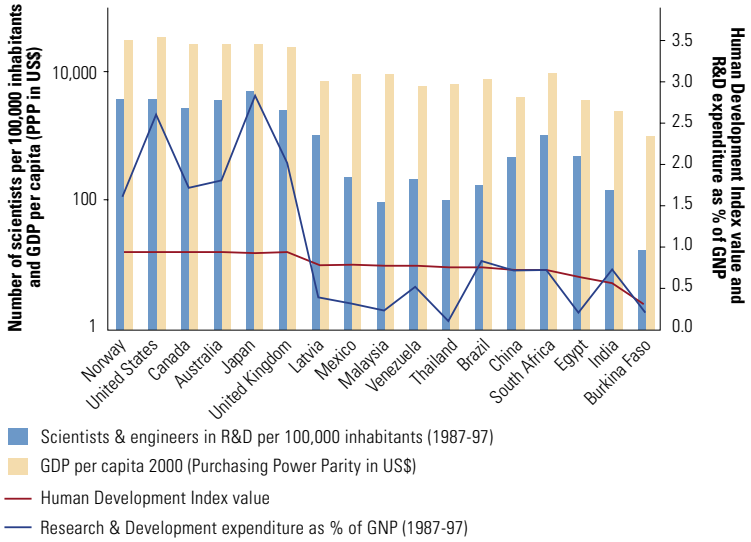
Meeting research and development needs: the production and use of scientific knowledge

Beyond its capacity to generate, analyse, store and share data, the scientific community requires observational rigour. Without an endogenous research base, how can countries adequately address issues from both a local and global perspective?

The World Conference on Science organized in Budapest in 1999 drew attention to the growing gap between science-rich and science-poor countries in the production and use of scientific knowledge. Today, North America, western Europe, Japan and the newly industrialized countries account for 85 percent of total research and development (R&D) expenditure worldwide. Figure 14.3 shows the number of scientists and engineers per 100,000 people, Gross Domestic Product (GDP) per capita (Purchasing Power Parity [PPP] dollars), Human Development Index (HDI) and the percentage of Gross National Product (GNP) spent on research in certain example countries, and illustrates clearly the difference between developed and developing countries.

Lack of investment in science and technology is maintaining the brain drain, depriving developing countries and those in transition of the high-level expertise required to accelerate their socio-economic progress and find solutions adapted to their needs. Up to 30 percent of African scientists are lost to the brain drain according to several

Figure 14.3: Number of scientists and engineers per 100,000 inhabitants, GDP per capita (PPP in US$), Human Development Index value and R&D expenditure



This figure shows the number of scientists per 100,000 people, GDP per capita, Human Development Index and the percentage of GNP spent on research and development in certain countries. The difference between developed and developing countries is clearly illustrated.

Source: UNDP, 2001 and 2002.

studies sponsored by the Research and Development Forum for Science-led Development in Africa.

The global economic context is ushering in a new framework that is transforming the social institution of science and research systems. According to UNESCO's regular *World Science Report*, science education at the post-secondary level is facing a severe crisis in many developing countries, marked by a growing perception that science is failing to tackle acute problems associated with water, sanitation, food security and the environment. Deteriorating working conditions in laboratories and universities and wide salary gaps favouring scientists in the private sector are accentuating the trend. This mostly holds true for non-water trades in which the trained water professional has valuable transferable skills. The impact of privatization is being felt in several countries through cutbacks in state funding, the closing of certain national research facilities and increasing dependence on foreign private and donor funding. Universities are knitting tighter relationships with the corporate world to become more responsive to the needs and demands of industry, but will this serve the public good and the needs of the poor? What are the consequences for research expenditure on achieving a finer understanding of basic water processes and developing more efficient techniques for water use and extraction, whether in the domestic, agricultural or industrial sector?

Assessments have pointed out that large numbers of technical and scientific personnel lack sufficient knowledge about overall water management and use. While important scientific and technological advances have been made – modelling capability stands out as an example – the specific needs of developing countries in monitoring and managing their water resources are not high on the research agenda. Many barriers to the effective management and supply of water lie in the institutional and managerial sphere and will not be solved by improved technologies alone. Research focused on effective institutional structures and management techniques is required.

A potential deadlock lies in the polarized standpoints within the water research community. At this stage, there remains ample scope for divergent policies and actions to evolve, all backed legitimately by the 'knowledge base'. The nature of the journal process – a key measure of academic performance which holds the influence to attract financing – makes it all the more difficult to find an objective middle ground. A vast array of academic papers exist. Two of the main bibliographic databases, Selected Water Resources Abstracts (1967–94) and Water Resources Abstracts (1994–present) identify 370,000 papers or abstracts. The figure is probably conservative given the lack of access to some bibliographies (particularly non-English ones). This leaves the knowledge base with an outstanding problem of consolidation. Conferences, thematic volumes, best practice documents and guidelines all attempt to streamline this fragmented body of information. The Toolbox for Integrated Water Resource Management, released in 2001 by GWP, provides a range of tools that users can select or modify according to their needs and local circumstances. Launched at the Freshwater Conference in Bonn in December 2001, the Tool Box draws together a wealth of experience and expertise in IWRM in one product. Divided into two main sections, Policy Guidance and Operational Tools, the tool box features a wide variety of options related to the enabling environment (what it takes to make policy changes on the ground), institutional roles and management instruments. To complement this information, case studies on IWRM practices are included. The Tool Box will continue to grow as users gain experience with it and start providing feedback on the success or failure of a particular set of actions in a given situation.[1]

This middle ground is reachable when a consensus, based on a shared vision, is sought by governments, the scientific community and society. As Michael Gibbons, secretary general of the Association of Commonwealth Universities wrote in the magazine *Nature* (Gibbons, 1999),

> *Under the prevailing contract between science and society, science has been expected to produce 'reliable' knowledge, provided merely that it communicates its discoveries to society. A new contract must now ensure that scientific knowledge is 'socially robust', and that its production is seen by society to be both transparent and participative.*

If this is to hold sway in the water field, there is an urgency to clearly demonstrate the links between new knowledge and socio-economic outcomes, and to generate stronger demand for access to clean water. The explicit linking of water issues to human development and economic productivity is generally lacking both in terms of national policy declarations and legislative and administrative support.

The traditional wisdom of applying general solutions to water issues is being replaced by the idea of developing locally specific and applicable ideas. However, new investigations into specific local issues require increased investment or knowledge generation. The countries where the need for focused knowledge to achieve results is highest are often the countries with the lowest investment.

1. For more details, see http://www.gwpforum.org.

The Road Ahead

New avenues for learning

A CD-ROM search of the World Higher Education Database (IAU, 2002) reveals that there are 3,873 institutes all over the world offering higher-education courses on water and water-related subjects (see figure 14.4).

Against this backdrop, a host of specific programmes and partnerships are seeking to offer new learning and training opportunities for water specialists. Development partners are increasingly recognizing the importance of building local educational capacity, in order to train people within their own countries and educational institutions. The past decade has witnessed an expansion of international freshwater resource institutions and programmes. International educational programmes have proliferated, particularly within the European Union, through such methods as university twinning.

Partnerships in water education (see box 14.9) are enhancing cooperation between academic centres and professional organizations. The UNESCO International Institute for Infrastructural, Hydraulic and Environmental Engineering (IHE) aims to build capacity in water education by linking educational organizations and regional networks.

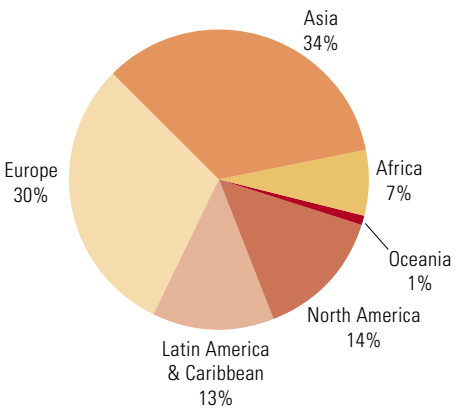
ICTs are also creating new learning environments, ranging from distance-education facilities to complete virtual higher-education institutions and systems capable of bridging distances. Online education facilities have flourished over the past decade, provided by universities, private companies and individuals. According to the Canadian TeleCampus database, there are at present about 45,000 courses available internationally for online learning, including some ninety in environmental engineering and thirty in hydrology and water resources.

In addition, many operational organizations are granting more importance to the links between qualifications/certification, employee status and rewards. To nurture local expertise, training and education systems will require further expansion, through, for example, professional associations and networking. In addition to ensuring high scientific standards, curricula must be constantly adapted to concrete problems and graduates taught to operate in an integrated, multidisciplinary environment.

Media and public information: furthering the cause

For water to become a shared global concern, it has to be viewed as such by society. In the endeavour, the media and public information

Figure 14.4: Institutes offering water-related subjects in higher education



The total number of institutes is 3,873. Water-related subjects include Water Science in Agriculture, Water Resource Engineering, Civil Engineering, Environmental Engineering, Rural and Town Planning, Public Health and Sanitation, Meteorology, Arid and Arctic Studies, Ecology, Environmental Science, Wildlife, Waste Management and Natural Resource Management.

The maximum concentration of institutes offering water-related subjects in higher education is in Asia, with 34 percent of the world total. This is closely followed by Europe, with 30 percent. Northern America and Latin America and the Caribbean have very similar rates, with 14 and 13 percent respectively. Africa and Oceania lag behind, with only 7 and 1 percent.

Source: IAU, 2002.

Box 14.9: UNESCO-IHE – a partnership in water education

The UNESCO-IHE partnership is contributing to the post-graduate education and training of professionals and to building the capacity of knowledge centres and other organizations in the fields of water, the environment and infrastructure in developing and transition countries. This is done through a partnership network of academic centres and professional organizations offering demand responsive and duly accredited educational programmes at the local and regional level. UNESCO-IHE encourages all those involved in the water sector, including its 12,000 alumni from more than one hundred countries, and scientists and professionals in public, private and civil society organizations, to participate in this dynamic network. Through international projects, regional refresher seminars for alumni, symposia and other routes, UNESCO-IHE is able to fine-tune its education, training and research programmes to ensure that they continue to meet changing demands.

play a critical role. At the Second World Water Forum, an event attended by some 600 journalists, World Bank Vice President Ismail Serageldin stated that the role of the media was to aid in ensuring transparency and to help combat corruption. The need to expose corruption, he said, 'is why we want all social actors and the media to be involved in all the issues of water' (Roberts, 2002).

In many countries where a free press is still in its infancy, the task of exposing corruption has sent journalists to jail more than once in recent years. The fact points to the powerful influence of the press – in asking hard questions, in exposing malpractices, in exploring who benefits from privatization contracts, in holding companies accountable, but also in creating broad consumer awareness.

The end of the Cold War, the ensuing wave of democratization and the introduction of digital technology have led to an upheaval in the media landscape. We have witnessed the emergence of an independent press and audiovisual in countries where information had until recently been held under tight state control, such as the transition countries of the former Soviet Union and parts of Latin America and Africa. New forms of television have emerged: cable and satellite television, video on demand, theme channels and new interactive services. These offer untold potential for 'popular' and scientific programmes on water issues. In contrast to this burgeoning offer, a trend towards concentration can also be gauged: three major agencies process and disseminate 80 percent of international information broadcast each day around the world.

Access to the media remains highly uneven across the world. The spread of the written press is hampered by financial resources and high illiteracy rates, particularly in southern Asia and sub-Saharan Africa. Circulation of daily newspapers stands at 226 copies per 1,000 inhabitants in developed countries compared to under 33 per 1,000 inhabitants for the rest of the world. The access to television and radio, while increasing, is also unevenly spread across the world, as shown in figure 14.5.

The rapid development of community radio, an especially powerful medium in regions with low literacy rates, is a particularly distinctive factor with the potential to play a positive role in garnering attention towards water issues. Since 1989, these stations have flourished in all parts of the developing world thanks to technological innovations, lower FM transmitter costs and slacker controls on broadcasting by public monopolies. Through novel approaches, based on listener participation, programmes tackle such issues as health, hygiene and rural development. These stations enhance dialogue within communities and promote the free flow of information and public accountability. In Sri Lanka, for example, Radio Mahaweli was set up in 1979 with the assistance of UNESCO and the Danish Agency for Development Assistance (DANIDA) when national authorities launched a construction plan for a hydroelectric dam. Over the course of six years, the news programmes broadcast by the mobile radio station enabled the population to be efficiently moved to new home sites.

Boosting coverage of water issues in the media is a two-way street: journalists themselves must become more educated on the complexity of water issues. Towards this end, the Water Media Network, supported by the World Bank, is an initiative designed to help journalists examine the social, environmental, regulatory and financial issues relating to water. The network features workshops, field visits and distance-learning courses for the media.

While water issues appear to have garnered heightened press attention in recent years, there is an urgent need to monitor their coverage more comprehensively in order to assess how the tools of the media are being used to foster understanding and awareness, and to promote debate. Capacity-building programmes are required both to strengthen journalists' professional skills and to sensitize the media to sustainable development issues.

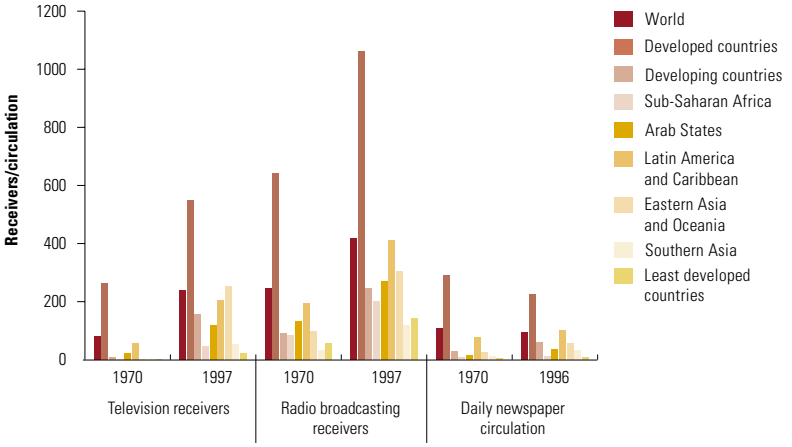
Public information sites and water portals are also vital tools for improving knowledge about water, providing specific information on water quality, risks of flooding or drought, tariffs and other matters. Access to specific and local information has been greatly facilitated through the Internet, flexible search engines and online computer services. Communication strategies are inherent components of public policy, with over 100 government departments for water maintaining official web sites. International and NGO web sites are contributing to building an improved knowledge base on global water resources. The World Water Portal (see box 14.10) is a gateway intended to enhance access to information related to freshwater available on the Internet, while the WWAP web site serves as a central communication network for this UN system-wide programme.

Hampering access: the digital divide

'Scan globally, Reinvent locally' runs a catch phrase urging stakeholders to take stock of this large circulating knowledge base in order to adapt it to local contexts in all domains. This recommendation, unfortunately, remains severely hampered.

The digital divide is the foremost hurdle. While ICT offers researchers and other communities in developing countries an unprecedented opportunity to overcome their economic and geographical isolation, the digital divide still prevents millions from taking advantage of this vast store of knowledge. The average numbers of fixed telephone lines – an accepted indicator of progress for knowledge in the Millennium Declaration – varies dramatically between regions, as shown in figure 14.6. OECD (Organization for Economic Cooperation and Development) countries account for 80 percent of people who use the Internet at work. In Asia, Latin America and Africa, more than 98 percent of the population is not connected to the Internet. The total international

Figure 14.5: Communications (television, radio, newspapers) per 1,000 inhabitants



Access to the media remains highly uneven across the world. The spread of the written press is hampered by financial resources and high illiteracy rates, particularly in Southern Asia and sub-Saharan Africa. Circulation of daily newspapers stands at 226 copies per 1,000 inhabitants in developed countries compared to under 33 per 1,000 inhabitants for the rest of the world. The access to television and radio, while increasing, is also unevenly spread across the world.

Source: UNESCO, 1999b.

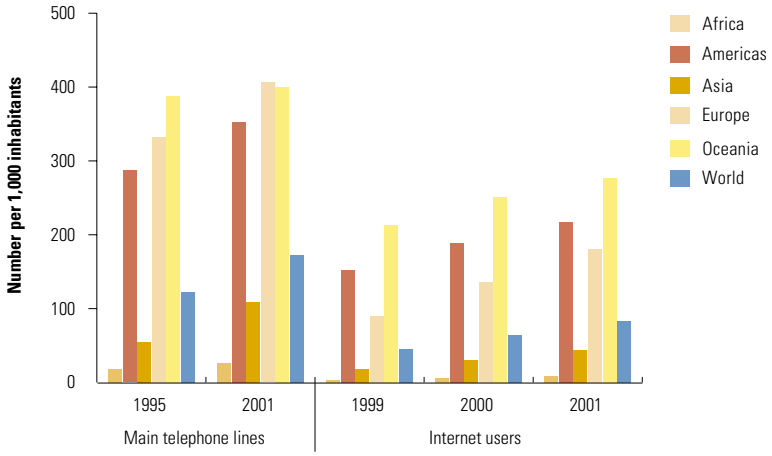
Box 14.10: The World Water Portal – a model for water information sharing and cooperation

WWAP, together with other water programmes and organizations, is developing the 'World Water Portal', a model for water information sharing and cooperation. This Internet portal will integrate various regional networks with the WWAP global water portal using common structures, protocols and standards to provide seamless access to a wide body of water information. Current priorities for the development of the World Water Portal include:

- development of a network of reliable water information providers;
- development of an organizational structure that will provide technical support (meta-data assistance/standards, 'good practice' guidance for database and web page development, search and database integration software, and development of processes for data acquisition) and ensure information quality through peer review processes (coordination/support of peer review process, discussion lists) and promote the adherence to sound information management standards;
- capacity-building in the area of information management and web site development for partners and contributing organizations, education and training for both managers and technicians enabling them to make more efficient use of the Internet; and
- the use of reliable information and the improvement of integrated water resource management decisions, with the goal of facilitating working partnerships. By accurately and consistently describing information resources, and linking to other information partners, the Portal aims to provide a valuable and self-perpetuating water information source for use by decision-makers, resource managers, researchers, students and the public at large.

In preparation for going global, a prototype water portal is now being developed for the Americas. If appropriate, its techniques for sharing and integrating information will provide a basis for the World Water Portal. This model will allow local, national and regional water organizations to develop the relationships and pursue the water information issues that are most important to them while contributing to the world's body of water knowledge. The prototype tools and technologies may then be easily implemented by other regions to rapidly expand the content and scope of the World Water Portal. (http://www.waterportal-americas.org).

Figure 14.6: Main telephone lines and Internet users per 1,000 inhabitants



The average numbers of telephone lines varies dramatically between regions, as does the number of Internet users: in Africa, less than 10 people per thousand are connected to the Internet, compared to over 250 inhabitants per thousand in Oceania. Both the numbers of telephone lines and Internet users are increasing worldwide.

Source: ITU, 2002. Taken from the ITU web site: http://www.itu.int/ITU-D/ict/statistics/.

bandwidth available for Africa is less than for the city of Sao Paulo in Brazil. Until the digital divide has been narrowed, the emergence of a society founded on knowledge remains severely compromised, as expenditure on ICT is much higher in developed countries, as shown in figure 14.7.

Innovative strategies are making small dents in the digital divide: UNESCO's International Initiative for Community Multimedia Centres (CMC), for example, combines community broadcasting with Internet and related technologies. A typical centre features radio both by and for local people and telecentre facilities offering access to Internet, email, word processing and other services. During radio-browsing programmes, presenters search the Internet in response to listeners' queries and discuss the contents on air with studio guests. Centres can gradually build up their own database of materials that meet the community's needs in such areas as health, education and income generation.

The UN Special Initiative for Africa focused on harnessing information technology for development, while the United Nations Development Programme (UNDP) has initiated a programme aiming to reduce the knowledge gap. One of the targets of the Millennium Development Goal addressing a global partnership for development calls for cooperation with the private sector, to make available the benefits of new technologies, especially information and communications.

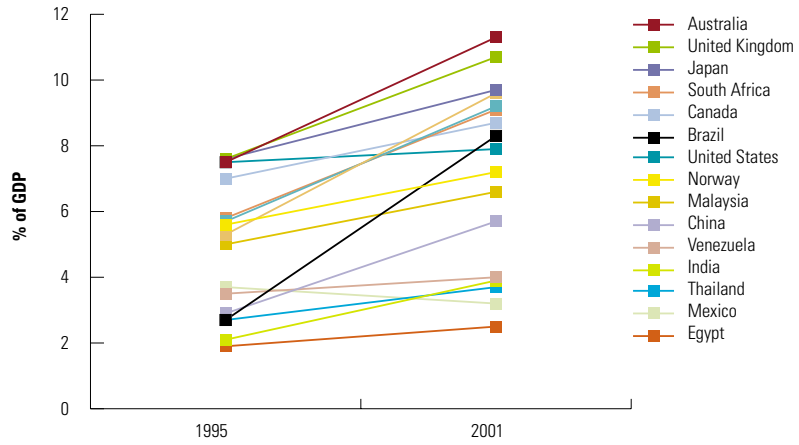
A separate trend towards the privatization of knowledge is another emerging obstacle. As a WMO resolution on the Exchange of Hydrological Data and Products underlines, water data should be unrestricted and freely accessible. This principle is crucial to ensuring that water data and derived knowledge do not become expensive merchandise in the hands of powerful interest groups. Private insurance companies, for example, are coveting the natural disaster market and collecting data and historical records for risk analysis. Such information must stay in the public domain if water is to remain everybody's business.

Conclusions

The lesson is straightforward: the wider the knowledge base, the more common ground there will be for negotiation and discussion, and advancing towards a shared vision of needs. This knowledge base must encompass the general populace as well as water sector professionals. Education, both formal and informal, is vital if the value of water is to be appreciated throughout the world and in ensuring that everyone has a knowledge of good water practice, in terms of efficient water use and safe hygienic practices. Water sector professionals require access to reliable, high-quality data as a prerequisite for understanding key changes, identifying significant trends and making informed policy decisions on water management.

To effectively utilize the existing knowledge base in the management and operation of the water sector, and to improve understanding of the issues involved, consultation and the participation of the various stakeholders are necessary. This is true at local, national and international levels, both for developing policy as well as implementation of individual water schemes.

Figure 14.7: ICT expenditure as percentage of GDP



This figure shows the dramatic difference in expenditure on Information and Communication Technologies between developed and developing countries.

Source: Extracted from the World Bank Group web site, 2002. Data by Country – ICT at a Glance tables. Data and Statistics. http://www.worldbank.org/data/countrydata/countrydata.html

New technologies can improve the method and reliability of gathering data. Advances in ICTs can improve the ability of water professionals to gather, analyse and share data. They also provide a further avenue for spreading the word, enabling individuals and interested parties to access information more readily. But caution is needed – access to ICTs remains highly uneven across the world. Developing countries, which arguably have the greatest need for the benefits of ICT in overcoming their geographical and economic isolation, are hindered by the digital divide.

The challenges are clear. The overriding urgency is to enhance the capacities of low-income countries to develop their own expertise, while also ensuring they have full access to the global body of knowledge. The goal is fundamentally an ethical one, linking water to equity and social justice. It is a task that demands a sustained pursuit of international collaboration and investment to meet the UN Millennium Development Goal and the World Summit on Sustainable Development target of halving the proportion of people without access to safe drinking water and sanitation by 2015, and to pave the way for fairer, more sustainable development by integrating social, economic and environmental concerns.

Progress since Rio at a glance

Agreed action	Progress since Rio
Regard ensuring knowledge as a practical basis for sustainable water resource management	
Conduct feasibility of water resource assessment services by 2000	
Establish long-term target of fully operational services including hydrometric networks	
Ensure effective sharing of knowledge and technology	

Unsatisfactory **Moderate** **Satisfactory**

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Note on Web Sites

By its very nature the Knowledge Base chapter is all-encompassing and vast. Without criteria agreed to and endorsed by all the partner agencies, it did not seem appropriate to single out some data sources as being more important than any others. For example, UNESCO, one of the two co-authors of this chapter, has data available across its fields of competence, in education, science, culture and communication. So how to choose? We have preferred simply to refer the reader to the more specialized lists proposed by the authors at the end of each challenge area.

We would also like to mention that initiatives such as the World Water Portal (see box 14.10) are intended as a response to this very problem of how to organize the mass of material available so that people can access data and information in a useful way. Developing such a resource in a coherent way requires a long-term effort. WWAP is already engaged in this and will continue to do its share.