Challenge for the 21st Century: Making Water Everybody's Business

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Abstract

Today the chronic and pernicious water crisis is less about a lack of water resources and more about the lack of access to basic water services, and serious environmental impacts that are a consequence of the way we manage water resources. With serious overpumping of key aquifers, major rivers running dry, and both surface and groundwaters being subjected to increasing levels of pollution, there is also a serious risk that if we do not change our ways we will run out of water to produce food, provide water for other human uses, and sustain our environment for future generations.

The dual objectives of the World Water Vision project initiated by the Wold Water Council and guided by the World Water Commission, were to: (1) increase the awareness of the water crisis; and (2) develop a widely shared vision of a desirable, sustainable water future and the way to get there. Over a period of 15 months the World Water Vision exercise has involved an estimated 15 thousand people in an unprecedented effort to shape public policy at the global level through stakeholder participation. The process culminated in the 2nd World Water Forum and Ministerial Conference in March 2000 in the Hague. The key actions identified through the World Water Vision process to achieve sustainable water resources management are to: 1. involve all stakeholders in integrated water resources management; 2. move towards full cost pricing of water services for all human uses; 3. increase public funding for research and innovation in the public interest; 4. recognise the need for co-operation to improve integrated water resources management in international basins; and 5. massively increase the investments in water.

Today's Water Crisis – and Tomorrow's

There is a water crisis today – though this crisis is not about a lack of water to satisfy our needs, but about managing water so badly that billions of people – and the environment – suffer badly.

During the 20th century the world population tripled, but water use for human purposes multiplied six-fold. The most obvious uses of water for people are drinking, cooking, bathing, cleaning and, for some, watering family food plots. This domestic water, though crucial, is only a small part of the total – an estimated 350 cubic kilometres in 1995 (Shiklomanov, 1999); see Table 1 and Figure 1. Worldwide, industry uses about twice as much water as households, mostly for cooling in the production of electricity. Far more water is needed to produce food and fibre (cereals, fruits, meat, cotton) – 2500 cubic kilometres in 1995 (Shiklomanov, 1999). Shiklomanov's forecast of 5235 cubic kilometres in 2025 is largely based on an extrapolation of the key trends over the last decades. He assumes a major increase in irrigated agriculture – which leads to acute water shortages.

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

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

But also half-empty:

- An unacceptably large portion of the world population – one in five – does not have access to safe and

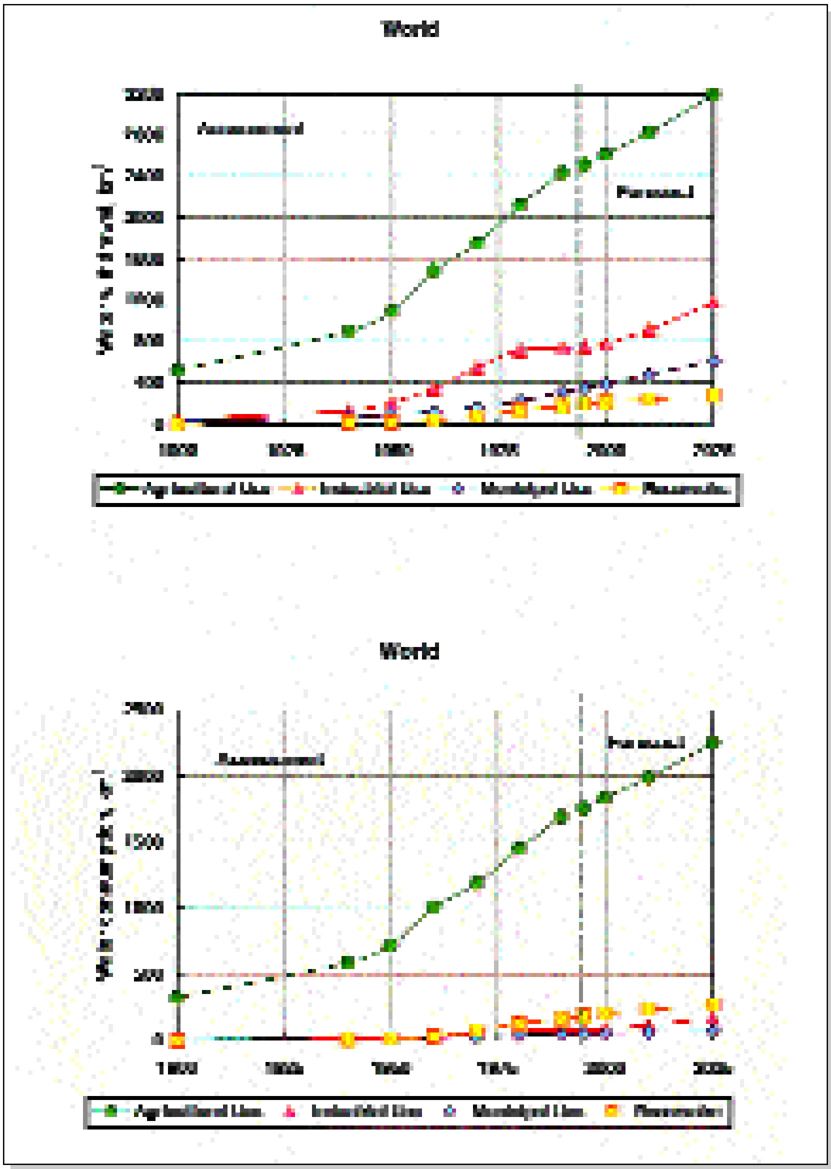
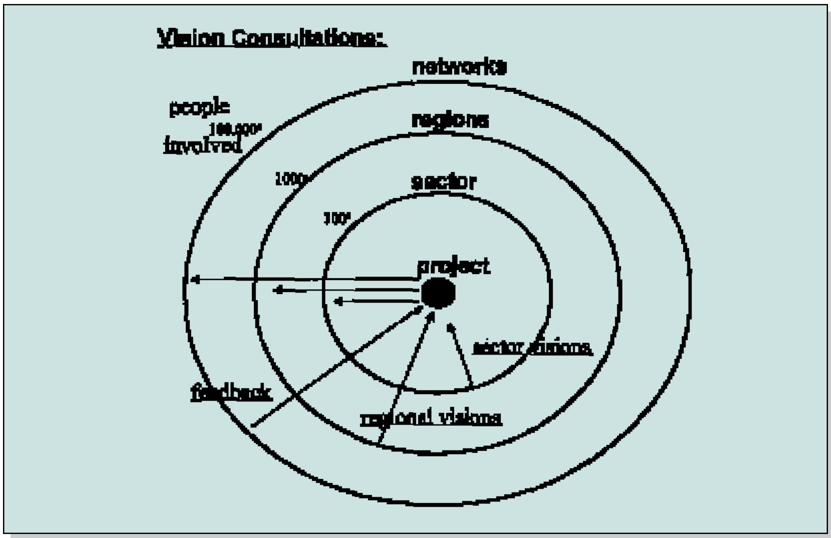


Figure 1
Total water withdrawal and water consumption in the world

Figure 2
Consultations for the World Water Vision



affordable drinking water, and half the world's people do not have access to sanitation. Each year 3-4 million people die of waterborne diseases, including more than 2 million young children who die of diarrhoea (WHO, 1999).

- More than 800 million people, 15% of the world's population and mostly women and children, get less than 2,000 calories a day. Chronically undernourished, they live in permanent or intermittent hunger.
- Much economic progress has come at the cost of severe impacts on natural ecosystems in most developed and transition economies. Half the world's wetlands were lost in the 20th century, causing a major loss of biodiversity. Many rivers and streams running through urban centres are dead or dying. Major rivers from the Yellow River in China to the Colorado in North America are drying up and barely reach the sea.
- Water services – irrigation water, domestic and industrial water supply, wastewater treatment – are heavily subsidised by most governments. This is done for all the right reasons (providing water, food, jobs) but with perverse consequences. Users do not value water provided free or almost free – and so waste it. Water conservation technologies do not spread. There are insufficient incentives for innovation.
- Unregulated access, affordable small pumps, and subsidised electricity and diesel oil have led to over-pumping of groundwater for irrigation and to groundwater tables falling metres per year in key aquifers. As much as 10% (or some 200 cubic kilometres) of global annual water consumption may come from depleting groundwater resources (Postel, 1999).
- In most countries water continues to be managed by a highly fragmented set of institutions sector-by-sector, ineffective for allocating water across purposes. Their processes do not provide for effective participation of other stakeholders in decision-making and management.

THE WORLD WATER VISION EXERCISE

Participants at the First World Water Forum – held in Marrakech, Morocco, in 1997 and sponsored by the World Water Council – called for a World Water Vision to increase awareness of the water crisis and develop a widely shared view of how to bring about sustainable use and development of water resources (Cosgrove and Rijsberman, 1998).

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

The participatory process that led to the World

Table 1.
Global water use by sector of economic activity (km≥/year)

Sector	1900	1940	1950	1960	1970	1980	1990	1995	2000	2010	2025
	Assessment								Forecast		
Population (million)			2542	3029	3603	4410	5285	5735	6181	7113	7877
Irrigated land area (mln.ha)	47	76	101	142	169	198	243	253	264	288	329
Agricultural Use	513	895	1080	1481	1743	2112	2425	2504	2605	2817	3189
	321	586	722	1005	1186	1445	1691	1753	1834	1987	2252
Municipal Use	21	59	87	118	160	219	305	344	384	472	607
	5	13	17	21	29	38	45	50	53	61	74
Industrial Use	44	127	204	339	547	713	735	752	776	908	1170
	5	12	19	31	51	71	79	83	88	117	169
Reservoirs	0	7	11	30	76	131	167	188	208	235	269
Total (rounded)	578	1088	1382	1968	2526	3175	3633	3788	3973	4431	5235
	331	617	768	1086	1341	1686	1982	2074	2182	2399	2764

Remarks: First line – water withdrawal, second – water consumption.

Source: Shiklomanov (1999)

Water Vision makes it special. Since August 1998 some 15,000 women and men at the local, district, national, regional and global levels have shared their aspirations and developed strategies for the sustainable use and development of water resources (Figure 2). The Internet made these consultations possible in a short timeframe. As the Vision evolved, more networks of civil society groups, non-governmental organisations (NGOs), women, and environmental groups joined the consultations that influenced the World Water Vision. The diverse backgrounds of participants offered a wide range of views (Cosgrove and Rijsberman, 2000).

WHAT BUSINESS-AS-USUAL PORTENDS: SEVERE STRESS

As part of the World Water Vision exercise a Scenario Development Panel of 14 distinguished water experts, modellers and futurists, co-chaired by Commission chairman Ismail Serageldin and the second author, developed three global level water scenarios (Gallopin and Rijsberman, 2000). These decribed scenarios for Business as Usual (BAU), Technology, Economics and the Private Sector (TEC) and Values and Lifestyles (VAL). Simulation models were subsequently used to explore these scenarios. The basic data set for renewable water resources availability and use (domestic, industrial and agriculture) at the national level in 1995 was provided by the State Hydrological Institute of Russia (Shiklomanov, 1999).

The BAU scenario shows that because of population growth, the global average annual per capita availability of renewable water resources is projected to fall from 6,600 cubic metres today to 4,800 cubic metres in 2025. The Vision's BAU scenario assumes, however, that lack of investment funding and social and environmental opposition will drastically limit the expansion of irrigated agriculture (Table 2). Given the uneven distribution of these resources, some 3 billion women and men will live in countries, wholly or partly arid or semiarid, which will have less than 1,700 cubic metres per capita, the quantity below which one starts to suffer from water stress. Also by 2025 about 4 billion people, or more than half the world's population, are estimated to live in countries where more than 40% of renewable resources are withdrawn for human uses – another indicator of high water stress under most conditions (Alcamo *et al.*,1999).

Under business as usual, with present policies continued, in developed and transition-economy countries economic growth to 2025 tends to increase water use (Gallopin and Rijsberman, 1999). But this increase can be offset by more efficient water use and the saturation of water demands in industry and households. In addition, the amount of irrigated land stabilises, and water for irrigation is used more efficiently. As a result, total water withdrawals should decline. Extrapolating current trends on water quality does not present a rosy picture, however.

Higher incomes and providing increased access in devel-

Table 2. Development of water use by sector for the World Water Vision BAU scenario, assuming the total area under irrigation increases only marginally

	1995	2010 BAU	2025 BAU
Total	3788	4036	4279
Industry	752	839	926
Municipal	344	609	873
Agriculture	2504	2400	2292
Reservoir	188	188 (*)	188 (*)

Source: WaterGAP simulations of the World Water Vision scenarios (Alcamo et al., 1999)

(*) WaterGAP calculations do not explicitly include water loss due to evaporation from reservoirs. Estimates for 1995 level from Shiklomanov (1999) given here, and extrapolated assuming the number of major reservoirs is not bound to increase.

TABLE 3. AREA OF REGIONS AND WORLD WITH SEVERE WATER STRESS (I.E. CR>0.4) IN 1000 KM² (PERCENT OF TOTAL AREA GIVEN IN PARENTHESES)

REGION	1995		BAU		TEC		VAL	
WORLD	36407	(25%)	38649	(27%)	37708	(26%)	33901	(23%)
North America	4310	(20%)	3827	(18%)	3575	(17%)	3448	(16%)
Central America	1057	(31%)	1044	(31%)	1209	(36%)	1036	(31%)
South America	1875	(10%)	1956	(11%)	1752	(09%)	1691	(09%)
Western Europe	1418	(18%)	1389	(18%)	1030	(13%)	774	(10%)
Eastern Europe	118	(08%)	118	(08%)	27	(02%)	13	(01%)
C.I.S.	1074	(06%)	1089	(06%)	605	(03%)	316	(02%)
Aral Sea Basin	2989	(74%)	3146	(78%)	2954	(73%)	2934	(73%)
Middle East	5431	(88%)	5676	(92%)	5317	(87%)	5298	(86%)
North Africa	6428	(67%)	6646	(69%)	7072	(74%)	6473	(68%)
East Africa	836	(18%)	927	(20%)	976	(21%)	973	(21%)
Western Africa	801	(16%)	1064	(21%)	1052	(20%)	1052	(20%)
Central Africa	288	(05%)	288	(05%)	288	(05%)	288	(05%)
Southern Africa	1161	(19%)	1638	(27%)	1588	(26%)	1161	(19%)
Australia	2020	(22%)	1834	(20%)	1918	(21%)	1738	(19%)
Japan (only)	96	(15%)	81	(13%)	38	(06%)	33	(05%)
China +	3793	(32%)	4171	(35%)	4656	(39%)	4009	(34%)
South Asia	2291	(49%)	3266	(70%)	3236	(69%)	2307	(49%)
Southeast Asia	422	(06%)	489	(07%)	413	(06%)	356	(05%)

Source: WaterGAP simulations of the World Water Vision scenarios (Alcamo et al., 1999)

oping countries lead to greater household water use per capita, multiplied by the greater number of people. Meanwhile, economic growth expands electricity demand and industrial output, leading to a large increase in water demand for industry. Even though water may be used more efficiently in households and industry, pressures to increase water use overwhelm these efficiency improvements. Providing food to the growing population and ending hunger will remain the largest challenge in terms of quantities of water demand.

The result is a projected large increase in water withdrawals in the agricultural, domestic and industrial sectors of the developing world, in response to rising population and industrialisation, and higher consumption from higher incomes. Adding together the trends in developed and developing countries under business as usual increases global water withdrawals from 3,800 cubic kilometres in 1995 to 4,300-5,200 cubic kilometres in 2025. The difference largely depends on how much irrigated agriculture does or does not expand.

This increase in water withdrawals implies that water stress is projected to increase significantly in more than 60% of the world, including large areas of Africa, Asia, and Latin America (Alcamo et al., 1999), which will lead to more frequent and more serious water crises.

MOVING FROM CRISIS TO VISION: TURNING POINTS

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

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

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

In the World Water Vision the increase in water use for irrigated agriculture would be drastically limited, with 40% more food produced (partly from rainfed agriculture) but only 9% more water withdrawn for irrigation (Table 5). Industrial water use and municipal use decreases very significantly in the developed countries but increases by more than that in the developing world. Recycling and higher productivity reduce the amount of water we withdraw to meet consumption for all of us.

LIMITING THE EXPANSION OF IRRIGATED LAND

The rate of expansion of irrigated land is the most important determinant of water stress, at least the stress related to quantity. The conventional wisdom in

TABLE 4. POPULATION OF REGIONS AND WORLD LIVING IN AREAS WITH SEVERE WATER STRESS (I.E. CR>0.4) IN MILLION PEOPLE (PERCENT OF TOTAL POPULATION GIVEN IN PARENTHESES)

REGION	1995		BAU		TEC		VAL	
WORLD	2138	(38%)	3993	(50%)	3524	(45%)	2627	(35%)
North America	133	(44%)	161	(43%)	104	(28%)	83	(24%)
Central America	57	(37%)	104	(45%)	89	(39%)	82	(39%)
South America	52	(16%)	94	(21%)	73	(16%)	60	(15%)
Western Europe	176	(40%)	185	(40%)	107	(23%)	60	(14%)
Eastern Europe	10	(08%)	10	(08%)	2	(01%)	0	(00%)
C.I.S.	49	(21%)	48	(23%)	25	(12%)	15	(07%)
Aral Sea Basin	46	(86%)	70	(89%)	66	(86%)	62	(86%)
Middle East	168	(95%)	355	(98%)	334	(94%)	309	(91%)
North Africa	128	(80%)	224	(86%)	212	(83%)	191	(79%)
East Africa	54	(31%)	127	(33%)	127	(33%)	121	(33%)
Western Africa	29	(14%)	77	(17%)	72	(17%)	69	(17%)
Central Africa	3	(04%)	8	(05%)	8	(05%)	8	(05%)
Southern Africa	21	(19%)	73	(36%)	65	(33%)	40	(20%)
Australia	9	(39%)	14	(44%)	5	(16%)	3	(12%)
Japan (only)	71	(57%)	67	(55%)	45	(37%)	37	(32%)
China +	453	(34%)	676	(41%)	636	(40%)	565	(37%)
South Asia	539	(44%)	1414	(77%)	1325	(73%)	728	(43%)
South Asia	140	(31%)	287	(46%)	229	(37%)	192	(33%)
Southeast Asia	422	(06%)	489	(07%)	413	(06%)	356	(05%)

Source: WaterGAP simulations of the World Water Vision scenarios (Alcamo et al., 1999)

agriculture, based on the need to produce food for the growing world population, is that irrigated agriculture will have to keep pace-and therefore expand by some 20-30% in area by 2025 (Shiklomanov, 1998; IWMI, 1998), see Table 1 and Figure 1. The other perspective – supported by environmentalists and by some stakeholders in agriculture – holds that a slowdown in dam – building and irrigation investments, combined with the consequences of dropping groundwater tables, will limit the expansion in irrigated area to 5-10% (Alcamo *et al.*, 1999), see Table 2. Neither is attractive nor sustainable and would deepen today's water crisis.

MAKING WATER MORE PRODUCTIVE: MORE CROP PER DROP

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

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

How can productivity be further improved in agriculture – the largest water user? A precondition is that the same conditions are introduced as elsewhere: payment for water services, accountability of the managers to the users, and competition among public and private suppliers. Then there are a range of technical and management options to improve productivity (IWMI, 2000).

First, through ever better agronomic practices, the traditional focus of agricultural research: crop variety improvement; crop substitution; improved cultural practices.

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

- Better irrigation water management. Better timing of water supplies can reduce stress at critical crop growth periods, increasing yields. For smaller systems this can be done through turning management over to water user associations directly; for complex systems the management needs to become service-oriented.
- Deficit, supplemental, and precision irrigation. Deficit irrigation is aimed at increasing productivity per unit of water with irrigation strategies that do not meet full evaporative requirements. Irrigation supplementing rainfall can increase the productivity of water when a limited supply is made available to crops at critical periods. Precision irrigation, using water-conservation technology as well as better information and communication technologies, can reduce non-beneficial evaporation, applies water uniformly to crops, and reduces stress.

Table 5.
Renewable water use in the World Water Vision

Water use	1995 (cubic kilometres)	World Water Vision 2025 (cubic kilometres)	Percentage increase 1995-2025
Agriculture			
Withdrawal	2,500	2,650	6
Consumption	1,750	1,900	9
Industrial:			
Withdrawal	750	800	7
Consumption	75	100	33
Municipal:			
Withdrawal	350	500	43
Consumption	50	100	100
Reservoirs			
(evaporation)	200	220	10
Total:			
Withdrawal	3,800	4,200	10
Consumption	2,100	2,300	10
Groundwater			
Overconsumption	200	0	

Source: Cosgrove and Rijsberman (2000)

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

The key to increasing food production without a major increase in water use is likely to be to: (1) increase yields on rainfed agriculture, as well as (2) 'closing the yield gap', that is increasing yields in areas where they are currently much below their biological and technical potential. Neither of these two key strategic directions is expected to be either easy or cheap, but limits to the water that is available for agricultural expansion may well force our hand.

Table 6. Annual investment requirements for water resources (to achieve our Vision in 2025, we need to invest $180 billion a year, a total of $4.5 trillion).

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

INCREASING STORAGE

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

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

- Large and small dams;
- Groundwater recharge;
- Traditional small-scale water storage techniques and rainwater harvesting;
- Storing water in wetlands.

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

CHANGING THE WAY WE MANAGE WATER

The following issues are in our opinion crucial elements of moving water resources management to a more sustainable basis.

- Pricing water services. Making water available to users at low cost, or for free, does not provide the right incentive to users. Water services need to be priced at full cost for all users, which covers all costs related to operation and maintenance and the investment costs for at least domestic and industrial users. The basic water requirement needs to be affordable to all, however. Goverments should provide targeted, transparent subsidies to the poor so that they can pay for their basic needs.
- Service-oriented management. The focus has to be on making managers responsive to user needs (Malano and Hofwegen, 1999). This requires a mutual dependency – such as service for payment – that can take various forms, including service agreements. The service need and expectations of the users will be influenced by the price they have to pay for those services, especially where they have to pay the full cost.
- Empowering communities. People's initiative and capacity for self-reliance need to be put at the centre of planning and action for water supply and sanitation (WSSCC, 1999). Recognising this can lead to systems that encourage genuine participation by empowered men and women, improving sustainable living conditions for all, particularly women and children.
- Increasing cooperation in international basins. Close to half the world is situated in 250-300 international river basins – rivers that cross national boundaries and whose resources are therefore shared. Experience shows that shared water resources

can be made into a source of co-operation rather than conflict (Green Cross, 1999).

VALUING ECOSYSTEM FUNCTIONS

Much more research is needed to improve our understanding of ecosystem functioning and to value the services that these systems provide. Recent global assessments of the services provided by freshwater ecosystems (watersheds, aquifers, and wetlands) for flood control, irrigation, industry, recreation, waterway transportation, and the like, come up with estimates of several trillion dollars annually (Costanza, 1997; Postel and Carpenter, 1997).

Such knowledge will allow careful assessments of the impacts of water resource use and development on ecosystems, particularly tropical ecosystems. That work needs to emphasise the river basin as the appropriate scale of management – from the forests in the upper watersheds to the coastal zones.

Many practices adopted to manage water for human needs – rules on extracting and sharing water, changes in cultivation and irrigation to save water for other purposes, returns to ancient and community-based water harvesting and storage – will also benefit ecosystems (IUCN, 1999). Other measures include reducing nutrients through farm-based manure storage, controlling silt by reducing erosion upstream, planning for joint hydropower generation and dry season irrigation, and reducing pollutants from agriculture and industry.

SUPPORTING INNOVATION

Increasing productivity will depend largely on innovation in new technologies, financing mechanisms and institutions, with basic research and the widespread dissemination and adoption of its results. A key to this innovation will be increased awareness of the water issues and the education and training of people capable of bringing the necessary changes about.

While pricing water is expected to be the primary motivation to bring in the private sector, there remain a host of public good aspects of water resources that will require public funding. These range from research on staple food crops in developing countries to finding cures for tropical diseases – important to populations that do not make up other markets large enough to make privately funded research attractive.

MOBILISING THE FINANCIAL RESOURCES

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

We estimate that to achieve the World Water Vision, those investments will have to rise to $180 billion (Table 6). Private firms – domestic and international – will be the main source of finance, and local communities will contribute much in cash and in kind. Government resources will be a smaller share in direct capital investment and maintenance costs for traditional water supply projects. This will free up public (and softer loan and grant) resources for water-related projects that supply public goods (such as flood management and environmental protection) and for subsidies to low-income and disadvantaged women and men to enable them to pay the cost of their minimum water and sanitation needs.

This explicit subsidy element accounts for the need for total government cash flows to remain at current levels, making total cash requirements greater than direct investments shown in Table 6. The key role of government is to provide a regulatory and policy framework for investments to ensure financial sustainability investments based on social equity and other guiding principles in the national water policy.

CONCLUSION

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

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