INTERNATIONAL DEVELOPMENT

Ideas, Experience, and Prospects

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CHAPTER 26

WATER RESOURCES: AN EVOLVING LANDSCAPE

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Introduction

Water management in much of the world is at a critical juncture. Even when it has to fulfill an essential role in promoting development and reducing poverty at the national and sub-national levels, water is often scarce, polluted, mismanaged, misgoverned, and poorly allocated. A main handicap has been that water management has often been considered an end unto itself rather than a means to an end, that end being to achieve overall development, economic prosperity, improvement of quality of life, and environmental conservation.

Overall, developed and developing countries are confronted with the urgent need to support the increasing demands of growing populations and of the energy, industrial, and agricultural sectors, as well as to respond to environmental concerns with sources of water that are scarce, over-exploited, or too polluted for the intended uses. In spite of its relevance in terms of security, water is generally not regarded as a key determinant for development and is conspicuously absent from political agendas.

At present, the fast-evolving global landscape is contributing to the complexity of the management of water resources, as related decision making depends increasingly on other sectors' policies, performance, and prospects. These include the economic growth of emerging powers that are setting their own agendas in the use of natural resources at the global level, including water; increasing urbanization, population growth, and changing consumption patterns; the growing need for clean and reliable sources of water for the expanding domestic, energy, industrial, and agricultural sectors; and the growing influence of new actors in decision making, with players changing in number and type. Clearly, global changes, driving forces, and water-based expectations for the myriad of uses and users present a challenging scenario.

Global drivers of change are also adding to the many old and unresolved issues that plague the water sector and impact development: water institutions that do not function properly, many of them with overlapping and/or conflicting decision-making structures; legal and

regulatory frameworks that are outdated and unresponsive; increasing and unregulated withdrawals for cities, industry, agriculture, and energy; a prevailing focus on increasing the quantity of water supplied rather than reducing consumptive demand; and water prices and tariff structures that do not consider socially desirable outcomes. The sum of these forces has resulted in a large number of "basin closures" around the world, where every available drop is allocated.

Conventional wisdom as it relates to the management of water resources needs to be challenged and reconsidered so that it is able to address current and future development. Looking forward, the water sector will have to become more innovative and develop more effective ways to become part of the development landscape, not as a bit player but as an active participant.

Following is a brief review of the international efforts that have aimed to influence global thinking on the environment, taking water into consideration.

History of Thought

Global thinking on environment and development has been influenced by a long series of international conferences, starting with the United Nations Conference on Human Environment held in Stockholm in 1972. For the first time at a global meeting, participants discussed the notion that environment should not be considered separately from economic and social development, because they depend on each other. Broad environmental policy goals were then proposed in the hopes of fostering a global response toward the goal of preserving the human environment.

Several UN world conferences followed, including the ones on Population (Bucharest, 1974), Food (Rome, 1974), and Human Settlements (Vancouver, 1976). In 1977, it was the turn of the Mar del Plata Water Conference. Fundamental aspects of water policies and water-related problems were discussed by countries that had committed to work toward a new international economic order and whose objective was to achieve collective self-reliance in the development efforts. A direct outcome of this conference was the International Drinking Water Supply and Sanitation Decade, 1981–90, aimed at providing universal access to safe drinking water and sanitation by 1990. In spite of the importance of these goals, it was impossible to achieve them for a myriad of reasons that included political, institutional, legal, policy, and financial limitations.

Many other water conferences followed, among them the Global Consultation on Safe Water and Sanitation for the 1990s, International Conference on Freshwater (Bonn, 2001), and several World Water Fora. The 1992 International Conference on Water and Environment, held in Dublin, was expected to propose sustainable policies and action plans on water for further consideration during the 1992 Earth Summit in Rio de Janeiro. However, the Dublin conference missed this extraordinary opportunity because it was organized as an expert group meeting, rather than as an intergovernmental preparatory meeting under UN rules. Its recommendations were thus not considered at the Rio Conference on Environment and Development.

In 2001, the German government held the International Conference on Freshwater in Bonn. The aim was to develop recommendations to be presented at Rio+10, the World Summit on Sustainable Development in Johannesburg. The conclusions expressed the concern of the international community about the situation of water resources in the world: "Ten years after the United Nations Conference on Environment and Development in Rio de Janeiro, and the Conference in Dublin, and years after the world conferences in Paris and The Hague, there is still a need for greater commitment by governments worldwide to implement the principles agreed in relation to water resources. . . . Although governments have agreed to implement nationally agreed principles internationally, there is a widening gap between theory and practice . . ." (Tortajada 2007).

In September 2000, the UN General Assembly adopted the Millennium Declaration. Among its numerous development goals (known as the Millennium Development Goals, or MDGs) was to reduce by half the proportion of people unable to reach or to afford safe drinking water by 2015. Meanwhile, the 2002 Johannesburg World Summit on Sustainable Development supported that the proportion of people without basic sanitation should also be reduced by half by 2015.

The achievement of these goals represented a major challenge for all countries, considering that 1.1 billion people lacked access to clean water and more than 2.5 billion to sanitation (WHO 2004). From that moment, it was clear that the economic, legal, institutional, and political implications of this decision were immense, and that the goals would be achieved only if governments, the private sector, civil society organizations, and national and international development agencies undertook to act upon them.

In another global effort, in 2003 the UN General Assembly established the International Decade for Action "Water for Life" with the overall objective of promoting a greater focus on water issues. Last but not least came the 2012 Rio+20 Conference on Sustainable Development with its focus on green development, which revealed that many fundamental development issues remain unresolved.

In translating the principle of sustainable development and sustainable water resources into specific targets and actions over the years, the philosophical consensus has shattered into a cacophony of definitional debates, interpretations, recriminations, and slogans. Regardless of the rhetoric, and although most countries have sought to protect their image over more than forty years of global conferences, poor management of water resources continues to have serious social, economic, and environmental impacts at the local level.

Additionally, there appear to be two realities in the world: one that countries and their populations are facing in the field, and a very different one that seems to be the result of the game of global target setting. In the midst of a very complex situation where billions of people face every challenge in terms of access to clean water, the UN announced in early 2012 that the MDG on "improved" drinking water had been achieved in 2010, five years ahead of schedule.

Unfortunately, "improved sources of water" does not mean that the water is safe and clean, much less drinkable and free of potential health hazards. For the UN, it means that people have access to twenty liters of water (not necessarily clean drinking water) from a source that is improved within one kilometer of their premises. Water can come from a polluted well or from a bucket of polluted rainwater that is unfit for drinking: it does not matter as long as it fits the statistics.

Trends

Much of the twentieth century focused on developing water infrastructure. During the early 1990s, the focus shifted to the management of water resources, still largely along sectoral lines. By the end of the decade, the concepts of river basin management and integrated water resources management were being promoted, encompassing a multi-sectoral approach and a wider range of social and environmental issues. It was recognized that many of the activities related to a broader approach to water resources management had little to gain from a paradigm that focused mainly on the construction of water infrastructure. The new policies were expected to take into consideration economic, social, and environmental aspects that would result in more effective regulations, incentives, instruments, and investment plans. Overall views then shifted from sub-sectoral and project-based approaches to broader issues like demand management, private sector involvement, water pricing, environmental protection, and stakeholder participation.

Even though both concepts (river basin management and integrated water resources management, or IWRM) have been part of national policies for years, their implementation continues to represent a challenge for the different countries. Reasons include institutional and legal frameworks that have not progressed over time; lack of coordination between sectors and institutions; centralized decision making; non-availability of financial resources on a timely basis; etc. Additionally, processes like decentralization have yet to produce the expected outcomes, such as availability of investment funds, more efficient and effective decision making, active participation by local institutions and water users, and encouragement of local initiatives, to mention only a few.

The development discourse continues to evolve, moving now into governance and varying concepts of "good governance." According to the UN, water governance includes political, economic, and social processes and institutions by which governments, the private sector, and civil society make decisions about how best to use, develop, and manage water resources (UNDP 2004). It refers to the range of political, social, economic, and administrative systems that are in place to develop and manage water resources and the delivery of water services at different levels of society. It comprises the mechanisms, processes, and institutions through which all involved stakeholders, including citizens and interest groups, articulate their priorities, exercise their legal rights, meet their obligations, and mediate their differences. It emphasizes the causality of water-related problems by pointing out not only the natural limitations of the water supply or lack of financing and appropriate technologies, but profound failures in water governance, such as how individuals and societies have assigned value to, made decisions about, and managed the water resources available to them (Tortajada 2011).

The water resources landscape has been influenced by ideas, concepts, discourses, and paradigms on specific issues that have ebbed and flowed over the years. Nevertheless, their effective incorporation and implementation at the local level have proved to be extremely difficult, irrespective of the country concerned. The fact that the global environmental situation (including water resources) continues to deteriorate seems to indicate that deeds have not matched the words of national and international leaders in terms of actual implementation of policies, programs, and plans, and that much still remains to be done.

Following are some global drivers for change that are having, and are likely to continue to have, substantial impacts on the evolving landscape of water resources. It would not be surprising if they also had a decisive influence on the future direction of the history of thought.

Drivers of Change

The world has become increasingly interconnected, witnessing a historic transfer of power from the West to the East. Unprecedented rates of economic and population growth, positive from many viewpoints, seem to overwhelm the pace of progress in curbing environmental and resource pressure. This, in turn, has negative long-term impacts on the development processes of the countries involved.

Natural resource sectors at the global level are facing increasing demands for their outputs, mostly as large economies like Brazil, Russia, India, and China continue to experience rapid growth. Sectors such as water (including quantity and quality), agriculture, energy, fisheries, forestry, and minerals still need to put stronger policies in place to reduce the environmental impacts of rapid growth.

OECD countries in general have addressed a number of environmental challenges by implementing policies that protect human health and ecosystems, and that tend to use resources more efficiently and aim at preventing further environmental degradation. Regarding water resources, planning and management practices have improved during the last decades in terms of both quantity and quality: institutions, laws, and regulations have been set; baskets of policy alternatives for more efficient management of the resource have been formulated; point sources of pollution (pollution discharges, mostly from industries and municipalities, that originate from a single location, typically a pipe) have been reduced; emerging contaminants and their implications on human and ecosystem health have been identified and studied; and stakeholders' participation is increasingly encouraged through different means. Overall, the interest in preserving sources of water has increased in response to domestic demands that can be supported by sound investments and policy initiatives.

Even then, OECD countries face major management, institutional, and financial challenges to comply with stringent environmental regulations, control agricultural (especially non-point) sources of pollution (those that come from oil, animal waste, pesticides, herbicides, fertilizers, road salts, bacteria, sediments, and any other contaminants that end up on the ground naturally or from human activity), and replace aging water infrastructure. For example, to maintain current services, the OECD estimates that spending on water would need to increase by 20 percent in France and the UK, and by over 40 percent in Japan and South Korea. In the case of the United States, the U.S. Environmental Protection Agency estimates that an investment of $192 billion for wastewater treatment plants, pipe repairs, and the purchase and installation of new pipes will be necessary. Overall, it is estimated that by 2025, annual (current and investment) expenditure on water and wastewater services will reach some $600 billion for OECD countries (half for Mexico and the United States), and $400 billion for large emerging economies (half for China) (Kauffmann 2012).

In terms of water use, even within the OECD, some countries are more efficient than others. According to the U.S. Geological Survey (Hutson et al. 2004), in the United States, water

use at the national level in 2000 was similar to that in the 1950s (1,383 gallons per capita per day) and 30 percent lower than in 1975. Water use for irrigation was 8 percent less in 2005 than in 2000, and withdrawals for domestic supply (the third largest user of water at the national level) were only 2 percent more in 2005 than in 2000.

Nevertheless, not all large economies use water efficiently. The last twenty years have witnessed radical increases in the economic growth rates of several developing countries, which in turn have put enormous pressure on natural resource utilization, often accompanied by their continuing inefficient use.

Limited water resources for different uses have led the world to increasingly consider the use of so-called non-conventional sources of water (e.g. desalinated sea water or treated wastewater). Wastewater is thus increasingly considered as a resource for irrigation as well as for direct and non-direct potable uses in several parts of the world, for example Australia, Singapore, and the United States.

Population and Consumption Patterns

A second driver of water use is the increasing global population, living mostly in urban areas with a decline in rural population. Much of the population growth over the next twenty years will occur in the poorest regions of Asia, Africa, and Latin America (UN 2011). In contrast, the population of the more developed regions is expected to change minimally and even decrease if not for immigration from other countries.

The forty-eight least developed countries are likely to grow the fastest, at 2.5 percent per year. It is predicted that the main increases in population up to 2050 will occur in only eight countries: in descending order, India, Nigeria, Pakistan, Congo, Ethiopia, the United States, Bangladesh, and China. Together they will account for almost half of the expected increase in global population during this period. The drawback of this situation is that water use in these countries is already limited because of physical scarcity and poor management.

In terms of economic growth and total use of natural resources, at one end of the spectrum are the United States and China. At the other end are the countries of sub-Saharan Africa, which remain vulnerable to economic disruptions, population stress, political instability, environmental degradation, and water scarcity. Despite increased demand for commodities, of which sub-Saharan Africa is a major supplier, local populations may not necessarily experience any significant improvement over the long term. The region is thus expected to remain at a disadvantage relative to other parts of the world. Unless the efficiency, management, and governance practices of water use improve significantly, population growth will lead to higher water consumption and greater pollution of surface and groundwater.

Economic growth over the past two decades has contributed to the emergence of a sizable middle class, particularly in Asia, and a corresponding increase in resource consumption. Assuming the growth of consumption continues at around the same rate as over the past twenty years, by 2030 Asia will be at the forefront, accounting for some 43 percent of global consumption. In terms of water resources, important concerns will continue to be reliable supply of clean water for a growing population; development of infrastructure and associated social and environmental impacts; and depletion of good quality water bodies, due mainly to increasing pollution in and around urban centers caused by very low levels of wastewater treatment and poor disposal practices.

Energy and Water Implications

Strongly linked to water availability in terms of quantity and quality is energy production. According to the U.S. Energy Information Administration (USEIA) (2011), the global demand for energy will increase by 53 percent from 2008 to 2035. Most of the increase in consumption will be in non-OECD countries because of sustained economic growth, which it is estimated will increase by 85 percent, compared to 18 percent in OECD economies. Fossil fuels will continue to supply much of the energy used worldwide, but renewable energy will witness the fastest growth, increasing from 10 percent of total energy use in 2008 to 14 percent in 2035.

Demand for electricity, which constitutes a growing percentage of global energy, has increased more rapidly than consumption of liquid fuels, natural gas, or coal in all end-use sectors except transportation. It is expected that non-OECD countries in general, and Asia in particular, will lead annual increases of electricity consumption averaging 4 percent from 2008 to 2035. Since no large-scale electricity can be generated without water (for hydropower, and cooling of thermal and nuclear plants) and since the water sector is a major user of energy (mostly for pumping), reliable sources of water would have to be available for the production of electricity, most likely at the cost of other uses and users. Some examples are France and the United States, where the major user of water is the electricity-generating industry and not the agricultural or industrial sector.

In terms of hydroelectricity, Brazil and Canada are the countries where hydropower produces the largest share of electricity, with 85 percent and 60 percent respectively. For the 2008–35 period, strong growth in hydroelectric generation, primarily from mid- to large-scale power plants, is expected in China, India, Brazil, and countries in Southeast Asia such as Malaysia and Vietnam (USEIA 2011).

Bhutan is one country where the energy sector (mostly hydropower-based) has had a very positive impact on the socio-economic development of the country. According to 2010 figures, with only 5 percent of hydropower potential developed, the country had the highest per capita consumption in South Asia, with the water-based energy sector representing 19 percent of GDP and 45 percent of direct internal revenues. It is also an excellent case of South–South cooperation, where India almost entirely finances Bhutan's hydropower developments and purchases most of the energy produced (79 percent in 2010). Even though energy production is so important economically for Bhutan, it is completely dependent on the sometimes very erratic monsoon rains and receding glaciers (Rinzin 2012). In Chile in 2008, almost 40 percent of the total generation of electricity was hydropower-based. Nevertheless, unusually hot and dry summers raised the possibility of power shortages, forcing the country to seek alternative sources of electricity.

Clearly, water requirements for the electricity sector are very important in order to meet national and international electricity demands. Therefore, they need to be explicitly factored into water use and management policies in order to respond to challenging long-term needs. In countries where available water resources are already allocated, finding additional water for electricity generation will be a very difficult task.

Not only is water required for generating electricity, but significant amounts of electricity are required to extract, pump, transport, treat, and distribute water. An estimated 2–3 percent of the world's energy consumption is used to pump and treat water for urban and industrial uses (Tortajada 2008). One example is Mexico City, where pumping stations have been

used for decades as part of the water supply, sanitation, and wastewater treatment networks, to bring in clean water and pump out wastewater. In 2000, the National Electricity Board estimated that one-fifth of the electricity Mexico produced was used to pump water in and wastewater out of the capital city. Another example is the city of Dhaka, where provision of water for domestic use depends on the availability of electricity for pumping purposes. In the case of India, dependence is even higher, since 60 percent of the urban population and 85 percent of the rural population rely exclusively on groundwater and consequently need electricity for pumping.

Development of thermoelectric power plants has become increasingly challenging because of trade-offs between energy, environment, and water security-related issues, as well as land use and political considerations. In the United States, for example, thermoelectric generation represents the largest percentage of electricity production, with coal-based power plants accounting for about half of the electric supply at the national level. According to the U.S. Geological Survey, thermoelectric power production in 1995 represented 41 percent of freshwater withdrawals (water taken from a source) and 3 percent of freshwater consumption (water that is not returned to the source), or more than three billion gallons per day. Overall, thermoelectric power plants withdraw approximately 94 liters of water for each kilowatt-hour of electricity generated, primarily for cooling. Since thermoelectric generating capacity in the country is expected to increase by nearly 15 percent between 2008 and 2035 (depending on the technology that is used), the associated water consumption nationwide is expected to increase from 28 to nearly 50 percent, resulting in escalating competition for water resources (Feeley et al. 2008). One of the trends at the global level is intense competition for scarce water resources, mostly polluted, to cover the needs of increasing numbers of uses and users.

Problems with finding adequate sources of water to generate electricity have already surfaced. For example, in 2006, in response to environmental and water supply concerns, an Idaho State House Committee unanimously approved a two-year moratorium on the construction of coal-fired power plants in the state. In Arizona, the government decided not to authorize a proposed power plant because of concerns about how much water it would draw from a local aquifer. In South Dakota in 2005, the governor called for the different parties to discuss drought-induced low flows on the Missouri River and the impacts on irrigation, drinking water, and power plants. Water availability is already a serious constraint for the further development of nuclear power, not only in the United States but in many other countries.

Water is also required for extracting oil and gas, with new sources such as oil sands and shale gas being particularly water intensive. The hydraulic fracturing process used to produce shale gas requires significant amounts of water, and many of the areas that have been identified as having shale gas resources in different parts of the world have limited supplies of water. In addition to water availability, there are also concerns about the potential contamination of aquifers from artificial wells or surface spills. Consequently, in the United States, particularly New York State, development of parts of the Marcellus shale is not progressing because drilling permits are not being issued. Similarly, France has taken legislative action to ban hydraulic fracturing, and South Africa has placed a moratorium on hydraulic fracturing while it investigates how best to regulate it to ensure that the environment and water resources are protected. In spite of the real and potential impacts of the above activities, economic priorities continue to prevail in both developed and developing countries.

Agriculture and Environment

Irrigation is the largest user of water at the global level (about 70 percent). Overall concerns are that the amount of land and water currently available will not be sufficient to provide enough food for the increasing global population, and that more crops will have to be produced with less water per unit of output. This could indeed be the scenario if irrigation organizations, services, and techniques do not improve; if technology cannot make irrigation techniques more efficient; and if non-conventional sources of water—such as wastewater, desalinated sea water, and brackish water—are not explored as alternatives for irrigation.

However, this is not the case. Water users associations have been working for decades to improve water allocation in developed and developing countries (including Australia, the United States, Mexico, India, and Turkey). Although their performance and results are still mixed, these projects have enormous potential. Technology has improved efficiency of irrigation tremendously (an excellent example is Nebraska in the United States), while greywater in Middle Eastern countries and wastewater in India and Mexico have long been used for irrigation purposes. They have contributed to the livelihood of millions of people, even though their use raises serious health and environmental concerns. There are thus vast possibilities to improve the efficiency of water use in the agricultural sector, with the distinct potential to feed the world for years to come.

Food production encompasses far more than water and land requirements: it also involves effective policies, efficient institutions, pricing, incentives, management practices, distribution channels, improved crops, technology, etc. Moreover, if the objective is to ensure that the world does not go hungry, the most immediate action for the public and private sectors as well as for the general population would be to focus on food availability, so that the food already produced can be made available to consumers. For example, India produces 15–20 percent of the world's fruits and vegetables, but nearly half that quantity is lost through lack of processing, supply chain, and storage facilities. The country also loses 25–30 percent of cereal production before it can reach consumers (see Swaminathan et al., this volume).

The interrelations between the different sectors often result in tensions because of trade-offs between domestic, agricultural, energy, and industry-related water uses and users, especially when water supplies are already insufficient in quantity and quality to meet the various demands. As for the environment, in spite of the progress made in terms of related policies, water allocation still depends on the water that is necessary for other uses. A noteworthy example of water allocation for the environment is the Murray-Darling Basin Authority in Australia, which has spent millions of dollars to buy water rights from farmers for use by nature. Between 2008 and 2009, water trading is estimated to have increased Australia's gross domestic product by $220 million and gross regional product by over $370 million, representing an important source of revenue for regions and local communities. In fact, water trading has maintained the productive capacity within the southern basin. It has also been beneficial to irrigators because it has offered a way to manage uncertainty around seasonal water availability, and has expanded their options to cope with the impacts of drought.

The use and misuse of water resources have serious impacts in terms of their quality, and thus quantity, available, which will be discussed next.

Water Quality: A Limiting Factor for Development

The perceived global scarcity of water resources does not correlate to the physical availability of the resource, but rather to its poor management and potential to impact countries' economic, social, and environmental fabric. One of the most challenging issues is water quality, where poor management has global consequences as degraded water resources are more limited in their overall use.

Water quality concerns are present in all countries as a result of overall sources of pollution affecting surface and groundwater. While it is often claimed that the main impediment to controlling water pollution is lack of investment funds, failed efforts to clean many river systems point to the complexity of implementing legal and institutional frameworks as well as water policy instruments (regulatory, economic, information, and participation-related). Other factors are lack of coordination among institutions, missing political will, and public apathy.

An example of failed implementation is the attempted cleanup of the Ganges River and its tributaries. The Ganga Action Plan (GAP), introduced in 1986, was a comprehensive set of core and non-core schemes, including sewage treatment plants to reduce point sources of pollution, low-cost sanitation, river-front development, and electric and improved wood crematoria for non-point sources of pollution. Despite investments of $17 billion over fifteen years, the objectives were not achieved. There were shortfalls in the allocation of resources, technical design flaws, problems with land acquisition, contract mismanagement, lack of adequate maintenance, and mostly, lack of interest from the affected states (Wate 2012). In 2010 the Government of India announced a $1.5 billion project for a second attempt to clean the river. The rest of the funds are expected to come from the five affected Indian states: Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal. Only time will tell how successful this latest attempt will be. One thing is certain: policies, management practices, and governance considerations are essential to clean the river. Money alone will never be enough to achieve this goal.

In China, water quality challenges have been growing for decades. Therefore, in its twelfth five-year plan (2011–15), the Chinese government allocated $190 billion for infrastructural development for drinking water and $156 billion for wastewater treatment. However, even such large investments cannot assure the success of the plan. That depends rather on the careful implementation of the individual objectives, which in turn rely on a complex web of politics and policies.

Serious water quality concerns due to point and non-point sources of pollution are not limited to developing countries: they also represent a serious problem in developed countries like Spain, Greece, and Portugal.

Non-point sources of pollution from agricultural activities, especially from nutrients and pesticides, are the major and growing problem for nearly all countries. This is of particular concern where groundwater is a major source of drinking water for human consumption. Agricultural practices are also responsible for an increasing number of hypoxic or dead zones in different parts of the oceans due to the over-enrichment of coastal waters, with the corresponding death of biodiversity, as the chemical breakdown of nutrients absorbs available

oxygen from the water. In the United States, for example, an estimated 383 million fish were killed along the Texas coast between the 1950s and the 2000s (Diaz and Rosenberg 2011).

There have been many global attempts to improve water quality, with mixed results. The Republic of Korea launched a stimulus package in 2009 that allocated $30.7 billion for water and waste management, renewable energy projects, energy-efficient buildings, and low-carbon vehicles. In the United States, an innovative scheme for Chesapeake Bay includes water quality trading programs that allow wastewater treatment plants to buy nutrient "credits" generated by other plants or by farms that reduce the nutrients they release into water bodies. Its implementation is very challenging because of the large number of stakeholders involved, and because it could have an impact on the economic growth of the states involved (Maroon 2011).

Increasing Participation

The involvement of an increasing number and diversity of actors outside the public sector has been a main driver for change in the water sector. This involvement comprises both urban and rural areas and has become global in scope.

Participation of non-state actors has completely transformed water planning, management, development, and governance-related decision making by ensuring that benefit-sharing mechanisms are taken into consideration. Both affected and interested actors now interact through partnerships that, thanks to modern communication technologies, transcend national boundaries. With the emergence first of non-governmental organizations (NGOs) and more recently of social media, the "who," "how," and "where" of decision making in the water sector have increased in richness but also in complexity. Decision making has shifted out of the hands of governments, moving out of the control of a single party. In fact, it has been in response to intense pressure from NGOs that policies for infrastructure development have broadened to include social and environment issues. The involvement of multiple parties has resulted in greater accountability and transparency of the government and private sector actors, although not necessarily of the NGOs themselves, an issue that remains to be resolved.

As emerging donors, China, India, Turkey, and Brazil comprise a new set of actors playing an increasing role in the water sector. Their importance is due not so much to the amount of aid they are disbursing as to the new roles they are playing, challenging the traditional "North–South" aid architecture and broadening it to "South—South" cooperation based on mutual national interests. This emerging architecture is modifying the sphere of influence of donor countries, and challenging the rules under which aid is normally provided (see Kharas, this volume).

Of these emerging donors, the most proactive has been China. Chinese aid to Africa, Latin America, and Southeast Asia has increased from less than $1 billion in 2002 to an estimated $25 billion in 2007 (Lum et al. 2009). It is claimed that China's investments in Africa and Latin America serve the country's long-term economic interests via infrastructure, public works, and natural resource development, while those in Southeast Asia reflect longer-term diplomatic and strategic objectives.

Overall, it is China that has been investing more heavily in the water sector through its support for infrastructure in the several countries, particularly in terms of dams. At present, its support for water infrastructure outweighs that of all the development banks (including the World Bank). In 2008, Chinese companies were involved in 97 dam projects in 39 countries, and by 2011 the country was supporting the development of 251 dams in 68 countries (Tanaka 2011).

A concern at the international level is that social and environmental considerations may not be an important part of dam construction guidelines when funds come from China, in contrast to financial support from development banks, which is normally accompanied by stringent requirements based on past experience (World Commission on Dams 2000). A fact is that China is rewriting the terms and conditions of development aid in the field of water development, and the rest of the world is having to take notice of this new major actor.

Water Resources and Development

As water resources are so vital for overall economic and social development, and thus security, of any country and any region, the question remains as to why their efficient management has been so widely neglected when many countries are facing unprecedented problems of scarcity and continuing deterioration.

Decisions regarding policy making, management, development, and governance of water resources do not originate exclusively from the water sector but from the interactions between the different sectors. It is actually in these interactions that the potential for cooperation and improvement exists, that discussions have to be carried out, alternatives have to be discussed, and trade-offs have to be decided (Tortajada 2011).

For example, sub-Saharan Africa, an arid and semi-arid region, is, and is expected to remain, the most vulnerable region in the world not only because of water scarcity and poor water management, but because of economic disruption, population stress, and political instability. In the Middle East and North Africa (MENA) region, water resources policy and management are comparatively better, but the governments' constrained capacity to manage natural resources, including water, leads to non-compliance of laws and regulations and to further deterioration of the resources. Other serious constraints include inefficient public expenditure on water services and related projects, subsidy regimes that do not promote organizational capacity growth, water organizations that do not attract and retain staff with the skills required for efficient service delivery, and legislation that lacks the necessary implementing instruments. Within the MENA region, Yemen is one of several countries where institutional reforms for water supply and sanitation have been hampered by political unrest. The reforms in the water sector have sought to improve water supply and sanitation services for an increasing population (20 million people according to the 2004 census) and enhance the representation of local authorities and communities in the management of water utilities (Gerhager et al. 2008).

Lack of natural water availability can constrain development, but not when there are platforms in terms of institutions, laws, investment funds, infrastructure, and human

capacities. One example is Singapore, whose broad vision for water resources has relied on holistic planning that goes well beyond the boundaries of the water sector to focus on the overall development of the city-state. Policy making has followed the "think ahead, think again, and think across" philosophy that proposes a comprehensive, holistic vision for the management of water resources. Within this philosophy, decision making considers possible future events ("think ahead"), re-evaluates and modifies decisions taken in the light of different scenarios ("think again"), and looks for experiences and know-how worldwide with the objective of enriching its pool of knowledge ("think across"). The importance of universal principles in the management of water resources has long been recognized in the city-state. Nevertheless, a pragmatic approach has prevailed, and concepts and ideologies have been valued only for their usefulness in real terms.

Much of the world has been trapped for decades in the concepts of sustainable development, integrated water resources management, and recently, green growth, with inaction as an all-too-frequent result. These concepts have permeated the development discourse without necessarily having visible impacts on natural resources management practices, water included. This is not necessarily because of the concepts themselves, but because of the complexity of their implementation, which involves institutional, legal, regulatory, financial, social, and environmental considerations. They collapse under their own weight rather than inspiring practical action in response to the reality facing each country. In contrast, Singapore paid attention not to the concepts themselves but to the search for long-term alternatives for water resources within overall development. This comprehensive policy making process has propelled the city-state along the path to economic prosperity, improved quality of life, and environmental conservation.

There is no doubt that water—for human use and for the energy, agriculture, and environment sectors—will be one of the most critical resource issues of the coming decades. Therefore, paradigms for its policy making, management, governance, and development need to be reassessed and modified on a constant basis within an overall societal and development context. This is what Singapore has aimed at, with lessons worth analyzing in much of the developed and developing world.

Conclusion

In the field of international development, it has long been recognized that there are major gaps between current paradigms and those that may be necessary to address rapidly changing conditions. Poverty is both a cause and an effect of environmental degradation, and societies living in poverty will not have the means or incentives to make their environment an important consideration. Similarly, even in a scenario of robust economic growth, increased income and improved environmental quality are not always related, since more affluent countries and citizens may not necessarily be concerned about protecting their environment and natural resources, including water.

There is no universal blueprint for a transition to a sustainable society—all the more reason why innovative and implementable policies are needed to reduce persistent poverty and

environmental degradation all over the world. In the water sector, policy making is more complex now than ever before in history because of the extent of interdependence and interlinkages between countries, sectors, users, and uses. For it to be effective, policies need to reach beyond the sector into a changing environment that becomes more intricate with time.

Contrary to what would be expected, the influence of global events on water resources policy making, management, development, and governance does not always result in new and innovative ideas but in a homogenization of them. The water community has often settled for the lowest common denominator in terms of thoughts, concepts, and innovations, many of which have failed to provide feasible solutions. The end result has been that, while the complexity of the management of water resources has increased exponentially, related paradigms have improved only incrementally.

The need to address a very broad range of societal challenges cannot be met only by narrowly focusing on strategies within one sector, such as water. It requires instead addressing diverse systems of governance, challenging financial landscapes, promoting evolving technologies, and learning to cooperate with a myriad of governmental and non-governmental actors under competing social, economic, and political priorities at the national and international level. Above all, long-term policies require instilling new mindsets with the capacity to respond to changing conditions and new interdependencies, a fact that is still to be acknowledged within much of the water and development communities.

The changing world order and its associated impacts require a proactive attitude that rejects old thoughts and concepts whose implementation has proved to be a serious problem in the past: if they didn't work in the known environment, they are unlikely to work in an environment where the only certainty is change. Crises provide the opportunity to challenge the unchallenged. The time may have come to engage in the construction of a new series of thoughts that aim at holistic long-term visions for water resources. In the final analysis, it will be the strong, sustained commitment of leaders and societies, and their willingness to challenge prevailing wisdoms, that will contribute to development.

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