

TODAY'S WATER CRISIS – A GLOBAL VISION

Chandra A. Madramootoo¹ and Colleen N. Robson²

McGill University

Abstract

All nations have come to realize that there is indeed a world water crisis. Not only have water shortages been exacerbated in arid regions, but the industrialized western world has also been faced with water shortages, due to rampant mismanagement, population growth, global climate change, and impaired water quality. The human tragedy associated with this world water crisis is that billions of people lack access to clean drinking water and proper sanitation, and there are over 5 million deaths per year from water related diseases. While the international community has reached a broad consensus on a global vision for action, there is a need for commitment by policy and decision makers, and a significant influx of financial and technical resources to solve the world's water challenges. Socially inclusive water policies need to be developed based on full stakeholder participation. A key objective is to implement integrated water resources management.

Résumé

Toutes les nations comprennent maintenant qu'il y a une crise de l'eau à l'échelle planétaire. Les problèmes de pénurie d'eau se sont aggravés non seulement dans les régions arides, mais aussi dans les pays industrialisés en raison d'une mauvaise gestion endémique, de la croissance de la population, des changements climatiques et de la détérioration de la qualité de l'eau. La tragédie humaine associée à cette crise mondiale de l'eau se traduit par des milliards de personnes qui n'ont accès ni à l'eau potable, ni à des installations sanitaires adéquates, ainsi que par plus de cinq millions de décès par année causés par des maladies liées à l'eau. Bien que la communauté internationale s'entende sur une vision globale des actions à entreprendre, il y a un besoin réel d'engagement de la part des décideurs et de la classe politique, de même que d'apports financiers et techniques majeurs pour s'attaquer aux défis posés par l'eau à l'échelle du globe. Des politiques de l'eau qui incluent les dimensions sociales doivent être développées en tenant compte de tous les acteurs. Un objectif fondamental est d'instaurer une gestion intégrée de cette ressource.

1. Introduction

Only 1% of all the water on Earth is both fresh and accessible for extraction by humans. A combination of mismanagement and population growth has resulted in the number of countries faced with water shortages escalating to 31, with the largest concentration in Northern Africa, the Middle East and Central Asia (Figure 1) (UNFPA, 2001). Indications are that the crisis is worsening and will continue to do so, with forecasts that by 2025, three billion people will be living in 48 such countries (UNFPA, 2001). The poor, particularly those living in developing countries, bear the brunt of the crisis. Already, more than one billion people lack access to clean water (Guerquin et al., 2003). Nearly 2.4 billion people do not have access to sanitation (Guerquin et al., 2003). Estimates are that 80% of illnesses and deaths in the developing world are water related (WWAP, 2003). Tragically, most of those who die and suffer are women and young children.

The magnitude of the human suffering and environmental costs that arise from poor water management cannot continue, and in this light the international community has come together to determine a global vision for action. The main issues and challenges facing the water resources sector have been determined over a series of events including the 1992 International Conference on Water and the Environment (Dublin Conference), the Bonn International Conference on Freshwater (2000), and the tri-annual World Water Forums, the most recent held in Kyoto in March 2003. Water has also been recognized as crucial for attaining the UN Millennium

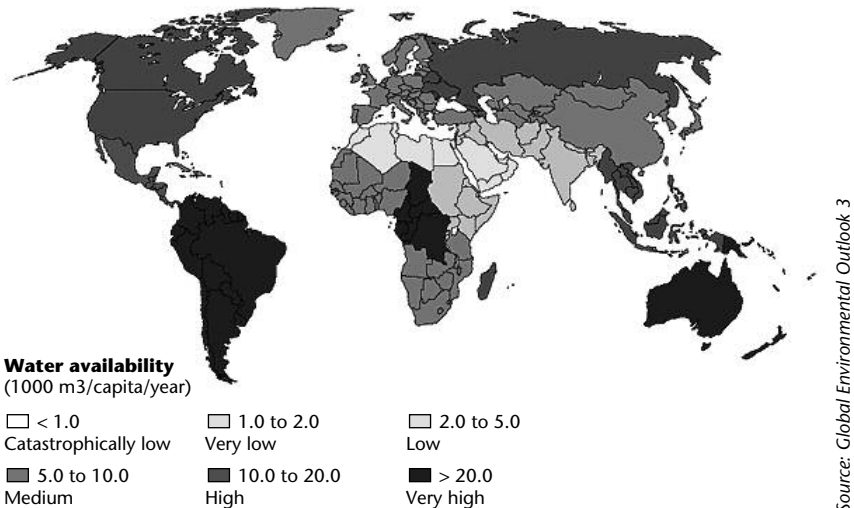


Figure 1: Worldwide availability of freshwater in 2000

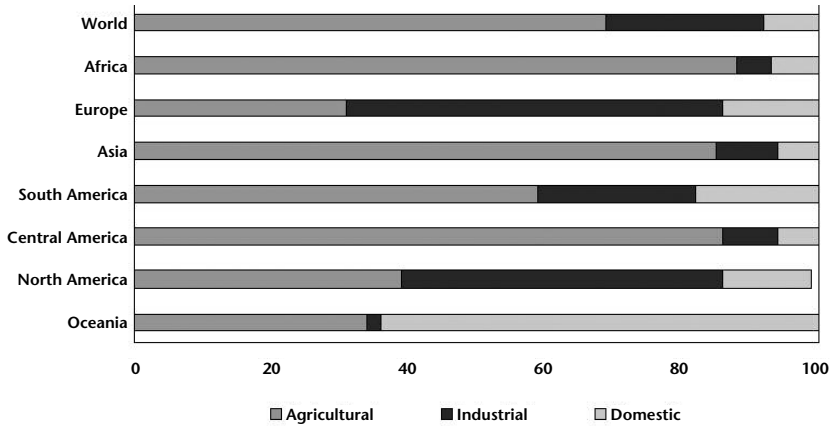


Figure 2: Water resource utilization by region (Source: WRI, 1998).

Development Goals and was the focus of the 2002 World Summit on Sustainable Development – Water Energy Health and Biodiversity (WEHAB) document. The Millennium Development Goals and the WEHAB sectors are widely seen as the key development targets of the modern era.

The authors will outline in this paper the key issues confronting the water sector today. Additionally, the challenges facing the global community will be explored, seeking to provide a comprehensive summary of today's water crisis. Some of the steps forward are also presented.

2. Key Issues Facing the Water Sector

Water scarcity

Earth's available freshwater is not evenly distributed in space and time. Some countries, including Canada, are blessed with an abundant supply (Figure 1). Other regions, including the Middle East, Central Asia, and Northern Africa, have continual water shortages. In some countries like Bangladesh, South China, and Southern India, the situation is one of periodic water shortages coupled with severe floods. In these situations, the majority of the annual rainfall comes in the form of monsoons over a very short timeframe that is not adequately captured and stored for future use.

Globally, agriculture is the largest user of freshwater – consuming an average of 70 percent of extracted freshwater (Cosgrove and Rijsberman, 2000). Regionally, however, Asia and Africa devote a higher percentage of available resources to agriculture than the global average, while Europe and North America allocate substantially more water towards industry (Figure 2). Thus, water scarcity

disproportionately impacts irrigated and rainfed agriculture in developing nations, impacting food security and leaving 1.1 billion people malnourished (UNFPA, 2001). This situation leads to many countries relying on unsustainable means to meet their water needs.

Irrigation practices in Central Asia have resulted in the Aral Sea dwindling to a fraction of its original size. Aquifers are being relentlessly mined in many parts of the world – including China, India and the western United States – resulting in water tables plummeting by as much as 1 meter per year (WCW, 2000; UNFPA, 2001).

Water quality

Worldwide, freshwater resources are becoming increasingly polluted. Industrial, agricultural, and human wastes are dumped directly into waterways in many countries (WCW, 2000). The resulting impacts on the health of both humans and the ecosystem can be staggering. The situation is particularly dire in developing countries in respect to human health where water treatment facilities are inadequate (WWAP, 2003). The safety of municipal drinking water has become a charged topic in Canada as a result of the deaths from *E. coli* contamination in Walkerton during May 2000.

The quality of Canada's freshwater resources is declining for many reasons, including contamination from fertilizers and pesticides. In summer of 2003, high levels of toxic algae, theorized to be partially the result of phosphorous seepage from agriculture, closed the beaches of Missisquoi Bay in the Eastern Townships, Québec. Worldwide, as the quality of freshwater resources continues to be compromised, the volume of water suitable for human use is reduced, increasing water scarcity (WWAP, 2003). There is a direct link between inadequate sanitation and water quality. In locations where sanitation and waste treatment facilities are available, there is a tendency for reduced pollution of waterways.

Fragmentation of water management

Institutional fragmentation is one of the most severe problems affecting integrated water resources management. Fragmentation of water management results in juridical overlap, mismanagement/misallocation of funds, and inefficient and ineffective use of time and human resources (Guerquin et al., 2003). The problems of institutional fragmentation are readily evident in Canada. Most areas of water management and protection are under provincial jurisdiction. The federal government, however, is responsible for international waters, conservation and protection of oceans and fisheries, water on federal lands, and the water resources used by the

First Nations people. There are many federal departments involved in water management including, Environment, Agriculture and Agri-Food, Transport, Natural Resources, Indian and Northern Affairs, Foreign Affairs and International Trade, and Fisheries and Oceans. The same type of departmental proliferation and overlap occurs at the provincial level. In addition, municipal governments are responsible for water treatment and supply, as well as wastewater treatment. There is also a growing interest by the private sector to become involved in municipal water services. These competing and conflicting interests in water management lead to lack of coherent and integrated water policies, and poor use of limited resources and funds.

Daunting financial challenges

The water sector has been chronically under-funded and funding levels continue to decline (Guerquin et al., 2003). Estimates are that the annual required investment is around \$180 billion US (Winpenny, 2003). At present, only \$70-80 billion US is spent (Helming and Kuylenstierna, 2001). In comparison, \$105 billion US is spent annually in Europe on alcoholic drinks. A second problem is the systematic under-pricing of water, which leads to insufficient capital for system maintenance as well as encouraging over-consumption. Such is the case in New Delhi where water prices cover a paltry 4% of costs. This leads to large parts of the city, in particular the slums, receiving water for only minutes a day. Québec has recently expressed interest in developing and implementing legislation relating to the “user-pays” principle (Québec ministère de l’Environnement, 2002). Mismanagement of funds in many countries is also a major hindrance to infrastructure development and management (Helming and Kuylenstierna, 2001).

Lack of awareness

A common assumption is that the world’s water supply is essentially limitless. Thus, political leaders and decision makers in many countries are oblivious to the dimensions of the imminent water crises. Resolution of the water crisis requires long term solutions that go beyond the typical short-term mandate of politicians. Additionally, raising public awareness is essential to ensuring public involvement and support of sustainable development projects and technologies.

Tensions and conflicts over water

The boundaries of watersheds rarely correspond to administrative or territorial boundaries. Currently, there are 251 transboundary basins

shared by 145 countries. Unfortunately, international law on shared waters is limited and weak (WCW, 2000). As water becomes increasingly scarce, increasing levels of tension and conflict may develop between nations (Wolf, 2001; Brooks, 2002). We have seen such instances in the Middle East and Central Asia. Despite the formation of the Interstate Commission on Water Coordination (ICWC) in Central Asia, much remains to be done on the political front to have a rigorous, robust and enforceable transboundary water treaty. The problems of varying stages of political, social and economic development in the five countries of Central Asia make the arrival of such an agreement very difficult. The ten countries that border the Nile are currently in negotiations as well over cooperative development of their basin.

Nevertheless, there are some good examples of successful transboundary water treaties. These include the 1907 Canada-US Boundary Waters Treaty, the 1959 Indus Water Treaty between India and Pakistan, and the 1995 Mekong Basin Agreement between Thailand, Cambodia, Laos, and Vietnam. It is worthy to note that the Indus river partnership has functioned through successive clashes between India and Pakistan.

Climate variability and change

While scientists cannot yet predict with certainty the extent to which climate change or climate variability will occur, it is well recognized that these changes will almost certainly result in increased temperatures and alterations to rainfall patterns (Table 1) (Bergkamp et al., 2003; Kabat and van Schaik, 2003).

Climatic extremes of floods and droughts result in death and destruction of villages and property, and malnutrition and hunger especially among the rural poor. Increased temperatures can have deadly effects as illustrated by the thousands of deaths from heat exhaustion this summer in India and Europe. In the Horn of Africa, years of droughts combined with civil wars have ravaged the economy, displacing millions and resulting in serious health problems and deaths (Kabat and van Schaik, 2003). Canada is also not immune to drought. Record low precipitation was recorded in many areas in 2001, depleting soil moisture and causing overall yields to drop 50 to 60 percent. The projected alterations to rainfall distribution include an expected decrease in the subtropics, which is expected to further impact food security in Africa due to the continent's reliance on rain-fed agriculture (Bergkamp et al., 2003).

Climate change projection	Climatic change already observed	To occur in the 21 st century?	Effects on water resources
Higher maximum temperatures and more hot days over nearly all land areas	Likely	Very likely	Water resources reduced
Higher minimum temperatures, fewer cold days and frost days, over nearly all land areas	Very likely	Very likely	Water resources reduced
Diurnal temperature ranges reduced over most land areas	Very likely	Very likely	
Increases of heat index over land areas	Likely over many areas	Very likely over most areas	Water resources reduced
More intensive precipitation events	Likely over many northern hemisphere mid-to-high latitude areas	Very likely over many areas	More frequent and more severe floods
Increased summer continental drying and associated risk of drought	Likely in a few areas	Likely over most mid-latitude continental interiors	More frequent and more severe droughts
Increases in tropical cyclone peak wind intensities	Not observed in the few analyses available	Likely over some areas	More frequent and more severe storm-surge floods
Increases in mean and peak precipitation intensities in tropical cyclone	Insufficient data	Likely over some areas	More frequent and more severe floods

Table 1: Summary of already observed changes, prospects for the future and likely impacts on water resources (Source: Kabat and van Schaik, 2002)

It is projected that the intensity and timing of storms are likely to change – leading to more extreme events such as floods in most equatorial regions and the high and mid-latitudes (Kabat and van Schaik, 2003). The devastation that resulted from the recent floods in Mozambique and Bangladesh provides chilling examples of the human and economic costs of extreme storm events. In the latter part of the 1990s, the costliest floods in Canadian history struck Québec and Manitoba. The economic losses from the 1996 Saguenay floods in Québec, including insurance claims and other indirect costs to the economy, were over \$1.5 billion. The 1997 Red River flood resulted in over \$500 million in damages.

The United Nations (UN) has stressed the importance of research to understand “how (climate change) will affect people’s livelihoods and opportunities and to identify what initiatives are needed at local, regional, and international levels to cope with them” (WWAP, 2003). Weather-related disasters inflict a large burden on humani-

tarian relief organizations and threaten the achievement of the Millennium Development Goals (Kabat and van Schaik, 2003). This research is critical, for even without the additional pressure of climate change, history has demonstrated that we need to improve water management in order to cope with natural climatic variability, such as floods or crop failure due to droughts.

3. Moving Forward: Challenges for the Global Community

Framework for action

While it is undeniable that we are in the midst of a crisis that has the potential to escalate over the next few decades, there is reason for cautious optimism. This crisis is predominately one of management and, so, we have a choice. There is enough water for all. It requires the financial and political will to manage this precious resource in such a way that no one is without. The past 30 years have seen a plethora of conferences at which the issues facing water resources were explored. In particular, events from the year 2000 and onwards have been instrumental in shaping the water sector's current agenda.

At the Second World Water Forum in March 2000, the Ministerial Declaration identified seven challenges for the global community that must be met in order to realize sustainable management of water resources (Table 2).

The UN's Millennium Development Goals (MDG) have become the key international development targets of the modern era. Improving water management will contribute to the achievement of the majority of the goals set forth by the UN (Table 3). A cornerstone of the MDG is the pledge to halve the number of people who lack access to clean water by 2015. This pledge was renewed at the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg, and furthered by also vowing to reduce by half the number of people who lack adequate sanitation by 2015. The 2002 WSSD identified action in five sectors, collectively known as WEHAB, as essential for alleviating poverty and attaining sustainable development. The WEHAB sectors are: Water supply and sanitation, Energy, Health, Agriculture, and Biodiversity. Substantial progress in each of the five WEHAB sectors is required for the timely realization of the Millennium Development Goals.

At the recent Third World Water Forum in March 2003, leaders renewed their vows to meet the water-related targets laid out by the MDG and the WEHAB initiative. Delegates identified and discussed the necessary actions for resolution of the global water challenges

Meeting basic needs	recognizing that access to safe and sufficient water and sanitation are basic human needs and are essential to health and well-being, and to empower people, especially women, through a participatory process of water management
Securing the food supply	enhancing food security, particularly of the poor and vulnerable, through the more efficient mobilization and use of water and the more equitable allocation of water for food production
Protecting ecosystems	ensuring the integrity of ecosystems through sustainable water resources management
Sharing water resources	promoting peaceful cooperation and developing synergies between different uses of water at all levels, whenever possible, within and – in the case of boundary and transboundary water resources – between concerned states, through sustainable river basin management or other appropriate approaches
Managing risks	providing security from floods, droughts, pollution and other water-related hazards
Valuing water	managing water in a way that reflects its economic, environmental, and cultural values in all uses, with a move towards pricing water services to reflect the cost of their provision. This approach should account for the need for equity and the basic needs of the poor and the vulnerable
Governing water wisely	ensuring good governance, so that the involvement of the public and the interests of all stakeholders are included in the management of water resources

Table 2: Seven challenges for the global community (WWAP, 2003)

and to meet the MDG and the WEHAB initiatives. More than 100 new commitments were reached during the Forum at global and regional levels. Some of the global commitments reached include The Community Water Initiative spearheaded by the United Nations Development Programme (UNDP). This initiative will provide innovative communities with small grants to expand and improve their solutions to the water and sanitation crisis. Japan has supported the establishment of the International Flood Network (IFNet) for global flood mitigation. The Forum also stressed that since the water crisis is predominately a crisis of management, the adoption of an integrated water resources management (IWRM) approach is crucial for its resolution. Other key issues raised include the need for capacity building, financing of infrastructure, and multi-stakeholder participation.

The challenges confronting the water sector are multifaceted. We have systematically, “threatened our water resources with bad institutions, bad governance, bad incentives, and bad allocations of resources” (Cosgrove and Rijsberman, 2000). Business as usual cannot continue if we are to meet the challenges first presented at the Second World Water Forum in The Hague and the Millennium Development Goals.

How water management contributes to achieving goals		
Millennium Goals	Directly contributes	Indirectly contributes
Eradicate extreme poverty and hunger: <ul style="list-style-type: none"> • Reduce by half the proportion of people living on less than a dollar a day • Reduce by half the proportion of people who suffer from hunger 	<ul style="list-style-type: none"> • water as a factor of production in agriculture, industry and other types of economic activity • investments in water infrastructure and services act as a catalyst for local and regional development • reliable water for subsistence agriculture 	<ul style="list-style-type: none"> • reduced vulnerability to water-related hazards reduces production risks • reduced ecosystems degradation boosts local-level sustainable development • improved health from clean water increases productive capacity
Achieve universal primary education: <ul style="list-style-type: none"> • Ensure that all boys and girls complete a full course of primary schooling 		<ul style="list-style-type: none"> • improved school attendance from improved health and reduced water-carrying burdens, especially for girls
Promote gender equality and empower women: <ul style="list-style-type: none"> • Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015 		<ul style="list-style-type: none"> • community-based organizations for women management improve social capital of women • reduced time and health burdens from improved water services lead to more balanced gender roles
Reduce child mortality: <ul style="list-style-type: none"> • Reduce by two thirds the mortality rate among children under five 	<ul style="list-style-type: none"> • improved quantities and quality of domestic water and sanitation reduce main morbidity and mortality factor for young children 	<ul style="list-style-type: none"> • improved nutrition and food security reduces susceptibility to diseases
Improve maternal health: <ul style="list-style-type: none"> • Reduce by three-quarters the maternal mortality rate 	<ul style="list-style-type: none"> • improved health and reduced labour burdens from water portage reduce mortality risks 	<ul style="list-style-type: none"> • improved nutrition reduces susceptibility to conditions that affect maternal mortality
Combat HIV/AIDS, malaria and other diseases: <ul style="list-style-type: none"> • halt and begin to reverse the spread of HIV/AIDS, malaria and other major diseases 	<ul style="list-style-type: none"> • reduced incidence of range of diseases where poor water management is a vector 	<ul style="list-style-type: none"> • improved health and nutrition reduce susceptibility to HIV/AIDS and other major diseases
Ensure environmental sustainability: <ul style="list-style-type: none"> • Integrate the principles of sustainable development into country policies and programmes; reverse loss of environmental resources • Reduce by half the proportion of people without sustainable access to safe drinking water • Achieve significant improvement in lives of at least 100 million slum dwellers 	<ul style="list-style-type: none"> • improved water management, including pollution control and sustainable levels of abstraction, are key factors in maintaining ecosystems integrity • actions to ensure access to adequate and safe water for poor and poorly serviced communities 	<ul style="list-style-type: none"> • development of integrated management within river basins creates conditions where sustainable ecosystems management is possible and upstream-downstream impacts are mitigated.

Table 3: Water and the Millennium Development Goals (Source: WWAP, 2003)

Governance and institutional reform

Good governance is perhaps the most important requirement for achieving the shared vision of sustainable water resources management. Even if the “vast bulk of the funding required to make this vision a reality comes from communities as labour and energy and from large and small private sector investments, governments remain the sovereign bodies that must be the enablers to make this possible” (WCW, 2000). Good governance includes involvement of all stakeholders in decision making, including women and the rural poor, and the devolution of power to water users (Brooks, 2002).

The international water agenda stresses the importance of the implementation of holistic and integrated approaches to water resource management (WCW, 2000; WWC, 2003). Integrated water resources management is the “coordinated sustainable development and management of water, land, and related resources to maximize equitable economic and social development while protecting ecosystems” (Guerquin et al, 2003). For this, institutions must move away from supply-driven to demand-driven management. In addition, mechanisms to eliminate fragmentation and needless duplication of services among various levels and providers are required. Governance must enable local level management which has already been proven effective (Brooks, 2002).

Initiatives and programmes promoting investment in people will further assist in institutional reform. Good governance could facilitate the dialogue between different professionals in the water sector including engineers, economists, social scientists, and scientists – strengthening both development and application of strategies for change. Universities can play an important role by promoting an interdisciplinary approach among the training of the next generation (Helming and Kuylenstierna, 2001). There is also a need for the development of innovative programmes to teach the young and the public.

Policy

Good governance will lead to the development and implementation of sound agreements and policies at regional and international levels. Governance is a particularly important and complex issue with respect to shared water resources. Limited legislation in regards to transboundary basins exists to date, one of the few being the United Nations Convention on the Non-Navigational Uses of International Water Courses adopted by the United Nations in 1997. Presently, unfortunately, it has been signed by only 16 countries

and ratified by just nine. There is a need for strong, comprehensive, international legislation that will make the integrated management of river basins easier to achieve. It is vital that the negotiation of agreements between countries occurs for all transboundary basins in the near future.

Another critical issue for policy makers is pollution. The costs of pollution can be enormous to human health, to the environment and to the economy. As always, the people who pay the highest price are usually the poor living in developing countries. Recent developments in international law related to the polluter pays principle – such as the United Nations Economic Commission for Europe Joint Protocol on Liability and Compensation – provide a solid foundation for further development of this essential tool for protecting the environment and the poor. Incentives and penalties can encourage industry and agriculture to reduce pollution at its source.

Research and development, technology and innovation

A key question facing researchers today is how to increase water productivity. In agriculture, for example, there is the slogan of “more crops per drop”, and this has been broadened to include more “jobs”. The over-use of water resources can be controlled by demand management approaches that include improved irrigation practices and less-water-consuming crops (especially in water-scarce areas) (Cosgrove and Rijsberman, 2000). The need for increased efficiency of water use in agriculture is leading to the expansion of drip irrigation technologies, sub-irrigation, improved on-farm water management practices, the alternate wet and dry irrigation of rice production in Asia, and improved tillage and agronomic practices to conserve limited soil moisture. Implementing drip irrigation can reduce water consumption by as much as 60 percent. These technologies will help to overcome local water scarcity, salinization, and desertification. Linked to conservation technologies is research and development into biotechnology (Cosgrove and Rijsberman, 2000). Advances in this area could help maximize water productivity by the development of both higher yielding and drought resistant plants with increased salt tolerance. Increasing the efficiency of water-use systems is also necessary. Delivery systems for municipal, agricultural and industrial water often result in huge losses of water en route.

In addition, rain harvesting would lower costs as well as reduce the strain on aquifers. Rainwater harvesting systems have been successfully installed in villages in both India and China, as well as

cities in the United States and Germany (Guerquin et al., 2003; Brooks, 2002). Water quality can also be preserved at a community level by implementing ecological sanitation technologies. Industry and agriculture can often utilize lower-quality water so demands on freshwater can be further reduced by recycling and reusing wastewater and drainage water (Brooks, 2002).

Desalination can reduce the demand on freshwater sources. The cost of desalination has already dropped due to advances in technology. In Saudi Arabia, desalination plants could already provide 33 percent of the domestic demand in 1997 (WWAP, 2003). In the future, the use of desalinated water could become a viable option in many more coastal cities. A caveat is required for desalination consumes vast amounts of energy and leaves a mountain of brine that requires disposal. Progress has also been made in reverse osmosis, an alternative to desalination.

The summary forum statement of the WWF3 stressed that “though increasing water use efficiency through developments in science and technology and improved demand management are essential, these alone may not be sufficient to meet the growing demand for water in most developing regions and particularly in cities”. The use of dams can be a way to manage and store scarce water. However, concerns on both the human and environmental cost of building dams are rampant. The World Commission on Dams recently completed a two-year study on the planning and management of dams and their alternatives based on the WCD core values. They concluded that if a large dam is the best way to achieve sustainable improvement of human welfare, and is economically viable, socially equitable and environmentally sustainable, it deserves support. Nevertheless, they maintain that when other options offer better solutions, they should be favoured over large dams.

Financial management

There are four main sources of funding for water infrastructure: government money via taxation, user contributions (water pricing), investment from private sources, and external aid (Helming and Kuylenstierna, 2001). In order to meet the Millennium Development Goals, investments in the water sector need to rise sharply. An investment in water infrastructure is also an investment in socio-economic development and poverty reduction. Investments in adequate water supply and sanitation systems can also save the country money in the long run. For example, a cholera epidemic in 1991

cost the Peruvian economy \$1 billion dollars in combined emergency health expenditures and lost revenue from exports and tourism. This figure is more than four times what Peru spent on water supply and sewerage between 1981 and 1988.

Perhaps the most important management issue regarding water and sanitation – the one that could have the most benefit for the poor, yet proving to be the most controversial – is the issue of water pricing. In many regions, water is provided for free or for very low cost. A common belief is that the poor benefit from such an arrangement (WCW, 2002). Agriculture is also heavily subsidized with farmers often paying little or nothing for what they use. Unfortunately, when water is subsidized it tends to be wasted. Subsidies impose a direct cost on taxpayers and an indirect cost through encouraging inefficient water use. The funds spent for subsidizing water might be better spent by society for other purposes, for instance, providing better services to the poor. A move towards full-cost water pricing is essential with the proviso that the poor receive assistance in payment. Chile has had success with their full-cost water pricing programme whereby they provide water stamps to the poor to ensure all can afford an adequate supply (WCW, 2002).

In order for private investment to increase, a business environment needs to be established in order for investors to be able to recover their investment over time (Winpenny, 2003). Traditionally, water investments have not been overly attractive due to high capital demands and low returns (Helming and Kuylenstierna, 2001). Water-pricing will assist in this need.

In the very poor developing countries, international development assistance for water projects must be increased. The United Nations has set a target for international aid for water of 0.7 percent of donor countries' gross national income. At present, developmental assistance averages only 0.24 percent. Canada and other countries are playing an important role in improving the water sector in African countries, through the New Partnership for Africa's Development (NEPAD) initiative.

The Québec Water Policy – A beacon for the future

Québec's Water Policy is a powerful, progressive, and innovative document that firmly establishes the government's stance on the importance of protecting and preserving this valuable resource. The Policy was developed using a participatory, multi-stakeholder approach, and has at its heart an integrated watershed-based management perspective. The Policy is centered on five major orienta-

Orientation	Courses of Action
Water governance reform: a strategic choice	<ol style="list-style-type: none"> 1. Revision of the legal framework pertaining to water 2. Implementation of watershed-based management 3. Acquisition of knowledge and information about water, 4. Introduction of economic instruments for governance 5. Strengthening of Québec's partnerships and relations.
Integrated management of the St-Lawrence River: a major challenge	<ol style="list-style-type: none"> 1. Grant the St. Lawrence special status 2. Implementation of integrated management of the St. Lawrence River
Protection of water quality and aquatic ecosystems: a necessity	<ol style="list-style-type: none"> 1. Ensuring safe, quality drinking water 2. Protecting aquatic ecosystems
Continued clean-up and improved management of water services: recovering lost uses	<ol style="list-style-type: none"> 1. Intensifying agricultural clean-up efforts 2. Broadening industrial clean-up efforts 3. Supplementing municipal clean-up efforts 4. Ensuring the sustainability of municipal infrastructures while improving the management of water services
Promotion of water-related recreation activities: the pleasures of water	<ol style="list-style-type: none"> 1. Expanding access to water and promoting sport fishing 2. Promoting water safety and the quality of life on lakes and watercourses 3. Promoting nautical tourism

*Table 4: Key aspects of the Québec Water Policy
(Source: Québec ministère de l'Environnement, 2002)*

tions with corresponding courses of action (Table 4). In addition, 57 specific commitments associated with the orientations were defined. They include a series of water quality initiatives to broaden industrial, agricultural, and municipal clean-up efforts. Another set of commitments focuses on improving management of water services (drinking water and sanitation) by promoting the use of new technologies, establishing conservation programmes, and developing new methods for calculating water costs. Together, these strategies strive for a minimum 20% reduction in per capita water consumption within 7 years and, to reduce losses through leakage to a maximum of 20% within 10 years. At present, Québec's municipalities consume higher per capita volumes of water than the North American and European averages. The Policy also specifically pledges to support initiatives aimed at protecting and restoring aquatic, riparian, or wetland habitats. Good quality fish habitat is crucial for preserving biodiversity and additionally benefits the sport-fishing industry which produces \$1 billion in annual economic spin-offs. The government also commits to revising Québec's legal framework as it pertains to water permitting, among other things, the establishment of legislation supporting "user-pays" and "polluter-pays" mechanisms. Finally, 33 priority watersheds where current conditions are poor have been identified and their agencies

receive additional financial and technical support. In all, this new water governance demonstrates Québec's resolve to meet the challenges of today in order to conserve water for tomorrow.

Conclusions

The peoples of the world are currently faced with a water crisis of unparalleled proportion. Citizens in the arid and semi-arid developing nations are faced with severe water shortages, affecting their livelihoods and ability to produce food. Water scarcity in these parts is also contributing to untold deaths of young mothers and children due to famine, malnutrition, and water related diseases. The developed, industrialized nations of the North, which are traditionally regarded as water rich, are not immune from the world's water crisis. Severe water pollution, overpumping of aquifers, inadequate and crumbling water infrastructure, human health concerns surrounding inadequate water treatment technologies, and drought due to water scarcity are seriously affecting the developed world. The world water crisis is real and touches all lives, rich and poor. The crisis calls for global solidarity and solutions.

Recent international water and environmental forums such as the Johannesburg Summit on Sustainable Development (September 2002), and the Third World Water Forum (March 2003), as well as the goals outlined in the UN Millennium Development Goals and WEHAB initiative provide some hope for the future. Wise water stewardship, implementation of transboundary water agreements, integrated water resources management, improved governance and institutional structures, broad participation of all stakeholders, including women, in all water decision making, introduction of water saving technologies, pollution control measures and increased financial investments in the water sector are all measures that will need to be implemented throughout the world. Governments must take the initiative and construct progressive action-oriented water policy acts such as Québec's to promote and guide the implementation of such measures. There is also the need to sharpen the research focus on innovative and cost effective methods of water conservation, water reuse, and water recycling. These aspects are key to poverty alleviation and sustainable development. In all this, political will is essential for overcoming the challenges.

Acknowledgements

The senior author thanks his employer, McGill University, as well as funding agencies such as NSERC, FQRNT, and CIDA, for providing the resources to undertake policy studies and research on local and global water problems.

REFERENCES

- Bergkamp, G., Orlando, B., and Burton, I. (2003). *Change – adaptation of water resources management to climate change*, The World Conservation Union (IUCN), Gland, Switzerland. Available from: <http://www.iucn.org/themes/wani/change.html>
- Brooks, D.B. (2002). *Water – local level management*. International Development Research Center, Ottawa.
- Cosgrove, W.J. and Rijsberman, F.R. (2000). *Making water everybody's business*. World Water Vision Report. World Water Council, London. Earthscan Publications Ltd.
- Guerquin, F., Ahmed, T., Hua, M., Ikeda, T., and Schuttelaar, M. (2003). *Making water flow for all*, World Water Council, Marseille.
- Helming, S. and Kuylenstierna, J. (2001). *Water – a key to sustainable development*. Issue Paper for the International Conference on Freshwater, Bonn, December 3–7, 2001. Available from: http://www.water-2001.de/co_doc/
- Kabat, P. and van Schaik, H. (2003). *Climate changes the water rules: How water managers can cope with today's climate variability and tomorrow's climate change*. Dialogue on Water and Climate, The Netherlands. Printfine Ltd.
- Québec ministère de l'Environnement, (2002). *Québec water policy: water, our life, our future*. Available from: <http://www.menv.gouv.qc.ca/eau/politique/policy.pdf>
- UNEP (United Nations Environmental Programme). (2002). *Vital Water Graphics*. United Nations. Available from: <http://www.unep.org/vitalwater/index.htm>.
- UNEP (United Nations Environmental Programme). (2002b). *Global environmental outlook 3 – past, present and future perspectives*. Available from: <http://www.unep.org/GEO/geo3/english/index.htm>

- UNFPA (United Nations Population Fund). (2001). *The State of World Population 2001: Footprints and Milestones: Population and Environmental Change*. Available from: http://www.unfpa.org/publications/index.cfm?filterPub_Type=5
- WCW (World Commission on Water for the 21st Century). (2000). *A water secure world: Vision for water, life, and the environment*. Report for the World Water Council. UK, Thanet Press.
- Winpenny, J. (2003). *Financing water for all*. Report of the World Panel on Financing Water Infrastructure. Available from: http://www.worldwatercouncil.org/financing_water_infra.shtml
- Wolf, A. T. (2001). *Transboundary waters: Sharing benefits, lessons learned*. Thematic Background Paper for the International Conference on Freshwater, Bonn, December 3–7, 2001. Available from: http://www.water-2001.de/co_doc/
- WRI (World Resources Institute). (1998). *1998–1999 world resources: A guide to the global environment*. Available from: <http://www.wri.org/wri/wr-98-99/index.html>
- WWAP (World Water Assessment Programme). (2003). *Water for people, water for life*. United Nations Educational, Scientific and Cultural Organization (UNESCO).
- WWC (World Water Council). (2003). *Summary Forum Statement of the Third World Water Forum, Kyoto, Shiga and Osaka, Japan, March 16–23*

NOTES

- 1 James McGill Professor and Director of the Brace Center for Water Resources Management. McGill University, 21 111 Lakeshore Road, Ste Anne de Bellevue, QC, Canada H9X 3V9 and Vice-president, International Commission on Irrigation and Drainage
- 2 Department of Geography, McGill University, 805 Sherbrooke St W., Montreal, QC, H3A 2K6, Canada