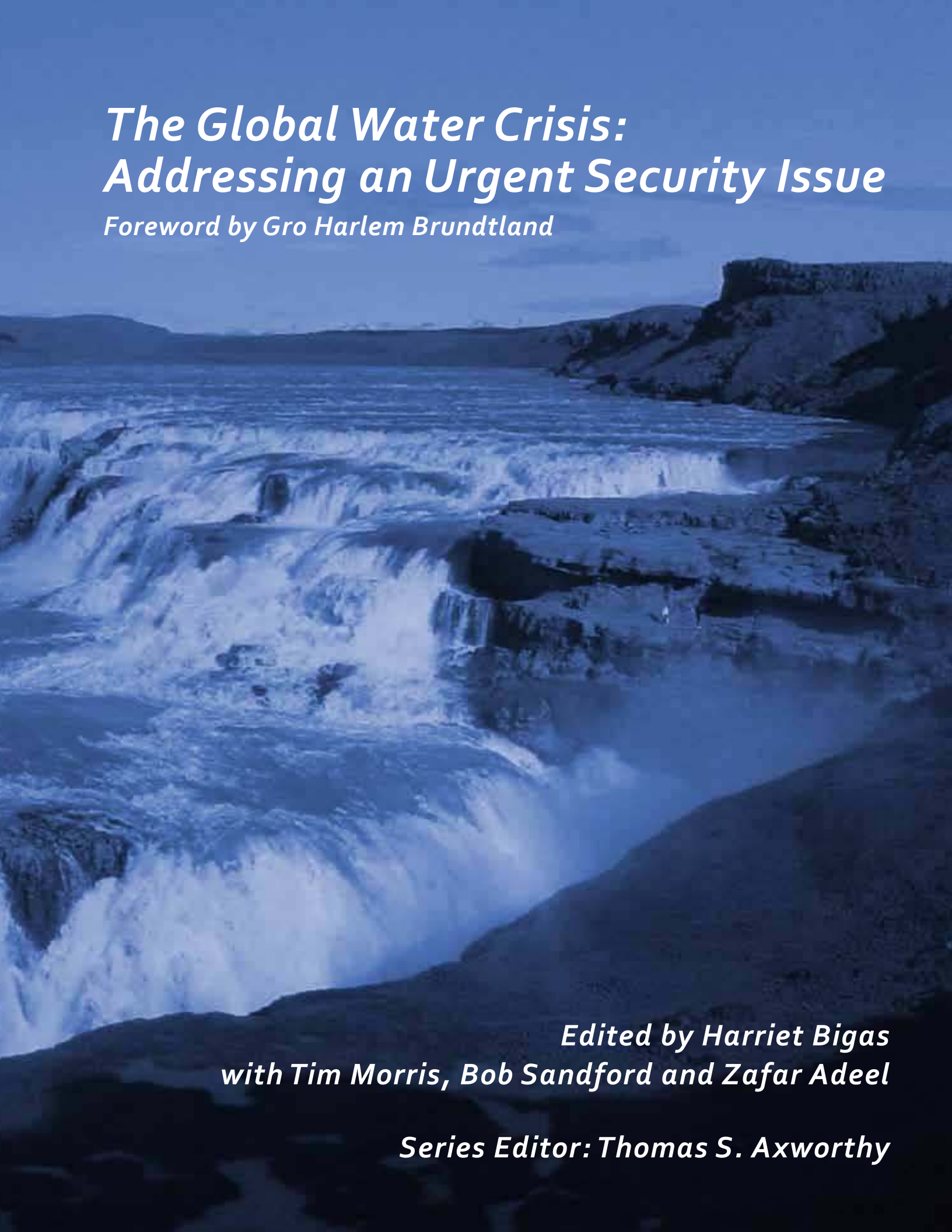
# The Global Water Crisis: Addressing an Urgent Security Issue

Foreword by Gro Harlem Brundtland



Edited by Harriet Bigas
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Series Editor: Thomas S. Axworthy

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*Papers for the InterAction Council, 2011-2012*

***Edited by Harriet Bigas***
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UNITED NATIONS UNIVERSITY
UNU-INWEH
Institute for Water, Environment and Health

Walter & Duncan GORDON FOUNDATION

INTERACTION COUNCIL

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Established in 1983, the InterAction Council of Former Heads of State and Government is an international organization whose objective is to address long-term, global issues facing humankind. Co-Chaired by the Right Honourable Jean Chrétien (Prime Minister of Canada, 1993-2003) and Dr. Franz Vranitzky (Chancellor of Austria, 1986-1997), the Council's membership is comprised of more than 30 former heads of state who volunteer their time to develop proposals for action and submit them directly to national and international decision-makers.

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# *Foreword*

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**H.E. Dr. Gro Harlem Brundtland**
Member of the InterAction Council
Former Prime Minister of Norway

The undeniable seriousness of the global water situation was first brought to the attention of the international community at the 1992 United Nations Conference on Environment and Development in Rio de Janiero, at what came to be known as the Rio Earth Summit. In response to the Rio Summit, the United Nations General Assembly designated the 22nd of March, 1993 as the first World Water Day. International World Water Day has been held annually thereafter, as a means of focusing attention on the importance of fresh water and advocating for the sustainable management of freshwater resources. The celebration of an annual World Water Day was followed by the proclamation of the International Year of Fresh Water in 2003; and the declaration in 2005 of the United Nations International Decade of Action 'Water for Life', which set clear goals with respect to water supply and sanitation globally to be met by 2015 in tandem with those of the Millennium Development Goals.

Twenty years after the Rio Summit, the global situation with respect to water has improved in some areas, but still has long ways to go in others because of the needs and effects of rapidly growing populations. The message that emerges today in the reports of water experts worldwide is one of caution and urgency with respect to how the world might prepare for and act to prevent a potential freshwater crisis with respect to supply and quality.

The authors of this important and timely book are experts in a broad range of water issues. Together, they make it clear that there is no question that water scarcity is becoming a major issue on our planet. The most important problems are all well-known. These include, *inter alia*: a rapidly growing population with associated changes in lifestyle and consumption patterns; competition between sectors, such as industry, agriculture and energy for precious land and water resources; inadequate access to water supply and sanitation services for what is now becoming known as the 'bottom billion' on this planet; the failure to adequately address the issue of indigenous water rights and include marginalized populations in water decision-making processes; matters related to environmental protection; and, growing tension over transboundary water issues. All of these problems will to some extent be magnified by the growing realization that past and current hydrological patterns will no longer be sufficient or a reliable guide for dealing with future hydro-climatic scenarios.

Water policy experts maintain that we must respond simultaneously to all these issues if we are to avoid a crisis of scarcity in many places in the world. Many places, particularly in sub-Saharan Africa or West Asia and North Africa, are already facing critical water shortages. As some of these nations are already politically unstable, such crises may have regional repercussions that extend well beyond their political boundaries. But even in politically stable regions, the status quo may very well be disturbed first and most dramatically by the loss of stability in hydrological patterns.

It is the slowness of institutional adjustments to water scarcity that has made the global water crisis one of governance more so than a crisis of absolute water availability. We are not facing water scarcity so much as we are facing water governance issues. What we have learned from what is happening widely in the world is that the failure of governance with respect to water management is often a failure to integrate water management at different levels and to take local and regional approaches into consideration. We also have yet to arrive at a mechanism for evolving our governance structures fast enough to keep up with the rapid pace of change that is occurring and with the challenges that are being created by population growth, destruction of biodiversity-based planetary life support functions, and climate change.

This does not imply, however, that we lack the means to deal with these problems. Time and time again, we have seen that local collaborations and close relationships go a long way in addressing water security issues. Engagement on water matters on a basin level with all stakeholders, including indigenous peoples, is no longer an option – it is a must. We must go beyond the norms we have come to accept regarding water governance and policies, and accept that water security transcends the limitations of government as the sole party responsible for it. It is without question that governments must be involved, but water security must also be defined by broader private and public interest and ownership through appropriate institutions and engagement, and actively advance as an individual and collective societal aspiration.

The contemporary understanding of water security concerns also makes it clear that broader principles must be incorporated into transboundary treaties if such agreements are to remain relevant in changing hydrological scenarios. These principles include: integration of surface and groundwater interactions with land use planning and water management; ecosystem protection; public and private sector involvement; collaborative, multi-level governance; and the need for adaptability

and flexibility in the management of shared waters. Examples from around the world demonstrate that principles that work at the international level are also applicable at the sub-national level. Strengthened trust and confidence can only emerge through collaboration and public involvement at all levels of basin governance.

There is another important subtext that emerges from these thoughtful essays. Together, they suggest that in our efforts to adapt to changing climatic conditions, our focus should rightly be on water. If we are able to balance our needs for water availability and quality in terms of nature, agriculture, populations and development, many other needs, including achieving sustainability, may very well fall into place. Thus, we see that moving quickly to manage water more carefully will generate greater global benefits in and of itself, while at the same time allowing us to imagine a future in which a water crisis does not exist.

Finally, the examples and direction put forward in this book affirm the fact that strong and persistent political leadership together with broad, ongoing collaboration is necessary if we wish to make progress in water governance. We see that it is possible to build a meaningful and durable bridge between science and public policy that will help to successfully address the global water crisis. However, in order to do so in a timely manner to assure water security for all, we need to move quickly in order to keep up with both humankind's growing and changing needs and demands, and the changes in the way water is moving through the global hydrological cycle.

# *The Global Water Crisis: Framing the Issue*

# *The Global Water Crisis: Framing the Issue*

**Thomas S. Axworthy**
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## Introduction

In March 2011, high-level experts from around the world were invited to Toronto, Canada, to meet with members of the InterAction Council about the status of the world's freshwater supply as it relates to global security issues (see List of Participants in this volume). These experts reported that that the global water crisis is real and that there is urgency in addressing the growing number of security risks associated with threatened water supply and quality. They also, however, expressed hope and identified opportunities that can be realized by the timely triggering of change in policies, institutions, and the way society thinks about water.

## 1. Something Must Be Done: Urgency and Risk

The magnitude of the global freshwater crisis and the risks associated with it have been greatly underestimated. One billion people on earth are without reliable supplies of water, and more than 2 billion people lack basic sanitation. Water is critical to the attainment of the United Nations Millennium Development Goals whose targets are set to expire in 2015; it is already known that the world lags far behind on the sanitation target, which is predicted to be missed by over 1 billion people.

In many countries, national security has historically been defined as military security. It is now understood that military might is only one element in the human security equation, and that water can play a determining role in international, national and transboundary conflicts. Although real potential exists for conflict over water, water tensions can also offer potential for cooperation between states, so long as the underlying institutions and capacity are in place for such cooperation to happen.

Water security is also the foundation for food and energy security, and for overall long-term social and economic development. Water underpins health, nutrition, equity, gender equality, well-being and economic progress, especially in developing countries. But equitable water supply and quality problems are also threatening the security of some of the most developed countries in the world. In the USA, for example, water availability has already been identified as a national security concern, threatening its ability to meet the country's water, food and energy needs.

To complicate matters further, water stress is expanding globally but especially at mid-latitude countries that are already deemed to be water scarce, threatening to further undermine important development progress. Add to this the increasing number of environmental migrants moving within and beyond national boundaries in response to impacts from climate change and other impacts on water, and the global water crisis grows more serious each day.

The environmental impacts of the water crisis are equally alarming. Multiple, cumulative and compounding problems with water supply and quality are converging globally. Increasing population growth is already competing with nature for finite water resources. A growing number of rivers do not make it to the sea, and there is widespread surface and groundwater contamination that makes valuable water supplies unfit for other uses. A growing number of contaminants, such as endocrine-altering substances, will demand higher wastewater treatment standards and more exhaustive monitoring of water contaminants.

Although in many parts of the world, economic development has been slow as has been investment in science, there is significant potential for investment, research and development in water technologies, systems, treatment, use and productivity. Advances in technology, innovation and best practices are needed in order to keep pace with the current rate of growth to be able to meet rising levels of water demand, decreasing water availability and aging urban water infrastructure. Advances in technologies and development offer multiple opportunities for involvement of the private sector in meeting the world's water needs, and the potential for public-private partnerships. Such advances will need to be integrated with national water policies.

Until now, an apparent inter-jurisdictional and cross-sector willingness to cooperate over water has not led to effective action. Difficult reforms remain necessary and must be based on integrated land and watershed management principles rather than the fractured jurisdiction of artificial management units imposed by political boundaries.

Ethical considerations also need to be taken into account in order to ensure equitable access and sufficient provision of water to all, particularly to marginalized groups who often have no say in the decision-making process. However, establishing a basic constitutional right to water come with its own limitations and implications, and can erroneously be seen as the magic silver bullet that will address many of the issues related to the water crisis.

What has also become clear is that there currently is a vacuum in international water leadership. New forms of hydro-diplomacy are desperately needed in order to address the lack of political will, financial resources and effective governance. Although leaders and policy-makers are increasingly inundated by 'legislative congestion', the fact remains that inactivity in the face of a growing global water crisis cannot go ignored. Future generations trust us to get it right; they will drink the very same water we drink. There is, therefore, considerable urgency in creating the political will to address the root causes of the global water crisis.

## *2. There Is Hope: Challenges and Opportunities*

Growing populations, changing diets, increased urban, agricultural and industrial water demands, and a growing understanding of nature's need for water require that we radically reform our attitude toward water and how it is managed globally. Water needs to be on the global political agenda not only in order to feed the projected 9 billion people that will inhabit the earth by 2050 with less agricultural water than is available today, but also in order to address the critical development challenge of doing so in a safe, sustainable way without compromising water resources that are essential to ecosystem services and functions. By addressing critical water issues, we will simultaneously address economic and public health woes while advancing our capacity to adapt to climate change. Addressing water security issues will create a foundation for peace and well-being.

What's more, not all solutions will require large amounts of funding. On the contrary: finance ministers may be inclined to action if they knew that inadequately addressing water and sanitation issues was costing them a significant portion of their country's GDP. However, having said that, the resolution of the global water crisis will require a level of funding commensurate with the seriousness of the problem. Despite the critical need, investment in water management has dropped by more than 25% in most countries since the late 1990s (World Bank, 2010). There is a disturbing mismatch between investment in the form of aid and results. Too often, there is a focus on water treatment at the expense of providing basic services in the areas where it is most needed. Achieving the target for both water supply and sanitation would bring economic benefits: investing US $1 would give an economic return of US $3-$4, depending on the region. Achieving this target would require an estimated additional investment of around US $11.3 billion per year over and above current investments (World Health Organization, 2012), an amount far less than the annual military budgets of many developed countries.

Money alone though will not be enough to solve all the problems. In many countries, major public institutions do not have the capacity to address water issues even if sufficient funding is available. Help from other countries as well as financing are required to ensure that water quality and availability issues do not stall economic or social progress or, worse yet, result in further conflict in many parts of the world. Development cooperation also needs to be encouraged in order to ensure that it includes all economic flows, and not just direct aid.

It will also be important to support and advance established United Nations international water protocols in order to make further advances in water security. The InterAction Council was informed that the UN has already devised a Legal Analytical Framework for water security, but that this is not being met by many countries (Wouters *et al.*, 2009). On the other hand, an example of real progress toward higher international standards of water management is the 1997 UN Watercourses Convention. Unfortunately, many nations have yet to ratify this treaty.

Regional cooperation is essential to creating transboundary relationships that result in optimal levels of water, food and health security for all users sharing a particular river system. International examples, such as that of the Nile River Basin, suggest that effectively orchestrated basin-scale management of water resources can generate increased benefits for all within a regional context if there is cooperation between all stakeholders. Other globally relevant models also exist, such as Canada's Northwest Territories 'Northern Waters, Northern Voices' water stewardship strategy, which demonstrates how the rights of both people and nature to water can be a foundation of sustainable economic development.

Another important example of successful international agreements over water management standards is the European Union (EU) Water Framework Directive. In this framework, water quality standards and parameters of aquatic ecosystem health are defined by the EU, but individual nations are charged with meeting those standards based on the strategy they decide will work best in local circumstances. Furthermore, the EU model links both agricultural and water policy, and it is a model which may be useful to examine in other regional contexts, such as in North America.

Innovative thinking can result not only in preventing crisis, but also in enhancing economic development and improving living standards at large. For example, when considering the issue of global food security, it relates as much to a lack of storage and transport as it does to food production. Improving these processes could lead to an improvement in water productivity and food security, and this can be done through revitalizing irrigation technology, practices and institutions. Water-use efficiency must also be improved in energy production, and alternative options, such as employing wastewater and saline water, should be explored. And while huge growth is projected in the use of biofuels and substitutions for traditional sources of fuel, it was unequivocally pointed out that these new sources of fuel should not be developed at the expense of growing food. It will also be important to explore the possible benefits of the virtual water trade. We should also consider payment for ecosystem services. Finally, it is important to explore the role of public-private sector partnerships in addressing the growing global water infrastructure deficit.

Government regulation can provide huge incentives for change. New laws can kick-start the 'ingenuity engine' and keep it running. As the Premier of Ontario, Dalton McGuinty, pointed out in his keynote address at the outset of the March 2011 High-Level Expert Group Meeting of the InterAction Council, setting high standards for the protection of water quality can produce rapid change by stimulating innovation in water conservation and treatment. This creates economic opportunity and demonstrates that it is possible for companies to do well for themselves while being socially responsible.

It must be understood, however, that human interaction with the environment is at the centre of water security. We should never forget that nature is a silent stakeholder in all water use. The issue of water security ultimately will only be addressed when humans can find a way to satisfy their growing needs without compromising the ecosystem services they depend upon to fulfill those needs, and to do so in a sustainable way so as to ensure water and environmental security for future generations. These are immense challenges, but they can be addressed in a timely way through innovation, creativity, investment and cooperation.

## *3. How Do We Trigger Policy Change? Recommendations to the InterAction Council*

Following the High-Level Expert Group Meeting of the InterAction Council (see List of Participants in this volume), a number of recommendations were made to the policy community on concrete steps that can be taken for a water-secure future:

*1. Continue the Global Dialogue on the Water Crisis*

Participants in the Toronto forum confirmed the value of linking science and water governance experience to the political process, and were grateful for the opportunity to collaborate directly with former heads of state via the InterAction Council, and saw this as a necessary step for continuing the global dialogue on the water crisis.

It is recommended that the InterAction Council support biennial forums at which high-level water and policy experts collaborate over the state and possible fate of the planet's water resources with the goal of cultivating support for current and future leadership on local, regional and global water matters.

*2. Endorse the Human Right to Water*

The failure to address the global water crisis is not a question of austerity but of priority. Implementing and enforcing the laws and policies recognizing the right to water is a first step towards achieving greater access to water and improved levels of human well-being.

It is recommended that the InterAction Council support the global aspiration to make the right to water implementable and enforceable through the rule of international law.

*3. Support Ratification of the UN Watercourses Convention*

It is recommended that the InterAction Council support the ratification of the UN Watercourses Convention by all nations and the development of the draft articles on transboundary aquifers.

*4. Encourage the UN Security Council to Focus on Water Security*

It is recommended that the InterAction Council encourage the UN Security Council to recognize water as a matter essential to establishing international, regional and national security.

*5. Support Increased Universal Sanitation Coverage and Safe Water Supply*

It is recommended that the InterAction Council encourage increased investment in urgently needed sanitation coverage and improved access to safe water supply globally.

*6. Facilitate Links between National and Global Water, Agricultural and Energy Policies*

The current trend of increasing water use in order to satisfy increasing agriculture and energy demands to meet the needs of a growing population has come at a cost of threatened water supply and quality levels.

It is recommended that the InterAction Council facilitate the linking of water, agricultural and energy policies, both nationally and globally, in order to reduce jurisdictional fragmentation that often acts as a barrier to improved water management practices.

*7. Support Necessary Hydro-climatic Monitoring*

Better surface and groundwater monitoring and mapping are central to water security regionally and globally.

It is recommended that the InterAction Council support a national, international and global priority on the monitoring of hydrological and hydro-climatic processes and encourage increased attention to the mapping and monitoring of both surface water and groundwater.

*8. Support the Protection of Ecological Sustainability Boundaries and Investment in Ecosystem Restoration*

It is recommended that the InterAction Council support the conservation of the world's intact freshwater ecosystems, the establishment of ecological sustainability boundaries, and investment in ecosystem restoration.

*9. Encourage Cooperation and Act as a Mediator in Water Conflicts*

It became apparent during the High-level Expert Meeting that there is a need to create a new era of hydro-diplomacy, beginning at the sub-national level but extending to the national, international and global levels of water governance. A global framework is needed around which countries can create a national water policy and complementary sub-national and local strategies that integrate water, food and energy within the national and regional security context.

It is recommended that the InterAction Council support the creation of an international water institution or forum that focuses on enabling water-troubled countries resolve their problems peacefully to fill the current hydro-diplomacy vacuum. It was suggested that this forum could be hosted in Canada.

*10. Call on National Governments to Strengthen Water Education Programmes*

It is recommended that the InterAction Council call on national governments to introduce or strengthen water education programmes that include early education, targeted education campaigns for water users, and broader public engagement using tools like social media.

*11. Involve the Private Sector*

It is recommended that the InterAction Council encourage broader private sector engagement in the development of new water treatment and conservation technologies, and new solutions to urban water infrastructure maintenance and replacement through equitable pricing of water services and other incentives that will improve the efficiency of water use.

*12. Create a White Paper Supporting the Above Recommendations*

Finally, it is recommended that a White Paper be produced for the InterAction Council to clarify and support each of the above recommendations.

## *Conclusions: Cultivating the Influence of the InterAction Council to Reach the International Community*

Water practitioners must find a way to help policy-makers translate effective action on public policy related to water into long-term support. However, ultimately, water security will require multi-term, non-partisan, and perhaps inter-generational political commitment. Renegotiating the relationship between people, water, and nature is not going to be easy and will take years to happen. We should begin cultivating these relationships and level of leadership now, and the InterAction Council could be a very effective vehicle for doing so.

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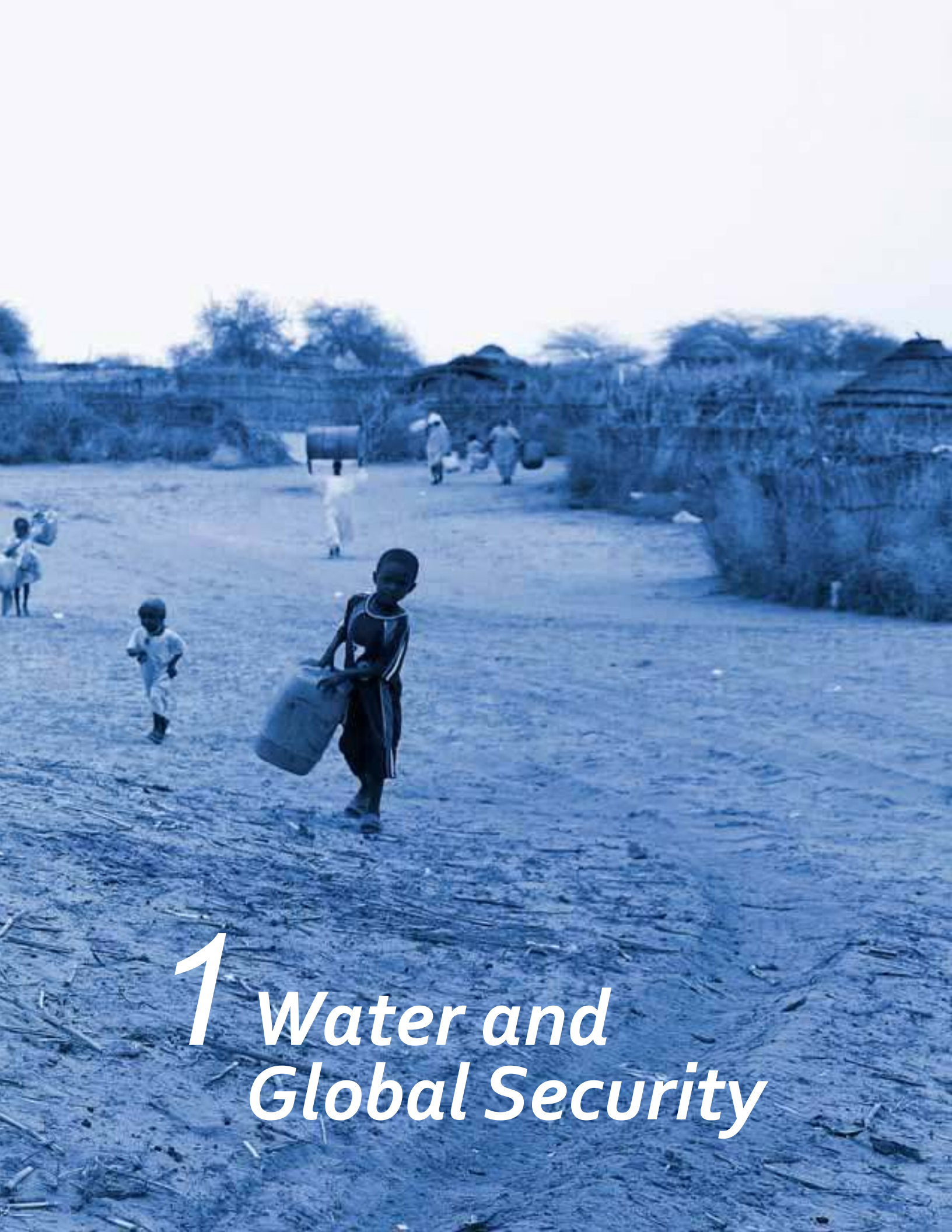

# 1 Water and Global Security

# 1.1 Will the Next Wars Be Fought Over Water?

**Bob Sandford**
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## Introduction

Since the serious state of the global freshwater situation became alarmingly apparent in the 1990s, there has been much debate in academic circles and in the popular media about whether global supply pressures will reach a tipping point that will result in a greater number of wars being fought over regional water security. Following Oregon State University's Professor Aaron Wolf's 1999 pronouncement that since the 1940s, cooperation over water has prevailed two to one over conflict (Wolf, 1999), it has become conventional wisdom in policy circles that the prospect of war over water remains distinctly less likely than it might be for other resources such as oil. "People are willing to do horrible things to one another," Wolf observed, "[w]hat they seem not willing to do is turn off each other's water" (Prud'homme, 2011: 199).

While observers such as Aaron Wolf and others (e.g. Dinar, 2004) have clearly demonstrated that collaboration over regional water issues has typically been a unifying experience as opposed to a divisive force in matters of regional political stability, rapidly growing human populations in combination with changing hydrological circumstances in many parts of the world are likely to exacerbate existing tensions over water security and create new sources of potential conflict in regions that are relatively stable today.

Though it is not possible to predict the future, emerging hydrological trends suggest that tensions and conflicts over water of the kind that have typically occurred in the past will soon represent only one of many emerging explosive hydro-climatic issues that are likely to bring sovereign nations into internal and external discord that could erupt in violent conflict or warfare.

## 1. Civilizations and Water: To Be Human is to Be Hydraulic

As Steven Solomon observed in *Water: The Epic Struggle for Wealth, Power and Civilization* (Solomon 2010), the long record of the rise and fall of hydraulic societies throughout history demonstrates that an abundance of water is necessary for the development of a strong, independent sovereign state. It does not, however, by any means assure it. Ours, Solomon points out, has become the greatest of all hydraulic civilizations. By the year 2000, humans had constructed some 45,000 large dams that in combination with the hundreds of thousands of smaller structures, quadrupled water storage for human purposes in only 40 years. Depending upon the time of the year, three to six times the water that exists at any given time in all the world's rivers is now stored behind giant dams.

As Solomon points out, however, no one examined or was able to predict the cumulative, global-scale effects that uncoordinated dam building, irrigation diversions and the related impacts of deforestation would have on the timing and extent of water availability and water quality. It has now become clear that human activity has begun to affect the earth's hydrology. Our presence and our actions and their consequences have altered the very composition of the atmosphere in which precipitation forms and from which rain falls. Humans have altered how much land cover exists to capture, store, purify and release water from the sky. Human behaviour is affecting rain and snowfall patterns, how much water flows in rivers, and whether the rivers even make it to the sea.

Add to this the serious groundwater overdraft, accelerating soil loss in many of the world's most important food production areas, the widespread contamination of water, and rapidly expanding desertification globally, and the causes and dimensions of the global water crisis suddenly become apparent. Thus, it becomes apparent that the same ecosystem depletions and limitations that contributed to the downfall of previous empires all over the world are now occurring on a global scale (Solomon, 2010). The question that needs to be asked is whether the widespread appearance of these depletions and limitations will lead to more wars, and whether existing and emerging mechanisms of diplomacy and collaboration can reduce this risk for these conflicts.

## 2. A Water War Defined

Of course, much depends upon how a water war is defined. Classic water wars are characterized, in the public imagination at least, as pitched battles over limited surface water supplies. This, however, is a simplification of the wide range of ways in which conflict can emerge from differences of opinion over water supply. The Pacific Institute's Peter Gleick has identified a broad range of conflict categories, which include: the control of water resources at their source; preventing or ensuring

equitable access to water; the targeting of water systems as a weapon during military action; the manipulation of water allocation for political reasons; the targeting of water systems by terrorists; and, development disputes in which water systems are a source of disagreement in the context of economic and social development (Gleick, 2004).

A careful assessment of this history of conflict reveals that while water systems have been used as weapons and targets during war, water resources in themselves have rarely been the sole source of violent conflict or war. This has led water scholars to maintain that – since the 1940s, at least – water is more than twice as likely to be a source of international cooperation as of conflict (Wolf, 1999). But as Peter Gleick points out, the fact that there has been widespread international cooperation over water should not allow policy-makers to underestimate the complexity of the relationship between water and national security (Gleick, 2004).

There are a number of factors that reduce the risk of traditional water wars, such as the presence of new transnational institutions like the United Nations, more effective international laws, the emergence of the International Court of Justice, more comprehensively crafted treaties, new water conservation measures and technologies, and better dispute resolution mechanisms. This hope, however, is founded upon the anticipated stability, or rather stationarity, of both demand for and reliable availability of global water supplies. Unfortunately, our global hydrological situation is changing rapidly (Milly *et al.*, 2008) and may soon no longer resemble anything that has existed on Earth before, at least in human memory.

Some 181 conflicts over water are reported to have occurred between 3000 B.C. and the end of 2007 (Gleick, 2009). Some 146 of these conflicts took place in the 5,000 years between 3000 B.C. and the year 2000. The remaining 59 conflicts therefore occurred in this century. During that same brief decade, new forms of actual and potential conflicts over water emerged. These include homegrown terrorist threats to water infrastructure in Afghanistan and Iraq, and a foreign terrorist threat issued by Al-Qaida in 2003 against domestic water supply systems in the United States (Gleick, 2004).

Conflicts in this century also involve tension over water privatization and the uncharacterized and unresolved water rights of indigenous peoples. Emerging conflicts at the nexus of water and energy as is presently happening in association with oil sands development and unconventional oil and gas activities in Canada can also be expected (Gosselin *et al.*, 2010).

Tensions are also very high in places where the equitable allocation of limited water is at issue. Bilateral agreements between nations in the Middle East, for example, have not arrived at fair access to precious water supplies. For example, even though the same basin is shared between two countries, Israel uses nearly twice as much water per capita as neighbouring Jordan. On the other hand, Palestinian communities on the West Bank and Gaza have access to only one-tenth of the water granted to Jordan (Zou'bi, 2011). While they may not be the direct cause of conflict, such disparities add fuel to an already tense geopolitical situation.

While tensions over supply and allocation are serious matters in many parts of the world, water scarcity in itself is only one potential trigger for conflict. The greatest threat to water security globally is humanity's growing numbers, which are exacerbating water scarcity widely.

## 3. Water and Population Growth

Most studies cite population growth as the principal driver of increases in the global demand for water. Although there are uncertainties surrounding future population projections, research shows that the world population is likely to grow by 30% between 2000 and 2025 and by as much as 50% between 2000 and 2050 (United Nations Secretary-General's High-Level Panel on Global Sustainability, 2012). At a minimum, the fact that the global population is expected to grow to projections of 9.5 billion by 2050 invites questions as to whether there will be sufficient water to support population increases of this magnitude.

The concern becomes more urgent when it is recognized that nearly all of this growth will occur in developing countries, many of which had inadequate or barely adequate supplies to support population levels that existed in 2000. Researchers Jury and Vaux (2007) showed that in 1995, some 18 countries were deemed water scarce in that they did not have adequate water supplies to meet the basic needs of their population, and 11 more were water stressed in that they did not possess adequate water supplies to meet the needs of all of their people for at least part of the year. The combined population of these 29 countries was over 450 million (Jury and Vaux, 2007).

Jury and Vaux project that the number of water-scarce countries could rise to 29 and the number of water-stressed countries is anticipated to rise to 19 by 2025. The combined population of these 48 countries is estimated to be 2.9 billion (Jury and Vaux, 2007). In addition, economic development is likely to fuel increased demands for water both directly, as in the growth in water-consuming industries, and indirectly, in the form of dietary and other lifestyle changes which tend to be more water consumptive.

A study of 92 developing countries (Vaux, 2012) shows that, as higher incomes drive improvements in diets around the world, as much as an additional 5,200 cubic kilometres may be needed annually for agriculture alone by 2050. Growth of agricultural water demand of this magnitude will put enormous pressure on existing water supplies in many parts of the world, leaving little left to support natural ecosystem functioning or other essential ecosystem services. In short, the picture is almost inescapably one of growing demand matched against static or shrinking supplies.

There is some urgency in responding to this important global trend. It is now recognized that in order to provide water and other benefits to people, nature needs water, too. Water allocated to the environment is critical in supporting the production of ecosystem services and biodiversity. The failure to supply adequate water for environmental services could result in a decline in the capacity of the environment to provide food and to support modern agricultural practices. The continued reallocation of water away from environmental support towards agriculture and other consumptive uses may in fact threaten the carrying capacity of the earth itself.

Unfortunately, however, a full 40% of humanity is already competing directly with nature for water. As a result, we are beginning to see some frightening convergences (Safriel, 2011). If nature is to have the adequate amount of water it needs in order to provide important basic ecological services, then less water will be available for agriculture, which means that there will not be enough food for people. If, on the other hand, priority for water allocation is given to agriculture in order to sustain growing populations, then there will not be enough water to allow nature to sustain its fundamental, long-term, planetary, life-supporting functions and self-regulation.

The resolution of such high stakes trade-offs and the associated conflicts such choices will generate are likely to be very difficult to resolve peacefully, especially given that the demands for water from other sectors and for other uses is not likely to remain static (Vaux, 2012).

Water quality and quantity concerns will become international transboundary political issues as the global agricultural sector tries to achieve the nearly impossible goal of doubling food production while at the same time reducing total water use by 10% by mid-century. The next wars may not be conflicts declared between sovereign states, but undeclared civil wars between cities and surrounding agricultural regions over the timing and extent of allocations.

But water availability will not just affect food production. As has been pointed out elsewhere in this volume, water and energy are also linked. The amount of water available to a given nation will determine its industrial capacity and the quality of life that citizens enjoy as a result of nature receiving the water it needs to make places worth living. Prosperous countries in the future will be those that have enough water for food, cities, industry and nature – and that know how to ensure that each of these gets the amount of water that it needs (Solomon, 2010).

Some observers, like Solomon (2010), have argued that a new world order is about to emerge out of the collision between population and economic growth and our planet's rapidly changing hydrology. Already, he claims, the divide is growing globally between those nations that have adequate water supplies to meet the current and projected needs of their people and the landscapes upon which they live, and those that that are unable to meet these needs on a consistent basis.

This explosive fault-line is likely to widen across the entire 21st century political, social and economic landscape. Tension between water 'Haves' and 'Have-Nots' will grow between those who control upstream water flows and downstream neighbours who do not receive all the water they need for industry and cities. The gap will widen even more between nations that have sufficient water supplies to grow their own food and support their growing populations, and those who do not. As these gaps grow, we should expect greater tension over water in many parts of the world.

## 4. Climate Change and the Loss of Hydrological 'Stationarity'

All these challenges to the current status quo will be compounded in one way or another by climate change, and it will be important for decision-makers to understand why climate change will play such a crucial role. Aside from inducing warmer temperatures, decision-makers will need to grasp exactly how climate change will affect water security.

We have known for some time that hydro-climatic hazards such as droughts and floods have the potential to trigger or exacerbate social tensions that may lead to intra- and inter-state conflict (Vidaurre *et al.*, 2011). While conventional wisdom in water policy circles today has it that growing populations and climate change do not necessarily translate into increased water wars, the same wisdom does not apply to temperature. Higher temperatures have already resulted in lower precipitation in North Africa, for example, and this has led to diminished agricultural production, greater unemployment and growing unrest, especially among younger males. Scientists have modelled the connection between temperature and conflict to demonstrate that conflict increases in lockstep with temperature. When conflict analyses and climate model data were assimilated, they projected a roughly 50% increase in armed conflict by 2030, with almost 400,000 additional battle deaths in Africa alone (Cullen, 2010).

It is not only in already politically unstable regions, however, that climate change is expected to cause economic and social disruptions. To understand why climate change is such a threat to established stability, it is important to understand the central role that water plays in our planet's weather and climate system.

The fundamental threat that climate change poses relates to what hydrologists call 'stationarity'. Stationarity is the notion that natural phenomena fluctuate within a fixed envelope of certainty, and implies stability. It is because of stationarity that we have come to expect that winters will be so cold and summers so hot; that melt from winter snow will always contribute roughly the same amount of water to our rivers; and that rivers will rise so high in the spring and fall so low in autumn. Stationarity suggests that lightening will strike only so frequently, and that tornadoes will occur only at the most extreme margins of the weather conditions we have come to expect. Stationarity provides the certainty that is needed to build houses to withstand winds of a certain speed and snowfalls of a certain weight, and to what size to build storm sewers because history has shown that rainstorms only last so long and only result in so much run-off. Stationarity provides the foundation for the reliable functions of natural ecosystem processes that provide a stable and resilient backdrop to human existence.

By assuming stationarity within a defined range, humankind has been able to create cities in which millions of people live with security, to develop water treatment and delivery systems that provide safe drinking water to billions of people, and to develop transportation systems that allow many people to travel anywhere in the world within a day. But the statistics and the standards upon which these were based to create these modern miracles no longer apply. What is happening now is that increased temperatures are altering the patterns of movement of water through the global hydrological cycle. This means that the statistics from the past related to how surface, subsurface and atmospheric water will act under a variety of given circumstances, and on which we have come to rely, are no longer reliable.

While it is well known that climate changes naturally over time, we have enjoyed a relatively stable period over the last century. As a society, we have been lulled into complacency by this relative stability. During this period, we established our own idea of the limited range of natural climate variability that we believed exists, and then built our society and the vast infrastructure that supports it around that range. Our risk assessments were also built on these same notions of relative stability that may now no longer exist. This mistake has made societies vulnerable, and this vulnerability is now being compounded by climate change. The warming of our climate has altered the fixed envelope of certainty within which we anticipated natural phenomena to fluctuate, the result of which we are seeing through increased droughts, floods and other extreme climatic events affecting the way we live.

As of yet, there is no adequate replacement for stationarity statistics. Until a new way is found for substantiating appropriate action in the absence of stationarity, risks will become increasingly difficult to predict or to price.

## 5. The Potential for Conflict and the Exploding Time Bomb

Changes in fundamental hydrology are likely to cause new kinds of conflict, and it can be expected that both water scarcity and flooding will become major transboundary water issues. At present, it is estimated that perhaps 25% of the world's major river basins run dry for part of each year (Solomon, 2010). New conflicts are likely to emerge as more of the world's rivers become further heavily abstracted so that they no longer make it to the sea. The prospect of the kinds of floods that were witnessed in Pakistan and Australia in 2010 and on the Great Plains of North America in 2011 suggests that the destruction of upstream flood protection and the failure to provide adequate downstream flood warning will enter into global conflict formula in the future. But is it not just floods that are likely to cause conflict. Prolonged drought as was experienced in the Horn of Africa in 2011 suggests that tensions will rise on both ends of the hydrological scale.

What this changing hydrology signifies is that it is unwise to take too isolated a view of what the anticipated impacts of climate change will be or mean. In Canada, the thinking surrounding climate change remains linear: many still think the effects of climate change will be local, minor and cumulative. In fact, it will not be long before climate change affects everyone, everywhere, simultaneously compounding every regional economic, social and political disparity. As this happens, it can be expected that the potential for general tensions and conflict over water will rise.

What humans have collectively done over time is to have quite accidentally – unwittingly, in fact – created a hydro-climatic time bomb. The bomb has already started to tick, but no one knows when it will go off. In order to avoid conflict, society needs to come up with solutions to quickly defuse this increasingly alarming situation.

One immediate partial solution to this problem is water conservation. It is widely accepted that water, energy and climate are linked. This realization suggests that head-turning economic benefits can accrue to governments and the people they serve by way of water conservation. However, in many parts of the developed world, wasteful water use is still accepted and encouraged as a social norm. At enormous public cost, water infrastructure has been overbuilt in order to support this wasteful norm. However, it has now become apparent that we cannot afford to maintain and replace the overbuilt infrastructure that supports this waste, which increases the risk of public health threats and leaves societies in a very vulnerable position.

It has become apparent that enormous amounts of energy are wasted treating and moving water. The cost of energy is rising and cities are discovering that they can't afford to spend up to 60% of their municipal energy budgets to move water to where it is being used profligately. In addition, there is the realization that this wasted energy for the purpose of wasting water is accelerating climate change, which in turn is accelerating damage to the infrastructure that cities can't afford to maintain or replace.

This has, unwittingly, created a positive climate change feedback loop – an obviously vicious circle that is simultaneously bankrupting societies while compounding climate change effects. This cycle will accelerate until improved water conservation measures are implemented and practiced by society at large, and a sense of responsibility and ownership are undertaken for securing water for the future.

The increase in the severity and number of storms has already been noticed by the industry. Insurers are particularly worried about the rapidly increasing rate of water-damage claims (MacGregor, 2011). In a special report on managing the risks of extreme events and disasters, the Intergovernmental Panel on Climate Change echoed the concerns of the insurance industry, claiming in addition that extreme weather events will have greater impacts on sectors with closer links to climate, such as water, agriculture and food security, forestry, health and tourism (IPCC, 2012). The report also went on to point out that opportunities exist to create synergies in international finance for disaster risk management and adaptation to climate change, but that these have not yet been fully realized (IPCC, 2012).

The wastefulness of some developed countries with respect to water and related energy use puts into relief the challenge we face in supplying water to the 1 billion people on earth who do not have a safe and reliable daily supply. It also speaks to the challenge of serving the additional 2 billion people on this planet who do not have daily access to adequate sanitation. Industry examples suggest that for every dollar saved in water use in the developed world, as much as four dollars more is saved on chemical, electricity and energy costs (Fishman, 2011). If such savings could somehow be directed in part towards water infrastructure development in the developing world, the improvements in human well-being would go a long way in reducing the potential for conflict over matters of water supply and quality in the future.

## *Conclusion*

There is a sense now of what is ahead. The loss of stationarity that is occurring is likely to be far more costly than what has ever been projected. But, because of the recent economic meltdown, societies and governments now find themselves in a situation in which economic recovery cannot be sustained if climate change mitigation is pursued too rapidly. This adds yet another level of vulnerability to the already substantial list of potential areas of conflict over water security: the 1 billion people without access to safe, reliable water supplies; the 2 billion people without adequate sanitation; the serious issues related to how much water will be needed to feed growing populations; the growing number of rapidly expanding mega-cities; the layer of contention related to growing transboundary water issues; and, the expected changes that will result in a warmer climate. From this, take away all the polluted water that is now unfit for other use and the amount of water that will be needed to produce energy and food, and support industry and growth. The results point unerringly in the direction of greater conflict over water.

Fortunately, we know that solutions exist, and we are employing many of them. More than ever, our global strategy makes sense. To avoid future conflict, we need to get to the root of the problem, and the goal must be to provide water security for the poor – everywhere. We must extend coverage of potable water and sanitation to all, and concentrate on improving its reliability for all. Even in difficult economic times, we must recognize the high economic, social, environmental, health and political costs of failing to do so.

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# 1.2 Water Impacts on Energy Security and Reliability

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## Introduction

Water is an integral part of energy development, production, and generation. Water is used directly in hydroelectric power generation and is used extensively for thermoelectric power plant cooling and air emissions control. Water is also used extensively in energy-resource extraction, refining, and processing, as well as for energy resource transportation. Therefore, as global energy consumption continues to increase, to as much as 50% by 2030, the demand for water supplies and resources to support this growth will also increase. This will place the energy sector into greater competition with other water users for already limited freshwater resources in many regions of the world. This competition for water resources will impact future energy development and could have significant impacts on energy reliability and energy security in regions around the globe.

## 1. Developing Trends in the Water-Energy Nexus

While the issues of the interdependencies between energy and water were highlighted in initial studies in the United States (DOE, 2007), concerns over energy and water security and reliability are being recognized worldwide by energy officials, energy and water managers, and the scientific community. For example, the World Economic Forum published a report in early 2009 discussing concerns about water demands for energy and the potential global impacts that could occur to long-term energy availability, reliability, and security (WEF, 2009). Likewise, the World Energy Council in September 2010 published a report on *Water for Energy*, highlighting "[i]n recent decades, the combination of more users, with more uses of water, has transformed the traditional water-energy ladder that underpins all human, social, and economic development into an escalator" (WEC, 2010: 4). As nations try to balance the demands and availability of water resources to support human health and economic development in the coming decades, it is clear that the water footprint, like the carbon footprint, will become an increasingly critical factor influencing nations as they consider future energy system, resource, and technology approaches to better support secure, reliable, and sustainable energy development worldwide.

Unfortunately, the current trends in energy development could significantly increase, rather than decrease, the water footprint. The projected water demands for electric power generation needed to meet carbon emission goals, especially for current carbon reduction, capture, and sequestration technologies, are twice as intensive in terms of water use and consumption as typical electric power generation technologies. Likewise, the trend towards the use of alternative transportation fuels – such as biofuels, oil shales, oil sands, coal-to-liquids, and hydrogen – to reduce fuel imports in many regions, can be anywhere from three to ten times more water use intensive than traditional fossil fuels. If irrigated agriculture is used for biofuels, the water use intensity per gallon or litre of fuel can increase by over 600 times. Also, the water use for hydraulic fracturing of gas shales for the development of new natural gas supplies can exceed 5 million gallons (20 million litres) of water per well. Therefore, the current trend in the utilization of energy resources that will significantly increase water use and consumption will intensify competition for already limited freshwater resources in many regions of the world.

While many of the efforts noted are being considered as a way to increase the utilization of local domestic energy resources, reduce energy imports and carbon footprints, and improve energy security, in reality these solutions will negatively impact water availability and actually reduce future energy reliability and security. Therefore, technology and energy system improvements and innovative energy supply and resource utilization approaches are needed that will reduce the freshwater footprint and overall water use of both current and emerging energy resource utilization and development options. The water-related energy concerns and improving regional energy reliability and security can be addressed in a number of ways, including by: developing additional surface water storage infrastructure and groundwater supplies; transferring water from the agricultural sector or from different regions; improving water conservation and water use and reuse efficiency in the energy and other industrial and domestic sectors; improving and integrating water and energy planning; or, by using non-traditional water resources, such as saline and wastewater, to offset freshwater use.

To provide a general overview of the relative scale of the emerging energy and water interdependencies and resulting security issues in many regions across the globe, emerging energy-water issues and challenges in the United States and recent efforts to assess potential energy and water conflicts are highlighted in this paper. Also presented are some of the major directions identified in a series of regional workshops in the United States with over 500 water, energy, industry, environmental, regulatory, and economic development professionals to reduce the water footprint of the energy sector, and reduce the impact of future competition over water resources and the impact of water shortages on energy reliability or security.

# 2. Emerging U.S. Energy-Water Issues and Challenges

In 2005, the U.S. Congress funded the Department of Energy to prepare an energy-water report to Congress[1] to identify and quantify emerging energy and water challenges and interdependencies, and to conduct a series of regional workshops to identify the science and technology needed to address and reduce the identified emerging energy and water challenges. Both efforts were coordinated by Sandia National Laboratories with support from all the U.S. national laboratories, the U.S. Department of Energy, and from an external advisory board composed of federal water agencies including the U.S. Geologic Survey, the Bureau of Reclamation, the U.S. Environmental Protection Agency, energy and water research agencies such as the Electric Power Research Institute, the Water Research Foundation, and the Water Reuse Foundation, the University of New Mexico's Utton Center (a transboundary water law center), and indigenous groups. The information collected from both efforts is available on the Sandia web site at www.sandia.gov/energy-water.

As identified in the U.S. energy-water report to Congress, over 50% of current daily water withdrawals in the U.S. and about 25% of all current daily non-agricultural freshwater consumption are for energy-related uses (DOE, 2007). As the population and economy of the U.S. grow, the demand for both energy and water are also expected to grow. While the water needs to meet the growth for electric power generation and production of transportation fuels will depend on the type and number of power plants built, cooling technologies used, air and carbon emissions capture and sequestration requirements, and the type and quantity of alternative fuels used, estimates suggest that water consumption in the energy sector could grow by a factor of three to four by 2035, increasing from about 4.3 billion gallons of water per day (BGD) (17 billion litres per day) in 1995, to about 12-15 BGD (47-60 billion litres per day) by 2035 (Pate, 2007; NETL, 2008). This would make the energy sector the largest non-agricultural water-consumption sector in the U.S.

The projected growth in water demand for energy generation and development over the next two decades will occur at a time when the nation's freshwater supplies are becoming increasingly stressed. These water issues were summarized in a U.S. General Accountability Office report on water availability:

> *"National water availability and use has not been comprehensively assessed in 25 years, but current trends indicate that demands on the nation's supplies are growing. In particular, the nation's capacity for storing surface-water is limited and groundwater is being depleted. At the same time, growing population and pressures to keep water in stream for fisheries and the environment places new demands on the freshwater supply. The potential effects of climate change also create uncertainty about future water availability and use"* (GAO, 2003: 1).

Figure 1 summarizes the results of a survey of state water managers in the U.S. showing a general, nation-wide, concern about future water shortages by 2013 under average water supply conditions (GAO, 2003). According to the GAO survey, 36 of the 47 states responding expect some portion of their state to experience shortages under average climate conditions by 2013 (GAO, 2003). Water managers indicated that their states were vulnerable to shortages because: they did not always have the infrastructure to store and distribute water when and where it was needed; they are relying more on groundwater supplies that are being depleted; or, because population growth has outpaced existing water storage and delivery capacity in some regions of their states.

The data in Figure 1 highlight the growing concerns over freshwater supplies in the U.S., and suggest that water problems are no longer just a concern in the southwestern U.S. but that they have become a national concern. While the data in Figure 1 shows a growing national concern about water supplies, even more important might be the impact of drought conditions on water supplies and impacts on energy development. Figure 2 is a map of the nominal periods of severe and extreme drought in the U.S. by region for 1895-1995 using the Palmer Drought Severity Index (PDSI), prepared by the U.S. National Drought Mitigation Center, and is available online[2].

[1] U.S. Department of Energy, 2006. *Energy Demands on Water Resources*. Report to Congress on the Interdependency of Energy and Water.

[2] See: http://drought.unl.edu/Planning/Monitoring/HistoricalPDSIMaps.aspx.

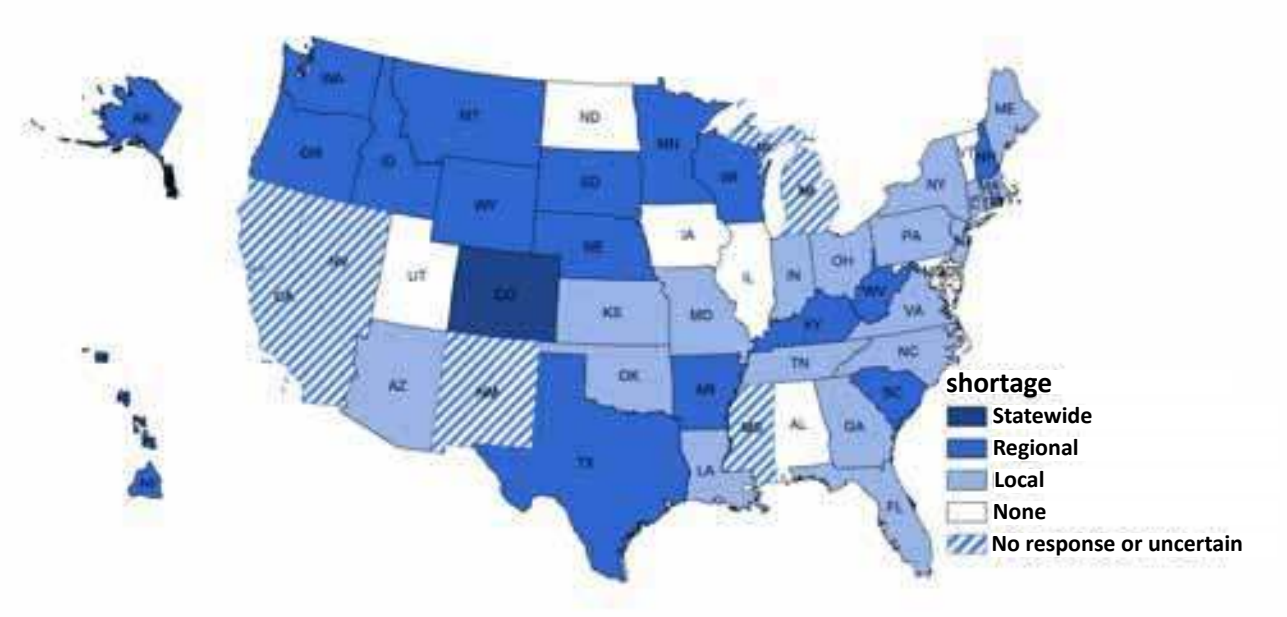


*Figure 1. States with expected water shortages by 2013 under average climatic conditions (GAO, 2003).*

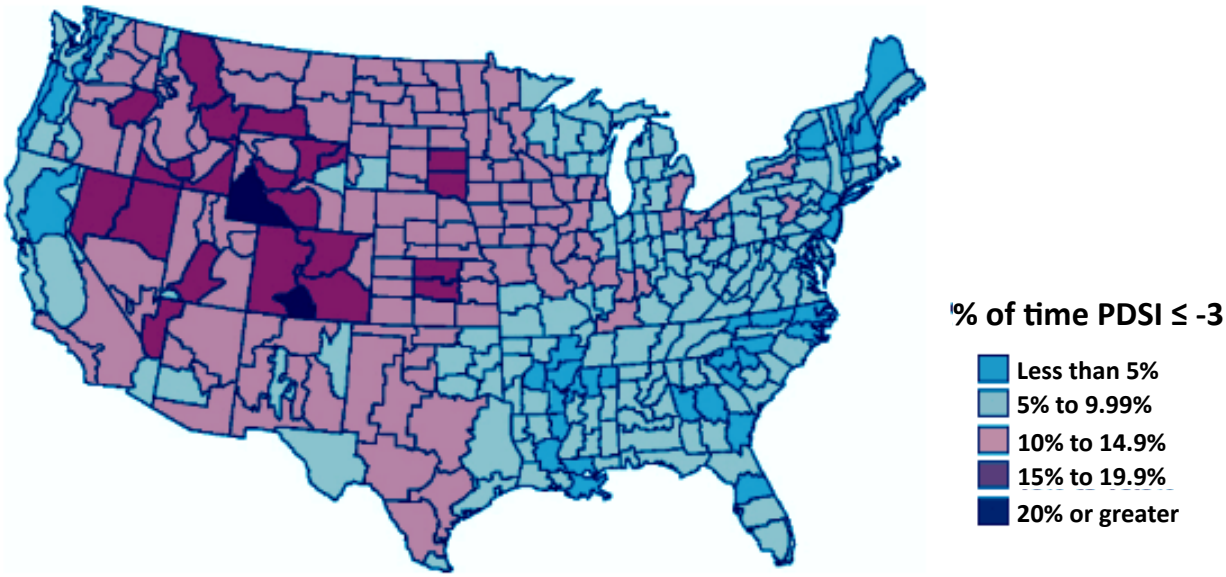


*Figure 2. Percentage of time watersheds in severe or extreme drought 1895-1995 (National Drought Mitigation Center, 2012).*

The data in Figure 2 suggest that severe to extreme drought is likely to occur from 10% to greater than 20% of the time in much of the western U.S., and occur 5%-10% of the time in much of the eastern U.S. This means that in many places, droughts will occur once every 5 to 10 years, which will put even greater stress on water resources than identified in Figure 1. According to the GAO study (2003), the water shortage effects are expected to broaden under drought conditions, with 46 of the 47 state water manager respondents suggesting that their states are expected to experience water shortages under drought conditions. In 40 of those states, the projections were for regional to state-wide water shortages, this despite many efforts in place to prepare for these shortages. These results suggest that the competition for increasingly limited water resources in many parts of the U.S. will not only will be exacerbated by droughts, which are quite common, but will likely impact current and future regional energy developments and therefore negatively impact current and future energy supply reliability and security.

These projections have played out in three recent major regional U.S. droughts. The first example was a drought in the northeastern U.S. from Maryland through New York in 2006 and 2007, where the drought impacted water availability for many power plants. While that drought was relatively short-lived and local in extent, the concern about water availability for electric power made many river basin management authorities, such as the Susquehanna River Authority, reassess water management, supply, and priority options as they relate to energy generation.

A second example with a more acute concern was the 2007-2008 drought in the southeastern U.S., covering states from Florida to Mississippi and up through Georgia and Tennessee. As highlighted in Figure 3, during that drought, 24 of the 104 U.S. nuclear reactors were in danger of having to shut down or curtail power production because of the lack of cooling water or low cooling water intake levels as a result of major surface water supply shortages.

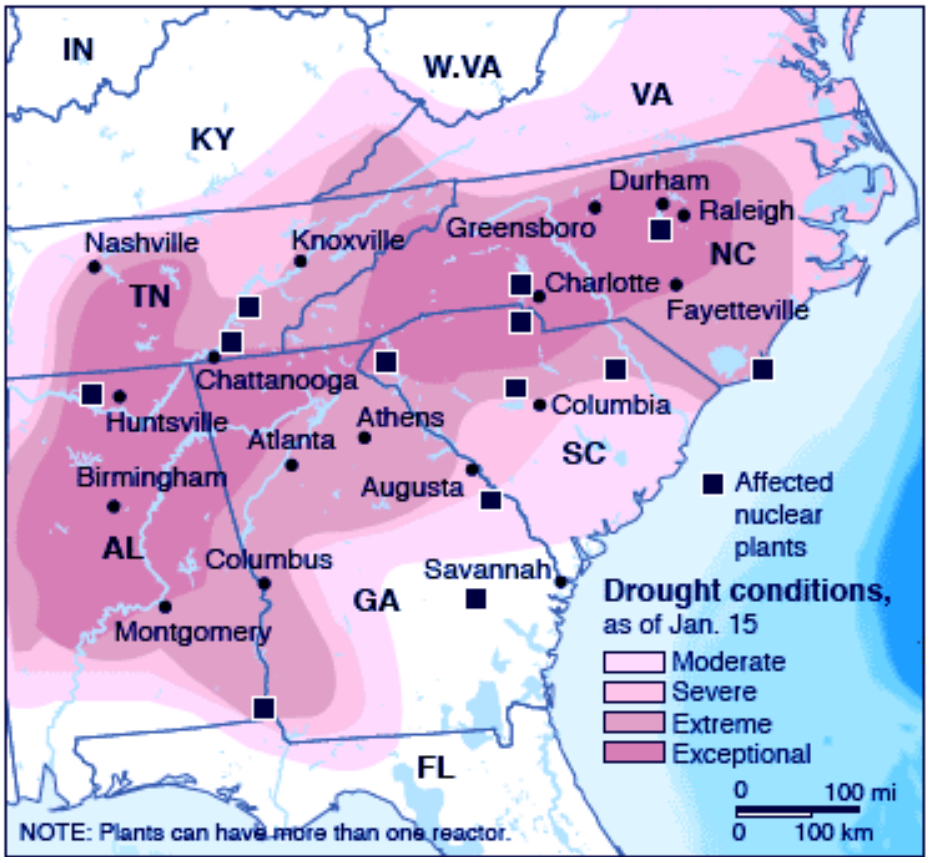


*Figure 3. Nuclear power plants impacted by cooling water availability in January 2008 during the drought in the southeastern United States (Associated Press, 2008).*

In the end, only a few nuclear power plants were directly impacted before a hurricane brought much needed rainfall to the whole region. But concerns over water supply availability and reliability for the next drought, which is sure to come, is a nagging concern, especially in this region where significant population and industrial growth is expected, which will continue to increase competition for limited water resources.

A third example is the current 2011-2012 drought in Texas. This drought is currently of epic proportions in a state that is accustomed to drought conditions. If the current drought conditions continue through March 2012, Texas will have to consider reducing power production in up to 15 power plants because of the lack of cooling water. If additional precipitation does not occur by June, and current climate forecasts indicate that they will not, then Texas will likely have to curtail power production at as many as 30 power plants because of the lack of cooling water supplies. This concern is compounded by the fact that Texas essentially has its own, independent regional grid that is minimally linked to other states which prevents it from being able to import sufficient supplies of electric power to minimize power outages. Additionally, these reductions in electric power production will come at the time of peak power demand for Texas, during the hot humid

summer months. To alleviate the concerns over water supplies and their impacts on energy supply, water managers may be required to take draconian measures on the distribution of water resources which will have significant social, health, and economic impacts on Texas and its neighbouring states.

Another type of energy and water example, although not related to electric power generation, is the emerging interest is natural gas from gas shales. The potential natural gas supplies estimated from shale resources is staggering, with estimates of reserves suggesting that North America may have upwards of a 100-year supply of natural gas, and with other regions of the globe having equally large potential reserves. Currently, the ability to access these natural gas supplies requires the use of horizontal drilling and hydraulic fracturing of the shale, technologies that have been developed and used extensively over the past 30 years. A major concern of gas shale development however is the ability to identify renewable and sustainable water supplies for the hydraulic fracturing process, since anywhere from 2-6 million gallons (8-24 million litres) of water are required for the hydraulic fracturing in each well (Mantell, 2009). Also, the water recovered after fracturing can be extremely high in salts, presenting not only water quantity but also wastewater quality concerns. In regions with readily available supplies of water, extensive gas shale development might not be a major issue, but in areas with water supply concerns, essentially those states highlighted in Figure 1 with regional water issues, gas shale development will be a new competing demand for already limited water supplies. With the interest in natural gas as a lower carbon technology applicable for use in both power plants and as a transportation fuel, there could be significant economic and environmental pressure to accelerate gas shale development, at the expense of other competing water demands.

## 3. Addressing U.S. Energy-Water Challenges

While the U.S. energy-water report to Congress focused on identifying emerging challenges and concerns overs U.S. energy and water interdependencies, the regional workshops focused on energy and water needs from a broad spectrum of disciplines, and identified research efforts needed to minimize future conflicts between energy and water development and foster more reliable and sustainable use of these two very important natural resources. More than 500 participants representing federal, state, local and tribal water and/or energy agencies, water and energy managers, water and energy utilities and industrial associations, environmental groups, technology developers, and academia from across the U.S. participated in the energy-water workshops that took place between November 2005 through May 2006. Based on these workshops, three major directions to address the emerging challenges of the energy and water interdependencies were identified. A short overview and summary of the energy research needs and directions suggested have been published by Sandia (Pate *et al.*, 2007), and presented in additional summary papers (Hightower, 2010a and 2010b; Hightower and Pate, 2011) for various technology areas. The three major science and technology research and development directions identified from the workshops are summarized below.

- ***Reduce freshwater use in electric power and transportation fuels development.*** Several renewable energy technologies and alternative cooling approaches for thermoelectric power plants exist that could reduce water consumption for electric power generation. Improving dry, hybrid, and other alternative cooling technologies and carbon sequestration approaches could lower future water consumption. Likewise, research to address the issues limiting implementation of renewable energy technologies that have low water use, such as electric grid integration, cost, and dispatchability, could accelerate their use, reducing both water consumption and carbon emissions which are important system-level operational requirements. Finally, since virtually all alternative transportation fuels currently being considered will increase freshwater consumption, any major scale-up of alternative transportation fuels must consider approaches that use less fresh water and improve water use efficiency in growing, mining, processing, and refining future fuel resources. Also, opportunities to reduce the use of water, the use of non-fresh or wastewater or recycled water for gas shale development will be a major opportunity in many areas.

- ***Develop materials and water treatment approaches to enable non-traditional water use in energy generation and refining.*** With limited freshwater supplies, wastewater reuse and non-traditional water use including sea water, brackish groundwater and produced water, could be increased to meet water demands in many sectors. New water treatment technologies will be needed that can meet the water quality requirements at much lower energy use. Improvements in materials that minimize fouling would reduce the need for higher quality waters, significantly expanding opportunities to replace fresh water with lower quality waters. A wide range of technology improvements in organics removal, bacterial treatment and disinfection, reduction of membrane

fouling, and improvements in salt removal and concentrate management and reuse, are areas where technological improvements could significantly reduce energy use in water treatment and pumping, as well as accelerate the use of non-traditional water resources by the energy sector.

- ***Improve water assessment, and energy and water systems analysis and decision tools.*** Compounding the uncertainty of available water supplies is a lack of data on water consumption. Without water consumption data, it is impossible to accurately determine resources available for use. Improved water data collection, better water monitoring and sensors, and improved assessment of non-traditional water resources are needed to effectively quantify our water resources. Also, improved decision support tools and systems analysis approaches are needed to help communities and regions better address emerging challenges for the demand and availability of natural resources such as energy, water, land, and environment. Tying improved water availability data with decision support and planning tools would improve collaboration on energy and water planning and support system-level solutions that can improve energy reliability while at the same time reducing freshwater consumption.

## Conclusions

While the final report on the energy-water research priorities for the next decade for the U.S. Department of Energy has not yet been published, the data presented in the Pate report (2007) does provide a reasonable overview of the global energy and water research directions and technology improvements needed to reduce the water footprint of future energy development in the U.S. Similar energy and water challenges and research needs have been identified and highlighted in recent studies in many countries and regions including Canada, Australia, Europe, and Asia (WEC, 2010; WEF, 2009; Kenway *et al.*, 2009). As nations try to balance the demands and availability of water resources to support human health and economic development in the coming decades, developing technologies and approaches that reduce the water footprint of the energy sector will become an increasingly critical factor in maintaining national, regional, and global energy reliability, security, and sustainability.

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# 1.3 Water and Enviromental Security: Supporting Ecosystems and People

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## Introduction

Water, economic and environmental security are inherently interconnected. Human life is intimately linked to, and utterly dependant on, the functions and services provided by freshwater ecosystems. Safe, reliable water supplies, flood protection, commercial and subsistence fisheries, cultural and spiritual values – the very foundations of economic development and human well-being – all depend on maintaining the integrity of the planet's aquatic ecosystems.

Yet there is a paradox in this interconnectedness. The current pace and scale of human development is altering the hydrological cycle in ways that has eroded the capacity of ecosystems to provide life-sustaining functions and services. Rivers that for centuries ran from source to sea now run dry in many years due to damming, diversion and depletion of water resources. In many areas, groundwater extraction is occurring at rates that exceed replenishment. In the face of rising water demands for energy, agricultural, industrial and social development, securing sufficient water to sustain the life-supporting functions and services of the world's rivers, lakes and wetlands is among the most significant challenges of the 21st century.

## 1. Water and Environment in the Anthropocene

In 2011, the world's population reached 7 billion people. Global economic output in 2010 was estimated at approximately US $63 trillion per year (World Bank, 2012). This scale of development is directly linked to humans' increasing hydrological ingenuity – the ability to manage and manipulate freshwater resources and ecosystems to meet society's needs and desires for food and fibre, energy, and urban growth and industrialization. In 1950, there were 500 large dams on the planet; today, there are over 45,000. This translates to an average of two large dams constructed every day for half a century (Postel, 2010). What's more, the amount of water impounded behind dams and other structures has quadrupled since 1960. In the same period, withdrawals of water from surface water sources have doubled (Waughray, 2011). Globally, approximately 3,800 $km^3$ of fresh water is extracted from aquatic ecosystems per year (Boelee, 2011); that is enough water to keep the Nile River flowing for approximately 43 years. More than half of this water is not returned to the watersheds from which it was withdrawn; it is either diverted elsewhere via canals and pipelines, or lost to evaporation (Balmford *et al.*, 2008).

Reflecting on this massive transformation and re-engineering of the planet's aquatic environment, Meybeck (2003) claimed that the global freshwater cycle has entered the Anthropocene[1]. Indeed, humans are now the dominant force driving the earth's hydrological cycle, altering global-scale river flow and hydrological processes including the patterns, intensity and timing of precipitation and evaporation (Rockstrom *et al.*, 2009). Nearly 60% of the world's major watercourses have been dammed (UNEP, 2010). When combined with massive and growing withdrawals from surface and groundwater sources, the impacts are striking. It is estimated that 25% of the world's river basins run dry before reaching the oceans (Molden *et al.*, 2007). Globally, freshwater biodiversity has declined 35% since 1970, a greater rate of decline than observed in terrestrial or marine ecosystems (WWF, 2010).

## 2. Water Scarcity and Ecosystems: Crisis and Competition

These global trends are the product of myriad local and regional water crises. Increasingly, communities, industry and agriculture are seen to be in competition with nature for finite water supplies. The shrinking Aral Sea in Central Asia is one of the best recognized examples of this crisis and competition. Once the world's fourth largest inland body of water, the Aral Sea has lost 80% of its water since the rivers that feed it, the Amu Darya and Syr Darya, were diverted to provide irrigation water for a burgeoning cotton industry. Where there was once a thriving, productive ecosystem that supported prosperous fishing livelihoods, there is now a parched inland seabed dotted with rotting and rusting ships. The Colorado River provides a similar cautionary tale. Over-abstraction of water resources and a vast system of dams and diversion infrastructure have radically reduced and altered natural river flows. What was once one of the world's great desert river deltas has shrunk from nearly 1.5 million to 150,000 acres, and biological productivity, including a once flourishing fishery, is currently estimated at one-fifteenth of its former capacity (UNEP, 2010).

[1] The Anthropocene is a proposed new geological epoch marked by the moment at which humans became the dominant driver of change to Earth's system (Steffen *et al.*, 2007).

The Aral Sea and Colorado River are just two of a growing number of water crises illustrating that, for much of the 20th century, an important stakeholder has been left out of the water security dialogue: nature. Development of water resources has progressed with little attention to assessing and addressing the water required to sustain the integrity of freshwater ecosystems, or what is commonly referred to as environmental flow. Environmental flow refers to the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems (Brisbane Declaration, 2007). The concept is founded on the recognition that the natural variability of freshwater flows is the 'master variable' underpinning aquatic ecosystem health, and that there are limits to the extent to which these patterns can be altered before aquatic ecosystems become compromised (Hirji and Davis, 2009; Postel and Richter, 2003; Poff *et al.*, 1997).

Global water scarcity assessments, which have traditionally focused on the relationship between water availability and human water demand, are evolving to better incorporate ecological water requirements (Smakhtin *et al.*, 2004; Hoekstra *et al.*, 2012). Applying a new approach that incorporates ecological water requirements, Hoekstra *et al.* (2012) categorized water scarcity from low to severe on a monthly basis for over 400 river basins that together account for 69% of global run-off, 75% of the world's irrigated area, and 65% of world population. Comparing human water use to estimated ecological water requirements on a monthly rather than on an annual basis provides a clearer picture of the realities of water scarcity and security because it better reflects the natural dynamic character of the hydrological cycle, and the variability in human water use over the course of a year.

In 50% of the basins studied, it was found that there was severe water scarcity during at least one month of the year, impacting approximately 2.7 billion people (Hoekstra *et al.*, 2012). In 35 of the basins, there was severe water scarcity for at least half of the year, impacting almost 500 million people. Clearly, increasing incidences of local water crises will add up to water scarcity and ecosystem impacts on a global scale.

Government water policies around the world are evolving to address and avert these crises by better incorporating environmental flow considerations into water allocation, river basin planning and hydropower developments. However, while governments and water management agencies are making some progress in developing policies and laws to recognize environmental flow needs, so far progress has typically remained at the stage of policy and debate rather than implementation (Le Quesne *et al.*, 2010).

## 3. From Crisis and Competition to Harmonization

The challenge of water security is to move beyond crisis and competition to a situation where the water requirements of people and those of the natural environment are harmonized (UNEP, 2010). This is now being reflected in most contemporary definitions of water security. For example, de Loë and Bjornlund note that "water security exists when sufficient water of good quality is available for social, economic and cultural uses while, at the same time, adequate water is available to sustain and enhance important ecosystem functions" (de Loë and Bjornlund, 2010: 43). According to a recent UN report, "[w]ater security represents a unifying element supplying humanity with drinking water, hygiene and sanitation, food and fish, industrial resources, energy, transportation and natural amenities, all dependent upon maintaining ecosystem health and productivity" (UNEP, 2009: 47). The decision is not about providing water for nature or people; it is a matter of satisfying both: water for nature is water for people. Translating this principle into water management practices will require a greater recognition of the value of ecosystem goods and services to human well-being and a framework to ensure adequate environmental flows are provided to sustain these goods and services over the long term.

### 3.1. The Value of functioning aquatic ecosystems

Healthy freshwater ecosystems provide some of the largest ecosystem contributions to human welfare. The wide range of goods and services they provide include: provisioning services, such as water supplies for irrigation, industries, cities, and homes, wood and fibre, and fish, waterfowl, mussels, and other foods; regulating services, such as flood mitigation, pollution dilution, water purification, groundwater replenishment and sediment transport and retention; cultural services, such as recreational opportunities and aesthetic and spiritual values (e.g. rivers and their landscapes being icons of cultural and religious heritage); and, supporting services, such as nutrient cycling, primary production, habitat provision, and biodiversity maintenance (Arthington *et al.*, 2010; Postel and Carpenter, 1997).

Economic analyses of ecosystem goods and services are an increasingly common tool for informing decisions about water resources development and aquatic ecosystem conservation. Globally, the value of ecosystem goods and services provided by wetlands has been assessed at US $15 trillion in 1997 (MA, 2005). At a regional scale, the value of ecosystem goods and services provided by the wetlands of the lower Danube River in Romania and Bulgaria, for example, has been estimated at € 250 to € 1,354 (US $348 to US $1,883) per hectare[2]. This includes a range of goods and services including fish, reeds and crops, water purification and regulation (e.g. flood management) as well as recreation and tourism (Tucker *et al.*, 2010). Similarly, it is estimated that the ecosystem services provided by lakes and rivers in Canada's Mackenzie River Basin have a value of CAD $189 billion per year (Anielski and Wilson, 2010).

Economic considerations also expose the benefits, and the real costs, of restoring aquatic ecosystem integrity. For example, a study concluded that restoration of the Laurentian Great Lakes – the world's largest freshwater ecosystem – would lead to direct economic benefits of US $6.5 to US $11.8 billion from tourism, fishing, and recreation (Austin *et al.*, 2007). Lessons from Australia paint a stark picture of the cost of returning water to an overdrawn ecosystem, where AUD $8.9 billion has been allocated to restoring environmental flows in the Murray-Darling basin by returning 2,750 gigalitres of water to the river by 2019, including AUD $3.1 billion to purchase water licenses back from water users (MDBA, 2011; Australian Government, 2010)[3]. This illustrates, quite clearly, the benefits of preventive and precautionary approaches to water policy that explicitly recognize the value of securing water for nature while also allowing for it to meet the needs of society for development.

## *3.2. Sustainability boundaries: Securing nature's water needs*

The sustainability boundary concept provides a framework for securing the water required to sustain the functions and productivity of freshwater ecosystems (Postel and Richter, 2003). Figure 1 illustrates how the concept was derived. As water use and related impacts increase over time, demands on aquatic ecosystems approach limits that, if surpassed, will erode their capacity to deliver valued ecosystem goods and services. Under this approach, ecosystem integrity is a central focus and an explicit goal of freshwater policy and management. When the sustainability boundary is reached, water withdrawals and further alteration of flows must cease in order to sustain ecosystem functions and productivity. In contrast, traditional approaches to water management tend to focus almost exclusively on the role of fresh water as an input to economic production, with water demands for agricultural and industrial activities, municipal water supplies and hydropower generation taking priority over the role of water required to support ecosystem functioning and productivity.

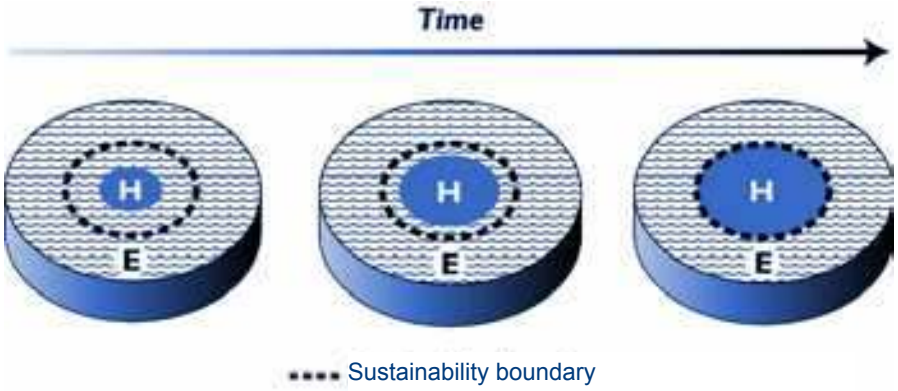


*Figure 1: Sustainability boundary concept (Postel and Richter, 2003: 39).*

To translate the sustainability boundary concept into operational water management, Richter (2010), drawing on the science of environmental flows, proposed a boundary-setting approach that reflects the natural dynamics of the hydrological cycle. The intent is to specify limits aimed at better harmonizing human water uses with the natural variability of freshwater flows. In an effort to further advance implementation of sustainability boundary approaches, Richter *et al.* (2011) proposed a presumptive standard for environmental flow protection. While the science of environmental flows is well

[2] Note: US dollars based on 7 March, 2011 exchange rate of 1 EUR = 1.39 USD.

[3] The remaining AUD $5.8 billion is allocated to programmemes aimed at improving irrigation and water management infrastructure.

developed, issues of cost, time and access to scientific expertise are major limitations to the widespread implementation that is desperately needed to protect and restore the planet's aquatic ecosystems. The presumptive standard approach provides quantitative targets for sustainability boundaries as percent deviations from natural flow conditions. A high level of ecological protection is provided when flow alterations are maintained within 10% of the natural flow; a moderate level of protection is provided when flow alterations are maintained within 10-20% of natural flow; and, moderate to major changes in ecosystem integrity are to be expected if alterations to natural flow exceed 20% (see Figure 2). The approach, considered to be conservative and precautionary, is proposed as an interim measure to streamline and expedite environmental flow assessment, while maintaining scientific credibility, until a more in-depth study can be undertaken.

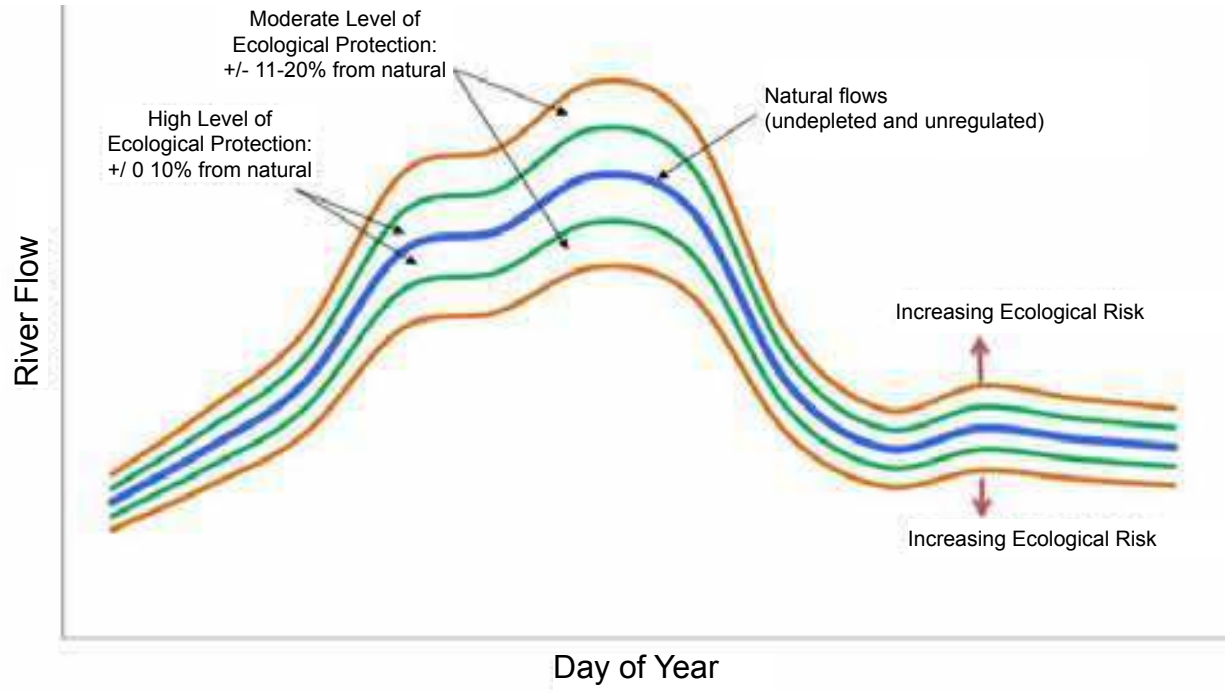


*Figure 2. The Sustainability Boundary Approach (SBA) incorporating the presumptive standards for environmental flows (Richter et al., 2011).*

## 4. An Implementation Agenda

Global water analyses have advanced to reflect both human and environmental water security. Water policy in many countries, such as Mexico, South Africa and Australia, is evolving to better address environmental flows and aquatic ecosystem integrity (Le Quesne *et al.*, 2010). But the ultimate success of these efforts will be reflected in the actual preservation and restoration of the integrity, productivity and resilience of the planet's aquatic environment. Realizing success will require a sustained effort to move from assessment and policy development towards a global implementation agenda. It is proposed that such an agenda be framed by three overarching objectives:

- ***Conserving the planet's remaining functioning freshwater ecosystems.*** Only one-third of the world's 177 large rivers – those over 1,000 km in length – remain free-flowing from source to mouth, unimpeded by dams and other obstructions. Only 21 retain a direct connection to the sea (WWF, 2006). Protecting the planet's remaining strongholds of freshwater biodiversity and ecosystem functioning is a critical, but often overlooked, aspect of global water and environmental security. There is a growing need to identify priority areas for freshwater ecosystem conservation and strict 'No-Go' zones where disruptive infrastructure such as dams and diversions and large-scale water withdrawals should be prohibited. Some important questions that need to be addressed include: which remaining rivers or river stretches should be kept free flowing; which remaining native wetlands should be maintained in a largely undisturbed condition; and, what extent of freshwater coasts should be protected from major development.

- ***Managing for sustainability.*** Despite significant negative impacts on aquatic ecosystems globally, in many areas there still remains a significant opportunity to set sustainability boundaries before they are surpassed. It is much less costly and far less controversial to establish sustainability boundaries before crises, conflict and the need for costly mediation processes arise. The presumptive standard approach provides a low-cost, science-based and precautionary approach for taking action. Further, establishing sustainability boundaries can be a driver for sustainable economic development by creating incentives to improve water productivity – to derive more economic and social benefits from the water available within the sustainability boundary – which will, in turn, spur innovation and economic development in the water technology and management sectors.

- ***Restoring what has been lost.*** Where ecosystems have been degraded, re-establishing the production of ecosystem goods and services may be possible and will depend upon the capacity for and feasibility of restoration efforts. Ecosystem restoration is a component of a broader notion of a restorative economy in which employment opportunities and wealth generation are the result of society's efforts to restore and sustainably use the earth's natural capital (Hawken, 1993). Large-scale restoration of aquatic ecosystems is the most challenging element of global water security, yet action is increasing. For example, large-scale restoration of environmental flows in the Kafue River in Zambia is underway to enhance ecosystem health and human livelihoods that were impacted by the construction of two dams that drastically altered the natural flood patterns in the Kafue Flats, a highly productive wetland complex. The consequences for human and ecosystem health included a drastic reduction in Kafue lechwe, a type of antelope endemic to the Kafue Flats, the disappearance of elephants, rhinoceroses, giraffes and wild dogs from the area, lower fishery yields, and reduced availability of grazing land. Recognizing the need for change, new operational rules have been developed for one of the dams (the Itezhi-tezhi Dam) to restore more natural flows and improve conditions for wildlife and local people (WWF, 2004).

Moving such an implementation agenda forward will require a far greater investment of social capital, potential for innovation and financial resources than is currently directed to water issues. Successfully securing the health and productivity of freshwater ecosystems will also require greater integration of water policy and management with other pressing global issues such as climate change, population growth and migration, and food and energy security.

## *Conclusion: A Secure Water Future for Nature and People*

The lives, livelihoods and well-being of people and the health of the environment are interrelated and interdependent. Social, cultural and economic systems cannot be separated from the ecosystems of which they are a part and that provide them with natural resources and life-sustaining services. Where an adequate flow of clean fresh water is ensured for the environment, it subsequently benefits people and communities by enhancing their health and well-being (UNEP, 2010). Rivers that do not flood adequately do not produce the fish biomass upon which communities may be reliant; wetlands that are drained do not attenuate flood waters that can result in downstream flood damage; and lakes that are polluted do not provide recreational opportunities.

Humanity is at a watershed moment. Ultimately, the challenge of water security cannot be approached only as a problem-solving exercise – it is about fundamentally redefining and reshaping humanity's relationship with water as it flows through communities, economies, and the ecosystems that sustain them. Addressing this challenge demands that human society envision and enable new ways to live in harmony with the natural water cycle. In fact, when considering the need to feed, clothe and provide energy for another 3 billion people on the planet by 2050 while also sustaining the health of rivers, lakes and wetlands – all with the same amount of water available today – the challenge may be more accurately described as a moral and ecological imperative for now and for the future.

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# 1.4 Water, Climate Change and Human Security: Conflict and Migration

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## Introduction

Water is an essential resource that affects environmental, economic and social systems. This resource, whether in the form of surface water or groundwater, is under increasing pressure through increased demand, which is being driven by population growth and changing lifestyles, direct anthropogenic stressors such as agricultural, urban and industrial pollution and, in some cases, reduced supply from ecosystems through the impacts of climate change and anthropogenic activities. Arnell (2006) noted that "increasing population densities, changing patterns of water use and growing economic activities are increasing the pressures on water resources" (referenced by Scheffran and Bataglini, 2011: 30).

Research literature between 1990 and today, including the IPCC 4th Assessment Report, as well as numerous public statements since its publication in 2007, have indicated that climate change will lead to more environmentally-related stressors, particularly in vulnerable developing countries. Some of these stress factors will occur in the form of hazards: floods, tsunamis, and droughts, directly threatening human health and life; whereas hazard-induced water scarcity and hazard-weakened ecological systems gradually undermine human well-being over an extended period of time (cf. UNGA, 2009).

These facts have led academics, politicians and the media to predict a bleak future for societies with the prospect of violent conflicts triggered by dwindling water resources or massive displacements of populations triggered by hydro-climatic hazards. But is this climate change/water hazards/security/displacement nexus likely? This issue will be addressed in this paper by reviewing some of the main scientific literature on the topic.

## 1. Water-related Hazards

The EM-DAT database maintained by the Centre for Research on the Epidemiology of Disasters (CRED) clearly indicates that the number of natural disasters reported worldwide since the 1900s is on the increase in the last few decades, as is the number of people affected by these disasters (EM-DAT, 2011). Fortunately, casualties have tended to decrease over the reported period (Figure 1). Hydro-climatic events such as droughts, floods and storms represent the majority of the reported events, and the recent devastating floods that have affected Pakistan, Thailand and Australia in 2010 and 2011 come to mind.

The frequency and magnitude of hydro-climatic events are likely to be exacerbated in the future by the effects of climate change. The Intergovernmental Panel on Climate Change (IPCC) noted that in coastal areas, sea-level rise will very likely expose millions of more people than today to hazards such as floods; in addition, drought-affected areas are projected to increase in extent; coastal erosion will affect more areas; and storm patterns will change in terms of magnitude and track (IPCC, 2007). In more general terms, the IPCC (2007) reported that climate change will exacerbate current pressures on water resources worldwide by affecting precipitation and run-off patterns as well as water quality. UN-Water (2009: 3) considers that "water is the primary medium through which climate change influences Earth's ecosystem and thus the livelihood and well-being of societies", even though water is not discussed as a specific theme in the climate change negotiations. This can be further highlighted by the fact that the Millennium Ecosystem Assessment (2005) emphasized that 2 billion people living in arid, semi-arid and sub-humid regions are extremely vulnerable to the loss of ecosystem services, including water supply, which is exacerbated by climate change.

Many in the scientific arena, political circles and mass media predict that the new or exacerbated water-related stresses will lead to mass displacement and/or increased likelihood of (violent) conflict. But can these fears be backed by empirical evidence?

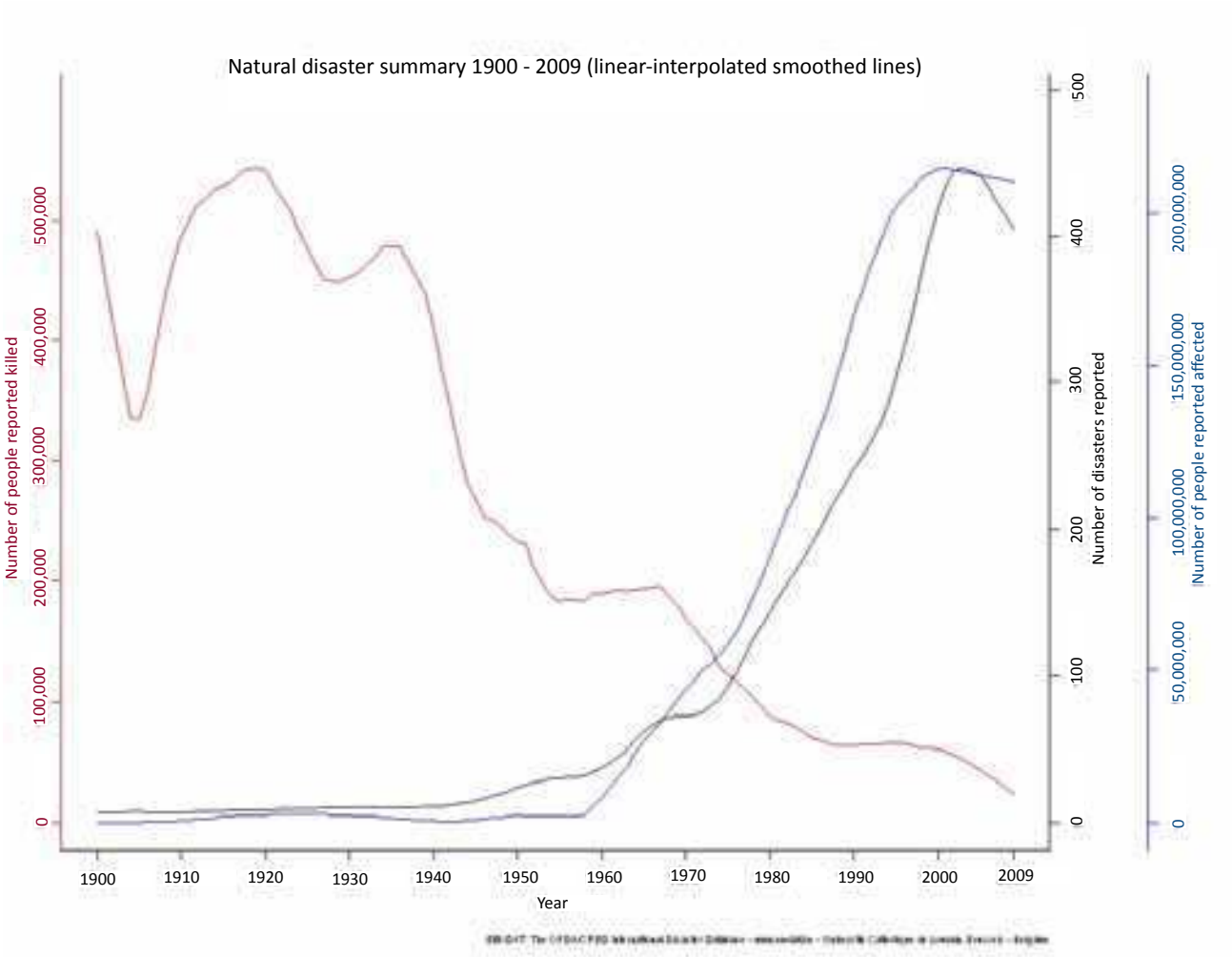


*Figure 1. Number of disasters reported, casualties and people affected since the 1900s (EM-DAT, 2011).*

# 2. Potential Conflicts over Water

> *"Since human societies rest on certain environmental conditions, a changing climate that significantly alters these conditions is expected to have an impact on human life and society. Understanding the complexity of interactions between climate stress factors, their human and societal impacts and responses is crucial to assess the implications for security and conflict"* (Scheffran and Battaglini, 2011: 28).

## 2.1. Violent conflict

According to the Carnegie Commission on Preventing Deadly Conflict, the 20th century was, altogether, the most violent in human history, "with armed conflicts taking the lives of over 100 million people and political violence responsible for an additional 170 million deaths" (Carnegie Commission on Preventing Deadly Conflict, 1997: 11). Hidden within these statistics are some important trends that elucidate the changing nature of violent conflict. Even though recently published numbers from the Heidelberger Institute for International Conflict Research (HIIK) (HIIK, 2012: 2) again show an increase of intra-state wars from 6 in 2010 to 20 in 2011, which is the highest number of wars since 1945, data jointly compiled by the Department of Peace and Conflict Research at Uppsala University (UCDP) and the Peace Research Institute Oslo (PRIO) show a general decline in the total number of violent intra- and inter-state conflicts around the world since the

early post-Cold War period, from a peak of 55 in 1992 to 30 armed conflicts in 2010[1] (cf. Gleditsch *et al.*, 2002; UCDP/PRIO, 2011). In contrast to the decline of violent armed conflicts or wars, a general increase of armed violence can be observed, which occurs in many forms, e.g. in conflicts or uprisings and unrest, or as gang violence, and in transnational organized crime. The 2011 Global Burden of Armed Violence report states that "more than 526,000 people are killed each year as a result of lethal violence. One in every ten of all reported violent deaths around the world occurs in so-called conflict settings" (Geneva Declaration on Armed Violence and Development, 2011: 1). This is also supported by numbers from the Heidelberger Conflict Barometer, which counted 148 violent crises in 2011 (HIIK, 2012).

The trend away from inter-state violent conflict and towards the more complex intra-state violence (perhaps well illustrated by recent and ongoing conflicts in the Northern Africa and Middle East regions) place emphasis on the importance of moving beyond simple models of resources scarcity as they have been developed for example by Homer-Dixon and others in the 1990s during the early times of environmental security research (Homer-Dixon, 1991 and 1994). As early as 2001, Ehrlich and coworkers noted that "it becomes critically important to pay attention to the relationship between, on the one hand, potential triggering events of environmental degradation", for example, water resources scarcity and natural hazards and, "on the other hand, such intervening variables as pre-existing social, political, or cultural cleavages, regime types, economic circumstances, and the incentives and disincentives certain social groups face regarding the use of violence" (Ehrlich *et al.*, 2001: 114).

## *2.2. Climate change and conflict*

During the past decades, scholars have drawn connections between climate change impacts and the possibility of violent conflict (most recently Burke *et al.*, 2009; Hsiang *et al.*, 2011; UNEP, 2011), many with particular reference to 'water wars' (e.g. Westing, 1986; Gleick, 1993; Butts, 1997; Postel and Wolf, 2001) and migration-induced conflicts (e.g. Homer-Dixon, 1991 and 1994; Barnett, 2001). The assumption that scarcity of renewable resources increases the risk of conflict has been widely influential in academic and policy circles, primarily driven by the findings of two research groups, namely the Toronto Project on Environment, Population and Security (Homer-Dixon, 1991 and 1994) and the Swiss Environment and Conflict Project (ENCOP) (Baechler, 1999), as well as by publications of the Woodrow Wilson's Environmental Change and Security Project (Dabelko and Dabelko, 1995; Dalby, 2002; Homer-Dixon *et al.*, 2003), the International Peace Research Institute in Oslo (Gleditsch, 1997), and Carius and Lietzmann's (1999) edited volume on Environmental Change and Security[2]. In response, other scholars have rejected these dire warnings about future 'water wars' on two grounds: i) a lack of evidence (or overwhelming empirical evidence against 'water wars' and 'climate refugee-induced wars') (Wolf *et al.*, 2005; Yoffe *et al.*, 2004; Barnett and Adger, 2007; Raleigh and Urdal, 2007; Nordas and Gleditsch, 2007), and ii) for fears of a securitization of water (e.g. Brown, 2007; Smith and Vivekananda, 2007; Brzoska, 2009; Carius *et al.*, 2008; Scheffran, 2009; Scheffran and Battaglini, 2011).

More recent research findings conclude that the research literature does not provide sufficient evidence to support a clear causal relationship between climate impacts, security and (violent) conflict, as economic factors seem to be more significant (Buhaug, 2010; Buhaug *et al.*, 2010; Buhaug *et al.*, 2008). At least there is a common understanding that climate change can be understood as a threat multiplier with the potential to exacerbate existing trends, tensions and instability which are often caused by continuous poverty, weak institutions both for resource management and/or conflict resolution, a history of mistrust between communities and nations, and inadequate access to information or resources (European Commission, 2008; UNGA, 2009). The German Advisory Council on Global Change concludes in its summary for policy-makers of its comprehensive assessment of the security risks of climate change, "that without resolute counteraction, climate change will overstretch many societies' adaptive capacities within the coming decades, (…) which could result in destabilization and violence, jeopardizing national and international security" (WBGU, 2007a: 1).

[1] Numbers taken from http://www.pcr.uu.se/research/ucdp/ on 31 January, 2012

[2] For a comprehensive and comparative discussion of these research groups and their approaches and results, see e.g. Brauch 2003, 2005a and 2005b, or Swatuk, 2006.

## *2.3. Water and conflict*

The notion of scarcity has been central to the debate on water-related conflicts due to the widely held assumption that it is scarcity of renewable resources that often leads to conflict. Boege (2006) reflects this thinking when stating that:

> *"[w]ater is not only becoming a scarce resource, but also one that is divided extremely unevenly between regions and states as well as within societies. Unevenly divided, scare resources are – as empirical evidence throughout history shows – contentious subjects leading to conflict. Conflicts may easily arise if water is – or is perceived as being – (over-) used and/or degraded by other actors at a cost to oneself. The possibility of conflicts at international, regional and local level regarding the access to and use of freshwater poses a serious threat to both human security and the security of states (…)."*

Animating much of the (mainly case studies based) research conducted on transboundary waters over the last two decades or so is the persistent sense that water will be "the oil of the future" and that "future wars will be about water" (Swatuk and Wirkus, 2009: 16). The available data, however, suggest a much more complex relationship between transboundary water and social stability. In Gleick's (2000) much referenced Chronology of Water Conflict, water was seen to be a political or military tool, a military target, an object of terrorism, part of a development dispute, or an object of control. Most of his cases involved inter-state activity, although intra-state conflicts were sometimes reported. He found no evidence for water being the principal cause of two states going to war. Given that 145 states and 40% of global population fall within 263 international river basins that account for 60% of global river flow, this is not an insignificant finding: the opportunities for violent conflict are abundant; yet tensions over water seem to stimulate cooperation rather than promote conflict. According to Wolf *et al.* "[n]o states have gone to war specifically over water resources since the city-states of Lagash and Umma fought each other in the Tigris-Euphrates basin in 2500 B.C. Instead, according to the UN Food and Agricultural Organization, more than 3,600 water treaties were signed from AD 805 to 1984" (Wolf *et al.*, 2005: 84).

Swatuk and Wirkus (2009) point to two empirical studies conducted five years apart by Gleditsch and colleagues: the first examining the probabilities of violent conflict between two states sharing a river (Toset and Gleditsch, 1999), and the second examining the probabilities of violent conflict among states sharing the waters of a river basin (Gleditsch *et al.*, 2004). In the latter, the authors conclude: "While acute conflicts over single rivers are rare, the presence of a large shared river basin provides far more to fight over (…) This is not evidence for 'water wars', but shared water resources can stimulate low-level inter-state conflict. That in no way excludes cooperation, and indeed the low-level conflict may be an important incentive for more cooperation. That relationship, however, remains to be investigated" (2004: 17 and 22).

In a summary of work conducted at Oregon State University, Wolf *et al.* (2005: 84-85) highlight four key findings: first, "the incidence of acute conflict over international water resources is overwhelmed by the rate of cooperation"; second, "despite the fiery rhetoric of politicians (…) most actions taken over water are mild"; third, "there are more examples of cooperation than of conflict"; and fourth, "despite the lack of violence, water acts as both an irritant and a unifier". In conclusion, the authors state: "The historical record proves that international water disputes do get resolved, even among enemies, and even as conflicts erupt over other issues. Some of the world's most vociferous enemies have negotiated water agreements or are in the process of doing so, and the institutions they have created often prove to be resilient, even when relations are strained" (Wolf *et al.*, 2005: 85). The authors of these studies put great stock in institutional capacity, arguing it to be the key to cooperation in situations of increasing scarcity.

However, the Basin at Risk (BAR) project, the Transboundary Freshwater Dispute Database (TFDD) and most other water and violence (war) related research have been limited to examining conflicts at the international level – the 'macro' level. Although the danger of international water wars may often be exaggerated, there is no doubt that water scarcity can and does lead to (violence-prone or even violent) conflicts between and – more importantly – within states – that is, at the 'micro' level. More recently, also triggered by the climate change discourse and after the refutation of the water war hypothesis, there is a spreading perception in the research community that water is – and will increasingly become – a source of violent conflict not in the international realm, but in the sub-national or local context (which does not exclude transnational repercussions) (Gleditsch *et al.*, 2004; Ohlsson, 1995, 1999a and 1999b; Ohlsson and Turton, 1999; Ravenborg, 2004; Swedish Water House, 2005; Carius *et al.*, 2004; Thomasson, 2006; Turton, 2004). The most advanced research in this field posits that water-related violence in the future will not take the form of water wars across national boundaries, but of localized water-point clashes between immediate water users, and of 'water riots' (Swatuk and Wirkus, 2009: 18).

### *2.4. Water, conflicts, and institutions*

In their 2009 report on Climate Change and Security in Africa, Brown and Crawford (2009: 6) summarized their review of emerging policy reports on the security implications of climate change by emphasising that "[l]ike much research about the links between environmental change and security, the literature on climate change and conflict tends to focus on the structural conditions in which conflict emerges, such as scarcity of a resource, rather than the role of individuals and institutions in initiating, sustaining, resisting or resolving conflict". They conclude that according to Barnett and Adger (2007), "it [that is, the research] tends to downplay the short-term causes (or triggers) of conflict and the importance of human decisions – the choices made by individual 'actors' in a conflict" (Brown and Crawford, 2009: 6).

Thus, at a fundamental level, conflict originates from the interaction between individuals and moves towards their surrounding environment in general. "Conflict is therefore mostly rooted in the 'micro' level. The way these conflicts evolve depends highly on the availability and the functioning of local level institutions or mechanisms" (Bildhäuser, 2010: 2). Likewise, the effects of climate change and water hazards will principally be felt locally by individuals, families, villages, and neighbourhoods. The diversity of climate change and hazards effects and of how individuals, households, villages, governments, and civil society deal with them are best understood through an analysis of their local circumstances. Crucial in that regard is the adaptive capacity of people and communities, mediated through institutions. Adaptation to climate change and water hazards cannot be effective without robust institutions.

Having said this, it is obvious that the understanding of climate change as a threat multiplier at the same time implies that strong and effective institutions and conflict prevention measures could function as threat minimisers. As emphasized by Scheffran and Battaglini (2011: 30), the marginal impact of climate change can make a big difference, particularly in less wealthy regions and in societies on the edge of instability: "[b]y triggering a cycle of environmental degradation, economic decline, social unrest and political instability, climate change may become a crucial issue in security and conflict", particularly by overburdening states and regions which are already conflict prone and/or affected by fragile statehood and which are characterized by an overlapping of diverse and competing logics of political and social order and behaviour (European Commission, 2008; Boege, 2009). A spillover of state weakness-induced security risks (e.g. social unrest, refugee flows, separation movements, warlordism) can contribute to destabilization processes, which could, according to WBGU, lead to the geographical expansion of a local crisis and to an overstretching of global and regional governance structures (WBGU, 2007b). Brown and Crawford (2009: 2) rightly state that "it is non-climate factors (such as poverty, governance, conflict management, regional diplomacy and so on) that will largely determine whether and how climate change moves from being a development challenge to presenting a security threat". Climate change or disaster triggered socio-economic and political stress might therefore "erode the functioning of communities, the effectiveness of institutions and the stability of societal structures" as indicated by Scheffran and Battaglini (2011: 29).

Hence, robust and sophisticated institutions at all administrative levels seem to be key to mitigating the aforementioned risks of an increase in climate-induced water conflicts. Although Tir and Stinnet (2012), who undertook an in-depth analysis of 315 river cooperation agreements signed between 1950 and 2002, found evidence for a higher risk of militarized conflicts under conditions of water scarcity, they could show on the other hand that "the more institutionalized the river treaty, the lower the likelihood of militarized conflict between the river treaty signatory states" (Tir and Stinnet, 2012: 220). They conclude that "[h]ighly institutionalized river treaties […] provide mechanisms for managing disputes before they escalate" and "that international institutions could be useful tools for some of the predicted consequences of climate change, such as water scarcity and changes in the seasonal flow patterns of rivers" (Tir and Stinnet, 2012: 223). This serves as an excellent example of the necessity, but also of the functioning, of robust institutions at the government and international, or rather the 'macro', level.

The same applies to the local or 'micro' level. Recent research results from Adano *et al.* (2012) and from Theissen (2012) showed that the likelihood for violent conflicts at the local level is higher in wetter seasons than in dry seasons, corroborating the academic discourse about the importance of local, often traditional institutions or regimes for conflict resolution and natural resources management (see Kramm and Wirkus, 2010; Boege, 2009 and 2006; Swatuk and Wirkus, 2009). They do so by pointing to the role of socially-embedded institutions and customary rules, which especially facilitate the survival of families, clans, villages and tribes in rural areas by managing access to natural resources and land, especially during drought periods or in water-scarce regions, and by mediating conflictive situations through traditionally accepted means (see Kramm and Wirkus, 2010; Boege 2009; Swatuk and Wirkus, 2009).

## 3. Water-related Hazards and Migration/Displacement

As already discussed above, societies must face an increasing number of environmental hazards, and in particular hydro-climatic hazards, and these could lead to the displacement of many people or communities around the world. Looking at floods alone, events from late 2010 in Australia and Pakistan clearly show people's overall exposure and vulnerability to these events. For the moment, although it cannot be clearly proved that these events are related to climate change, this is of minimal importance, as hazards will increasingly affect populations worldwide by the simple fact that global population and urbanization is on the rise and more and more people are settling in hazard-prone areas. The floods in Australia affected some 200,000 people with, fortunately, a low number of casualties and, in relative terms for the country since the 1900s, limited economic losses (EM-DAT, 2011). In contrast, Pakistan reported 1,985 casualties, 18.1 million affected people, and US $9.5 billion in damages representing 5.9% of GDP (CRED, 2011). Eleven to twenty percent of the surface of the country was inundated, resulting in hundreds of thousands of people being displaced. Following major events such as the 2010 Pakistan flood or the 2004 Indian Ocean tsunami where 2 million people were displaced (see University of Adelaide *et al.*, 2009) and for long periods of time (Naik *et al.*, 2007), the fate of people who are displaced needs to be considered. The following discussion is principally based on that found in Renaud *et al.* (2011).

Individuals or groups of individuals who are displaced or migrate because of an environmental push factor (including the stressors mentioned above) are often referred to as 'environmental refugees' in the academic literature and the media. Several discussions have emerged surrounding the 'environmental refugees' terminology, and there is a debate around the concept itself (see Renaud *et al.*, 2007 for further discussion on this). The argument that migration decisions are seldom triggered by a single factor has been put forward by several researchers who have opposed, or at least doubted, the usefulness of the concept of environmental migrants/refugees (see Castles, 2002; Black, 2001). However, there is genuine concern by actors in the development and humanitarian fields with respect to the plight of people who are or will increasingly be displaced due to predominantly environmental factors. For example, Antonio Guterres, United Nations High Commissioner for Refugees (UNHCR) stressed that human displacement is likely to be worsened by the effects of climate change and has flagged that when it comes to cross-border displacements, there is a legislative gap in terms of securing support for people who are on the move (Guterres, 2008a and 2008b). This governance gap needs to be addressed rapidly (see Warner, 2010). However, when it comes to internally displaced people, which represents the majority of displacements linked to environmental disasters, individuals should in principal be covered under the 1998 Guiding Principles on Internal Displacement (UNHCHR, 1998).

Although difficult to establish, the role of the environment as a push factor for migration and displacement is being increasingly investigated while at the same time the complexity surrounding migration decisions is increasingly being recognized (e.g. Foresight, 2011; UNEP, 2011). Estimates of people migrating or being displaced because of environmental stressors vary greatly, often by order of magnitude depending on the estimation method, types of stressors considered and time spans (see Renaud *et al.*, 2007 for a review). Increasingly however, refined estimates are emerging. For example, IDMC and NRC (2011) have reported that sudden-onset disasters caused by natural hazard events have displaced 36 million people in 2008, 17 million in 2009 and 42 million in 2010, with climate-related disasters such as storms and floods being the main sudden-onset hazards responsible for most of the displacement in 2009 and 2010.

The difficulty in estimating the number of environmental migrants globally is due to the inherent complexity of factors explaining migration decisions, but is also due to the fact that, until recently, there was no definition of what constitutes an environmental migrant. The International Organization for Migration proposed the following definition: "Environmental migrants are persons or groups of persons who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad" (IOM, 2007: 1).

This definition is broad and inclusive, and identifies environmental degradation as the main push factor triggering migration. It does not distinguish between temporal or permanent migration, nor does it identify the end destination of migrants. Although this definition is useful for providing an understanding of whom and what is being addressed, the concept of environmental migration also needs to consider the conditions of migration more specifically. This is needed to inform the actors dealing with migration issues so that they can act or react in case of emergencies and/or assist migrants to ensure that their basic rights are being respected. For this purpose, it is useful to distinguish between various types of population movements induced by environmental factors instead of only referring to those on the move as 'environmental migrants or refugees' in a broad sense.

Renaud *et al.* (2011) proposed a preliminary typology for environmental migration with examples relevant to water hazards:

- *Environmental emergency migrants:* These are individuals who flee the worst of an environmental impact on a temporary basis. Examples include people fleeing floods, tsunamis or hurricanes.

- *Environmentally forced migrants:* These are people who 'have to leave' in order to avoid the worst of environmental deterioration. Water-related examples includes sea-level rise, when, together with coastal erosion, communities face the physical loss of their land.

- *Environmentally motivated migrants:* These are people who 'may leave' a steadily deteriorating environment in order to pre-empt the worst. Water-related examples include the steady decline in water quantity/quality.

It is urgent to address the governance gap if the (very variable) predictions linked to future displacements of populations are to materialize in the coming decades. Developing typologies and a conceptual framework as presented by Renaud *et al.* (2011) could help operational agencies that are dedicated to providing support to people who are displaced or migrate because of environmental stresses as it would provide a list of criteria that can then be used to determine appropriate and timely interventions.

## Conclusions

Water resources worldwide are under increasing pressure through a combination of factors that includes population growth, pollution, and the consequences of climate change. In some regions of the world, acute stresses could be magnified or become the norm, and many, in academic, political or media circles, predict that this will inevitably lead to violent conflicts. Scientific reviews of past conflicts reveal that very few inter-state conflicts have had water resources as a root cause. However, water-related conflicts and violent conflicts at the local level have been reported. Although history can prove to be a poor predictor of what may happen in the future under the combined effects of population growth and climate change effects, consideration needs to be given to the fact that the rarefaction of resources could lead to further cooperation as opposed to major conflicts. Institutions need to be strengthened at the international and national levels to ensure that this can take place.

In many parts of the world, an increasing number of people are exposed to environmental hazards, including water-related hazards, in part due to increased population and urbanization. This has and will increasingly lead to a displacement of populations and here again, norms and institutions are not currently in place to allow for the protection of people on the move. Instead of focusing attention on whether concepts such as environmentally-induced migration are relevant or not, a precautionary approach would be to set up an international governance mechanism and institutions to assist with what many perceive will be increasing numbers of environmental migrants in the future.

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# 1.5 Water and Political Security: Conflict in West Asia and North Africa

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## Introduction

In the West Asia and North Africa (WANA) region (Figure 1), water scarcity has played a crucial role in shaping people's activities, habits and lifestyles, as well as social and economic growth. The great rivers of the region, among which are the Nile, Euphrates, Tigris, and Jordan rivers, have hosted some of the earliest civilizations on earth. The people of the region have shown their resilience and adaptation to the harsh climatic conditions throughout history. However, climatic factors have been influential in inciting regional disparity, disunity and conflict, as well as in the demise of great civilisations (Hashemi, 2011). These problems have been aggravated by a lack of good governance (i.e. a lack of transparency, accountability and empowerment of citizens) leading to a considerable disparity in terms of political, economic and social aspects within nation states in the region (WANA Forum, 2011).


*Figure 1. The West Asia and North Africa (WANA) region (in dark green).*

Climate change and variability, being a major element in the water stress formula, will only degenerate this already water-stressed region further into severe water stress conditions, which will have implications in terms of food insecurity and political and social unrest. Hashemi (2012) asserts that "physical water scarcity is partially induced by human behavior as well as being affected by natural phenomena like droughts since there are some empirical evidences that climate change is induced by human lifestyle because of greenhouse gas emissions" (Hashemi, 2012: 30). Across the 'Arc of Crisis', that is, from Somalia, Sudan and Egypt in Africa to Yemen, Iraq, and Syria in the Middle East, water scarcity has already led to drought and famine, the loss of livelihoods, the spread of water-borne diseases, forced migrations and open conflict (WANA Forum, 2010b). Water scarcity is closely linked to food and health security, making better water management a key stepping stone for poverty reduction and economic growth. There is a need for an integrated approach to water, hunger, climate change, health and poverty, with a view to averting future conflict with concentric circles of cooperation (Bin Talal, 2010).

Another challenge is that the persistent reduction in the region's ecosystems to provide services such as food, water and other necessities are leading to an increased deterioration in the well-being of people. In the WANA region, policies at the national and regional levels must address the relevant questions that need to be answered in order to ensure water security; these policies should be designed to create opportunities for the people based on adaptive management approaches and enhancement of people's resilience to cope with water scarcity while maintaining their dignity. The effective mainstreaming of water policies is urgently needed and should address these challenges within the larger context of social and economic development.

# 1. Water Security as a National Political Issue

Grey and Sadoff (2007: 546) define water security as "harnessing the productive potential of water and limiting its destructive impact". Water security has emerged as a crisis of global proportions, with major implications for national and regional stability and conflict. Furthermore, water security is a decisive component of social and political security. This cannot be truer than in the WANA region, where most of the countries are situated in a semi-arid to arid climatic zone where more than 60% of the renewable water resources in the region are shared by one or more countries. Despite warnings by regional experts that the wars of the 21st century will be fought over water (WANA Forum, 2010a), in the Arab-Israeli wars of 1967 and 1978, and in the tension between Lebanon and Israel in 2002 and the subsequent war in 2006, water was the primary cause. In the absence of peace, and continual disregard of international humanitarian law, water security is leading to increased tensions, instability and conflict. Examples of water conflicts in the following river basins in the WANA region have already been experienced:

- Syria - Turkey - Iraq (Euphrates and Tigris rivers)
- Israel - Jordan - Palestine (Jordan River, Dead Sea)
- Israel - Palestine (groundwater aquifers of Occupied Territories)
- Jordan - Saudi Arabia (Al-Disi Aquifer)
- Syria - Jordan (Yarmouk River)
- Egypt - Sudan - Ethiopia (among 10 countries sharing the Nile River)
- Iran - Afghanistan (Hirmand River)

Each of the countries in the region considers water security to be of national concern. For example, water security is key to establishing peace between the Palestinians and Israelis. As expressed by Nabil Al Sharif, former Minister of the Palestinian Water Authority: "There will be no real peace if there is no water. If there is no water, I don't think any agreement of peace will live more than two or three years" (Vigotti and Hoffman, 2009). To shed light on the seriousness of the conflict over water in the region, in June 2002, Lebanon restarted new infrastructure works to connect 60 communities to running water for domestic use, supplying them with 10,000 $m^3$ of water for domestic purposes a day (or 3.65 million $m^3$ a year). For Israel, these unilateral Lebanese acts were a violation of international law and a threat to the water security of their country. Lebanon, referring to the 1953 Johnston Plan which granted Lebanon 35 million $m^3$ of the Jordan (Hasbani) River headwaters (Abujaber, 1989) argued that the move was in accordance with the principle of equitability in its water share, and was therefore in accordance with international water law. Israel however, feeling threatened that their water security was at risk even when the amount of water used by the Lebanese is less than 0.5% of the Israeli's annual water consumption, was ready to take up arms to stop the measures taken by Lebanon. The case was brought before the United Nations, and only through intervention by ambassadors of the European Union and UN officials to deter possible Israeli attacks during the inauguration of the project was the matter closed. It is painfully clear to see the importance of water to the countries in the region and how conflict over water can easily escalate already tense relationships.

Governments of the region have now realized the shortcomings of having limited supplies of renewable water resources that have reached their physical limit. Since the year 2000, governments have begun to pay more attention to the development of water policies in line with the internationally recognized Integrated Water Resources Management approach (IWRM), with longer planning horizons to cope with the expected water deficit challenge. Even though regional governments have endorsed the recommendation from the World Summit on Sustainable Development (WSSD) to articulate IWRM as a management option by formulating their own water resources management plans (Arab Water Council *et al.*, 2005), few countries have yet to create sufficient capacity to implement these plans.

Furthermore, short-term fragmented management through the adoption of water policies that focus on meeting demand should be replaced with flexible policies coordinated with agricultural, financial, social, environmental, energy, urban, trade, and industrial policies. This should lead to water sustainability, ecosystem protection, and adaptation to the impacts of climate change. The past explicit or implicit water policies in the region between 1960-2000 have largely focused on addressing water resources scarcity by meeting the Millennium Development Goals (MDGs) targets, specifically through securing adequate water supplies and sanitation services, especially in urban areas and through expansion of irrigation schemes that have led to extensive groundwater mining. However, this will not be sufficient for ensuring sustainable development and water security in the region, and a more integrated approach will be needed.

## 2. Water in the WANA Region

### 2.1. Demographic and economic conditions

Currently, the total population of the WANA region stands at about 500 million (UNDP, 2008; World Bank, 2007). The average annual rate of population growth is 2.6%, although it varies from one country to another. The highest growth rate is 6.5% in the United Arab Emirates (UAE) and the lowest is 1.1% in Iran. The urban proportion of the total population is 55%, although it varies widely between states and is at more than 80% in Bahrain, Djibouti, Jordan, Kuwait, Lebanon, Libya and Saudi Arabia, and less than 40% in Comoros, Somalia and Yemen. The average gross domestic product (GDP) in the Arab states is US $1.043 billion, or US $1.915 billion in terms of purchasing power parity (PPP). The corresponding per capita values are US $3,659 and US $6,716, respectively. However, these averages hide the fact that the GDP per capita is significantly higher in oil states compared to non-oil states. For non-oil states, the per capita GDP varies between US $700 and US $1,800, while the highest GDP of the oil states is US $6,716. The average Human Development Index (HDI) scores low at about 0.7, with 13 of 26 countries above this average. Although data on the Human Poverty Index is limited, the average rate of poverty is 38%. Poverty values of less than 10% are reported for Jordan, Lebanon, Qatar and UAE (UNDP, 2008).

### 2.2. The sharing of water resources

Many of the countries in the WANA region share their primary surface and underground water resources. The UNDP 2006 *Human Development Report* (HDR) states that Iraq and Syria obtain between 50-75% of their water from rivers outside their national borders, while Egypt gets 75% of its water from outside its borders (UNDP, 2006). As stated in the HDR: “Managing shared water can be a force for peace or for conflict, but it is politics that will decide which course is chosen” (UNDP, 2006: 203). If no action is taken or efforts are made to enable cooperation, tension over water is likely to increase in the future.

The sharing of water resources between nations in the region underlines not only the importance of knowledge sharing, understanding regional groupings and common approaches to IWRM, but equally the importance of international legal frameworks that codify interaction and can both enable and inhibit cooperation over resources. More often than not, water is treated legally at a national level, and it is this mentality that must be changed if water management is to be addressed between nation-states. International instruments, such as the UN Watercourses Convention, can serve as a precedent for legal cooperation between states. For example, UN Resolution A/RES/63/124 on transboundary aquifers (United Nations General Assembly, 2009) is a non-binding agreement between states that “encourages the States concerned to make appropriate bilateral or regional arrangements for the proper management of their transboundry aquifers, taking into account the provisions of these articles” (United Nations General Assembly, 2009: 1). Based on such international legal precedence, there exists the possibility for states to cooperate at a regional level, supported by international legal frameworks that can be developed and built upon in unison. The legal frameworks that exist in Europe, such as the Danube River Basin or the EU Water Framework Directive that regulates all member countries (Kaika, 2003), can also serve as examples of political-economic integration at an institutional level, developing the necessary legal frameworks that facilitate cooperation over various resources.

The regional dimensions of water management can be better served by improved communication between water experts and policy-makers and diplomats in a manner that is both comprehensible and politically practical. Science must inform decision-makers of the factual and academic-led dimensions of water security to help them make better decisions, while decision-makers have a responsibility to inform scientists of the practical realities and guidance needed to realize change at the policy level. Fundamental, sweeping change can only come about through cooperation between science and politics that works in unison with societal change.

## 3. The WANA Forum: Water Management in the WANA Region

At the consultative meeting for the West Asia and North Africa (WANA) Forum in February 2010, water experts discussed regional challenges and opportunities in water management. These include the necessary political and legal frameworks, financing, technology, and institutional development, each of which is discussed briefly here. In each instance, the

involvement and empowerment of local communities is essential.

It was discussed that it will be crucial to establish effective policy and legal frameworks in order to develop, carry out and enforce rules and regulations that govern water and land use. This will need to be done at local, national and regional levels through appropriate networks to facilitate cooperative, integrated policy-making that will ease water-related tensions in the region.

Financing is an essential component that cannot be overlooked, and will be required in order to offset the considerable costs involved in harnessing and managing water. This will require third sphere partnerships with the private sector in order to tap into potential resources and develop solutions that promote socially and environmentally acceptable trade-offs.

Technological innovation will be key for managing water resources and ensuring continued water security in the region. Such innovations can act as a driver for change in overcoming social, financial and environmental hurdles, creating successful and sustainable solutions.

Cross-sectoral cooperation via institutions, such as those in the agricultural, industry and energy sectors, can help in dealing with current and future challenges through reforms such as decentralisation, stakeholder participation and transparency, capacity building, establishing partnerships and coordination (public-private, public-public, public-civil society), and developing new supra-national (regional) administrative systems.

# 4. Water and Political Security: Case Studies from the WANA Region

## 4.1. The Nile Basin Initiative

The Nile Basin Initiative (NBI) is a regional initiative covering 10 countries aimed at harmonising the transboundary water conflicts in the Nile basin. The dispute over the sharing of the Nile River waters surfaced recently through the introduction of the Cooperative Framework Agreement (CFA) in 2011[1]. Burundi is the latest signatory to the CFA in 2011, joining Kenya, Uganda, Ethiopia, Tanzania and Rwanda. The upstream Nile countries, in their struggle for receiving an equitable share of the river's waters, have negotiated the CFA for years without a full agreement in sight. Egypt, Sudan and the Democratic Republic of Congo, even with the latter expected to sign, are still not party to the CFA. Article 14(b) on water security in the draft CFA has been used as a stopping block by both Egypt and Sudan. The article states that member countries would work together to ensure that they will not "significantly affect the water security of any other Nile Basin State" (Nile River Basin Cooperative Framework Agreement, 2010); Egypt and Sudan would like for the article to read that the countries will not "adversely affect the water security and current uses and rights of any other Nile Basin States", without the qualification "significantly" (Nile Basin Initiative, 2012). Through the CFA, the upstream countries seek to substitute the 1959 treaty between Egypt and Sudan that gave nearly 90% of this resource to the two downstream countries – that is, 55.5 billion $m^3$ to Egypt, and 18.5 billion $m^3$ to Sudan (Mekonnen, 1999). This treaty did not include any of the upstream countries, including Ethiopia, which contributes 85% of the river's water. Based on a provision carried over from an agreement signed with Britain in 1929, Egypt has veto power over any new treaties or proposed agreements that would affect their allocated share of water resources of the Nile River, which it has been using ever since to protect its share of the water resources.

The signing of the CFA by Burundi came at a crucial time during a major political transition in Egypt following the Arab Spring and the Tahrir Square uprising, followed by the regime change of long-time president Hosni Mubarak. It can be expected that whatever governance structure is established in Egypt, the issue of the Nile waters will be taken very seriously by its new leaders. In fact, during the first meeting of the Egyptian Military Council following the change in regime, the Nile water issue was the first item on the agenda as it is considered to be a national security issue (AhramOnline, 2012). Although it remains to be seen what the water diplomacy of the future democratically elected Egyptian government will be, it is anticipated that the new democratic wave will bring with it a new attitude in Egypt towards the sharing of the Nile River with upstream states.

[1] For a copy of the Agreement, see:
http://www.internationalwaterlaw.org/documents/regionaldocs/Nile_River_Basin_Cooperative_Framework_2010.pdf.

Following on this, during a personal conversation between the author of this paper (Dr. Walid Saleh) and Dr. Sally Toma, member of the executive Egyptian Revolution Youth Council, she stated that "45 [members] of the Revelation Youth Council visited Ethiopia to discuss the Nile water issue and were informed by Ethiopian government officials that they will not act unilaterally until a proper government is installed in Egypt" (Toma, 2012). She went on to say that the Ethiopian Government officials revealed to the Egyptian delegates that the problems with the previous regime in Egypt stemmed from the authoritarian attitude and the language of power and threats. They indicated that these were major obstacles to reaching an agreement over the sharing of the Nile waters. The recent creation of South Sudan has now added to the complexity of the situation. Therefore, there is an urgent need for a regional vision to avert any future conflicts in the region. It must be stressed that all countries in the Nile River basin have shown restraint and acted in a responsible manner during a very difficult transition period during the post-colonial era.

### *4.2. The Jordan River basin and Palestinian aquifers: Towards equity of access and allocation*

In addressing potential solutions for chronic issues over Middle Eastern waters, one might be inclined to think that the problems might be solved through regional cooperation or by applying modern management approaches. However, the water problems that exist in the Middle East are not just water scarcity problems, but are political issues that have been and continue to be used as strategic weapons. This is true in the case of the water conflicts between Israel and Palestine, and Israel and Jordan, Syria, and Lebanon, respectively. Since the establishment of Israel in 1948, there has been conflict over the Jordan River basin. In fact, the 1967 Arab-Israeli war was fought not only over territories, but also over the control of water bodies of the River Jordan and its tributaries. When the Golan Heights were seized by Israel, all the headwaters of the Jordan River and a large stretch of the Yarmouk River consequently came under its control. The occupation of the West Bank also gave control of the lower Jordan River basin to Israel. The 1982 Israeli invasion of Lebanon and the creation of the 'security zone' in the south gave Israel greater control of the Jordan and Litani rivers. The disagreement over water has been a serious stumbling block in the present ongoing negotiations between Israel and Syria, and Israel and the Palestinians. The Israeli failure to honour a water sharing agreement with Jordan has also been a source of tension.

Furthermore, the Israeli mining of the underground Palestinian aquifers and the denial to the Palestinians of this water can be seen as a war tactic used by the Israeli to drive the Palestinians out of their land. In addition to the mining of the waters, the Israeli are directly polluting the underground waters under Palestinian control by releasing raw wastewater from the illegally-built settlements in the West Bank (Lendman, 2009). In fact, Israeli scientists have recently warned that polluting Palestinian groundwater will not only directly destroy the aquifers under Palestinian control, but that it will also eventually pollute the Palestinian aquifers under Israeli control. Israeli scientists are calling upon their government to stop these immoral, illegal, and inhuman practices.

A recent report from the French Parliament's Foreign Affairs Committee entitled *The Geopolitics of Water*, concluding on the work of a fact-finding mission from October 2010, accused Israel of implementing "apartheid" policies in its allocation of water resources in the West Bank (Glavany, 2010: 19). Glavany asserts that water has become "a weapon serving the new apartheid" (Glavany, 2010: 19), with examples and statistics to back up these claims. The report states that "[s]ome 450,000 Israeli settlers on the West Bank use more water than the 2.3 million Palestinians that live there" and "[i]n times of drought, in contravention of international law, the settlers get priority for water" (Glavany, 2010: 19). Through these examples, the report highlights the unfair allocation of water to West Bank Palestinians and the fact that Palestinians have no access to the territory's underground aquifers (Glavany, 2010). Glavany further states that "Israel's territorial expansion is seen as a 'water occupation' of both streams and aquifers [...] the separation wall being built by Israel allows it to control access to underground water sources… [and to] direct the flow of water westward" (Glavany, 2010: 17-20). The findings from the Glavany report underline the need for the attainment of equity and justice in terms of water access and allocation as paramount to resolving this ongoing conflict. Without equitable and just allocation of water resources, there can be no real conflict resolution.

### *4.3. The Euphrates and Tigris river basins*

Syria and Iraq, as the downstream countries of the Euphrates River, are affected by the construction of the Turkish GAP project. It is estimated that because of the GAP project, Syria and Iraq have seen 40% and 80% reduction, respectively, of their equitable shares of the river water. The impacts are already strongly felt by the Iraqis and have had drastic effects on the country's food security, demonstrated by the fact that many farmers have abandoned their farms. In addition,

the Turkish authorities' damming efforts have also focused upon the Tigris River water, and this has further alienated the Iraqi water situation to levels that cannot be tolerated. The water stress conditions in Iraq are destabilizing the country's already fragile economic growth, and creating pressures on the Iraqi government to meet its food security challenges. According to Bulloch and Darwish (1993), cooperation between the riparian states of the Euphrates and Tigris rivers dates back to 1946, when Turkey and Iraq agreed that the rivers' control and management depended in great part upon the regulation of flow in Turkish source areas. Turkey, at the time, agreed to begin monitoring the two streams and to share the related data with Iraq. In 1980, Turkey and Iraq signed an agreement to establish the Joint Technical Committee on Regional Waters, followed by a bilateral agreement between the two countries in 1982. Syria was then included in the Committee in 1982, creating a common ground for cooperation. In 2008, with the help of UNDP-Iraq, meetings were held in Istanbul to initiate further cooperation. It has been suggested that the dispute over the Euphrates and Tigris basins can be resolved with dialogue between the parties; however, a suitable political atmosphere is essential for such cooperation to take place, which unfortunately is not available at present due to the insecure climate in Iraq and Syria.

### *4.4. The Yarmouk River basin: A regional development vision*

The Yarmouk River, being the main surface water source for Jordan and a major tributary of the Jordan River, flows through the East Ghor Canal, and is a source of tension between Jordan and Syria. Jordan constructed the East Ghor Canal in 1957, as the first phase of the Greater Yarmouk Project. This project was in line with the 1950 Johnston Plan, which included the construction of two dams on the Yarmouk (the Al-Wahda Dam and the Unity Dam), with a holding capacity of 110 million $m^3$ (Haddadin, 2006). The project was designed to help Jordan meet some of its water supply and irrigation demand while providing Syria with its much needed power supply.

A joint Jordanian-Syrian water committee established an agreement in 2010, which called for Syria to cease its agricultural activities upstream from the dam in order to guarantee optimal water flow. The agreement states that once the dam reaches its maximum capacity, Syria would receive 6 million $m^3$ of water from the Al-Wahda Dam for agricultural purposes. However, years after completion of the dam, the amount of water that flows to it is significantly below its capacity, which means that Syria does not receive the water stipulated in the agreement for its agricultural activities.

## *5. Proposed Solutions: Towards a Supra-national Governance Mechanism for Cooperation*

The looming water crisis in the WANA region will affect all nations and their people, and cannot be addressed solely through the traditional methods of bilateral and national policies. The numerous factors in shared water basins that transcend nation-state borders and national policies, and the impact of climate refugees, mean that only through regional solutions, collaboration and joint management can this crisis be overcome. In this context, the emphasis should be on opportunity rather than on challenges; opportunities to share knowledge, to reflect on best practices, and to develop solutions that can be applied at a regional level. It will take innovative and creative proposals that offer new methods and solutions, built on regional dialogue and knowledge sharing, to offer sustainable and peaceful solutions to this crisis. Within these opportunities, there is a need to underline the importance of addressing the concerns and needs of those who suffer most and directly, and to provide real and viable solutions that tackle both local and regional dilemmas in order to enable people to realise their own human dignity.

The disparity between water resources consumption and allocation is a significant factor that underscores the importance of improved management and multilateral cooperation. Almost without exception, there is a need for neighbouring countries to regulate their water management of shared services, and to regulate and better manage their shared resources. Regulation of water resources exists in the Tigris and Euphrates river basins, but Turkey, Iran, Iraq and Syria need to work out water sharing formulas if they are to ensure a sustainable and peaceful environment. Unfortunately, no joint water management plan exists in the region, and it is this that might help to bridge some of the water disparities.

Below are some suggestions for how the water crisis in the WANA region can be managed through cooperation.

- ***The regional WANA Forum Initiative.*** With an aim of realizing regional cooperation, the WANA Forum was founded in 2009 for an initial 5-year period with the aim of becoming a platform for new regional thinking based on shared values and interest in the common good. The Forum is apolitical, non-partisan and an independent platform for dialogue (Hashemi, 2011). The dialogue centers on the formation of a regional perspective on the governance of water and land resources, and a policy brief has been developed on supra-national (inter-state) governance mechanisms for cooperation to deal with water scarcity in the region (WANA Forum, 2011). The WANA Forum Chairman, Prince El Hassan Bin Talal of Jordan, has stated that

  > *"there exists an opportunity for the region in addressing its water scarcity crisis. The scarcity of water in the region, coupled with an abundance of natural energy resources, offers the potential for an exchange or trade-off, one comparable to that of Europe in the 1950s, between France and Germany. Indeed, it is the common pooling of resources – energy and water – that can lead to an integration of economic infrastructure and political systems. Such a system – as the example of the European Union has demonstrated – can herald an era of nation-state cooperation and multilateral thinking, fostering relationships and building trust. Economic and political integration can therefore become a fundamental part of positively and proactively addressing the socio-economic and political aspects of water and energy. With a shared history and values, the resources can be agents of cooperation and the creation of a Community of Water and Energy can pave the way to cooperation, and arrest potential conflict"* (Bin Talal, 2010).

  This offers hope for positive cooperation in the region in the future.

- ***Enhancing cultural heritage for regional cooperation.*** The WANA Forum further aims to enhance the cultural ties in the region by involving other key players in the region including, Iran, Turkey, Pakistan and Afghanistan, as part of the WANA region. For example, in the past 20 years, Turkey has examined the possibilities of exporting water through a 'peace' pipeline; a project was proposed to supply Syria, Jordan, Palestine, Israel, and Saudi Arabia with water. The recently published report *Blue Peace: Rethinking Middle East Waters* (Strategic Foresight Group, 2011) states that, on average, Turkey can export at least 1-1.5 billion $m^3$ from its national rivers (excluding the Tigris and Euphrates rivers) to the Jordan River valley countries. As the 2010 Global Risks report highlights, the impact of declining quality and quantity of water will be increasingly severe in the forthcoming years (World Economic Forum, 2010). Therefore, building on common values can bring satisfactory solutions to transboundary water resources issues in the region.

- ***New regional administrative systems.*** In the context of regional cooperation, the benefits of IWRM need to be examined to determine what role it might play, how it might function, and what potential it holds for the region. Most – if not all – decisions regarding water are political. The underlying theoretical background of IWRM is integration itself – which is a political process – and is in line with the concept of sustainable development that can meet the needs of people without compromising the value of the ecosystem, demonstrating the human element in managing water and natural resources. The numerous dimensions to successful integration, such as institutional reforms, spatial adequacy and manageability, are inextricably linked to social cohesion and unity. In addition, integrated research policy that reflects the multitude of factors in integrated management is required in order for IWRM to play a key role in integration and management. In addition to the juridical and historical background of the region, another important issue to be taken into consideration is the people of the Euphrates, the Orontes, the Yarmouk and the Nile rivers, together with their 11 African states. In this respect, the formation of regional water commissions, such as those like the Danube, the Rhine and the Mekong Commissions, could indeed help to promote regional cooperation rather than wars, as wars do not create additional water.

- ***A regional database and information system.*** In order to realise both IWRM and a region-wide knowledgebase, there must exist an awareness of, and understanding between, the various actors and organisations working in WANA. Too often information is compiled only for the purpose of recommendation research, publications and conclusions to be carried out independently of work being done elsewhere, failing to take into account the broader picture. It is therefore proposed that work is needed at three levels, the national, regional, and global levels, each working in harmony with the others towards the same objectives. Furthermore, it is recommended that such

a system, coupled with a Decision Support System (DSS), might enable modelling and water predictions, which could in turn inform decision-makers. The need for such modelling and information across the WANA region is imperative to establishing viable and practical solutions for shared water management. Furthermore, the value of water information is key in planning and assessment and is also important in research and development and for project monitoring. Finally, data must be available and accessible to civil society and the public and private sectors in order to facilitate investment, raise awareness and improve the level of planning and transparency. Nevertheless, the political will to share information and pool data is essential, and positive examples of this exist elsewhere in the world; it is now up to governments in the WANA region to prove and demonstrate the potential benefits of knowledge-sharing on water information through cooperation and goodwill.

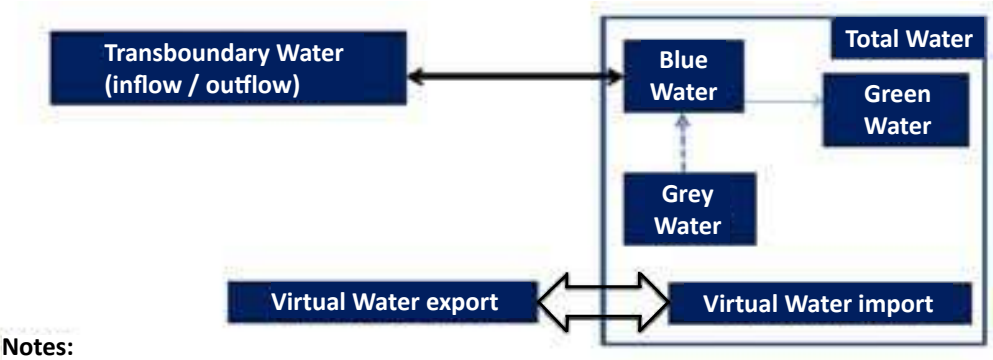
- ***Alternative resources.*** In a water-scarce region such as the WANA region, where groundwater and river basins often are not reliable sources of water, there is a need to find non-conventional sources of water. With growing populations and limited water availability, water supply can be a source of economic growth and potential, particularly in the Gulf, where freshwater supply is particularly limited. Water can only be discussed in the Gulf in the context of desalination, where saltwater provides the majority of the water in the region. Furthermore, in order to overcome the expected water deficit estimated at 240 billion cubic metres[2], projected to occur by 2025 (World Bank, 2007), it will be necessary to increase supply through new sources and options such as increased dependency on desalination, increased reuse of adequately treated wastewater sources, and reasonable mining of non-renewable groundwater sources. It will be equally important to address climate change impacts through mitigation efforts, combined with efforts to implement measures for integrated water management that are coordinated with other development policies and reflect the prevailing harsh, arid environment, and social, economic and cultural conditions.

- ***Environmental sustainability and efficiency measures.*** An effective water resources management framework in line with the IWRM approach is essential. Such a framework must emphasize: enhanced water use efficiency and justified allocation in all development sectors; a supply-demand model supported by effective and enforced institutional arrangements and legal frameworks; mandated coordination with other related policies; effective stakeholder participation; strengthening of water governance issues; development of partnerships with the private sector; effective regional cooperation through the United Nations and regional organizations; a commitment of adequate financial and trained human resources; and, preservation of environmental integrity. Such a complex IWRM approach will enable governments of the region to shift from rigid, traditional approaches of supply augmentation and their role as services providers to the implementation of more flexible integrated management measures and to act as regulators of services.

- ***Regional development plan.*** To seek a genuine solution for the water crisis in the WANA Region, and taking political will as a pre-condition, many scenarios to overcome any potential conflict over water in the region can realistically be made which are also economically viable. What is required at this stage is a shift from a consultative and concept-building mode to the development of a new master plan for water and land use in the region. The question that needs to be addressed, however, is how to formulate an integrated development plan that takes into consideration the rising conflict over water resources due to the tension between upper and lower riparian states. A regional solution can only be achieved with regional projects that take into account the equity of water needed among all countries in the region. One example of such a project is the proposed Red-Dead Sea Canal (Sharp, 2008). The project aims to pump vast quantities of water from the Red Sea in the Gulf of Aqaba to the Dead Sea, situated 417 metres below sea level. The conveyance would be utilized to generate hydroelectricity and desalinate water, with drinking water pumped to regional population centres, and desalination brine discharged into the Dead Sea in an attempt to arrest its shrinkage. This project is being promoted as an initiative to cement peace in the region. The cost of the project has been estimated at US $5 billion over 20 years (Sharp, 2008). This massive effort requires both international technical and financial support and cooperation. A recently completed environmental impact study financed by the World Bank concluded that the impacts of abstracting millions of cubic metres of seawater from the Red Sea are negligible, according to the preliminary Red Sea Modelling Study (World Bank, 2009). Regional development plans may also wish to consider the concept of Virtual Water (e.g. Allan, 1997) as a way to reduce transboundary conflicts by affecting water resources developments in transboundary waters (Hashemi, 2012). As shown in Figure 2, Virtual Water policy can shift attention to Green Water (soil moisture and water consumed by

[2] Water demand is expected to reach 500 billion $m^3$ while water supply is projected to be 260 billion $m^3$.

plants through evapo-transpiration) and rain-fed agriculture from emphasis on Blue Water (surface and groundwater resources). The result would be less transboundary conflicts due to Blue Water developments (Hashemi, 2012). Hashemi (2012) concludes that "food security (and [by extension] water security) and [the] removal of world hunger cannot be addressed without considering the full water cycle, including Green Water" (Hashemi, 2012: 27).




**Notes:**

- The Water box shows total water available within a political boundary
- Blue Water = run-off + sub-surface flow + groundwater
- Grey Water = recycled water + wastewater + return flow
- Dotted arrow indicates that Grey Water is not fully available as a resource
- Transboundary Water is both exogenous and endogenous to the Water Box – it has a lot of bearing on Blue Water through water development and dam building policy
- Virtual Water has a bearing on the Total Water Box and is both exogenous and endogenous to the Water Box
- Virtual Water influences Blue Water by shifting priority from water for food to water for drinking on industry
- Virtual Water shifts attention to Green Water by emphasising on rain-fed agriculture
- Virtual Water can reduce Grey Water by shifting the attention from Blue Water use (irrigation agriculture) which produces a large sum of return flow as well as reducing industrial wastewater

*Figure 2. Virtual Water as exogenous and endogenous to the Water Box, which represents total water in a system within political boundaries (after Hashemi, 2012).*

## Conclusion

The optimism over the Arab Spring in re-shaping the WANA region political map is real. Democracy, long awaited and much needed, has arrived. The newly democratically elected governments in Morocco and Tunisia, and the future Libyan, Egyptian and Syrian governments, will set the stage for future cooperation in the region. The Turkish support for the Arab Spring has placed Turkey in a respected position within the WANA region; indeed, many are calling to adopt the Turkish model of democracy. The historical, cultural, and religious ties between the nations in the WANA region cultivate the right atmosphere for overcoming transboundary water conflicts such as those over the Euphrates, Tigris and Nile rivers. This is possible if the Arab Spring brings real democratic governments to the countries. It is expected that the Arab Spring will bring common values, ethics, and a shared vision to face regional challenges. Rae (2002) asserts that "there is a historical precedence for regional governance systems, e.g. [the] Ottoman water and land governance systems [that] are [still] in force as of today in Palestine, Syria and Jordan". Water scarcity is a regional common good that, together with energy security, can make the WANA vision of creating a 'Supra-national Community of Water and Energy for the Human Environment' a reality.

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# 1.6 The Blue Economy: Risks and Opportunities in Addressing the Global Water Crisis

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## Introduction

> *"The trouble with water – and there is trouble with water – is that they're not making any more of it."*
> *Marq de Villiers, Water: The Fate of our Most Precious Resource*

By 2050, the global population is projected to exceed 9 billion people, and with the continued increase in water demand, it is expected that over 4 billion of these people will live in regions with chronically short water supplies (Clarke and King, 2004). Current demands are already placing massive pressures on global freshwater supplies, causing pollution, depletion and inequalities in accessibility. As these demands grow exponentially, they will be compounded by the disruptive impacts of climate change that will make some areas drier, other areas wetter, and increase the instances of floods and droughts.

Narrowing the gap between water demand and supply has become one of the greatest challenges of the 21st century, if not the greatest. In order to meet this challenge, governments, businesses and civil society need to dramatically accelerate the development of solutions that re-define our approach to water. To date, we have focused on supply-oriented approaches that rely on ever-increasing withdrawals from our stressed water systems. Increasingly, leaders from public and private sectors are recognizing that this approach is outdated and unsustainable, both from an environmental and an economic perspective. The successful water management of the future will be defined by efforts to reduce demands through conservation, efficiency, re-use, and the replenishment of our natural systems.

The pioneers are already shining a light on the path forward. Singapore has become a leader in reclaiming and recycling water. Israel leads the world in irrigation efficiency. Ontario, Canada is seeking to build on its internationally recognized water treatment technology sector. There are companies that are developing information systems to detect and monitor water use along the entire length of a city's distribution system; start-ups that are transforming wastewater into new sources of energy or fertilizers and eliminating the waste stream in the process; business clusters that are seeking to standardize best practices and regulations for water recycling; organizations that now track the water risk profile of the world's largest corporations; and investors who are focused entirely on innovation in the water sector. This is the beginning of the 'Blue Economy', an economic paradigm in which water sustainability is rewarded and water profligacy means that a particular city, business, or country is failing. How quickly society is able to shift to this paradigm will determine whether it is up to the challenge.

## 1. Water Fuels the Global Economy

Water is the most valuable and irreplaceable resource on this planet. Without it, there would be no life. There would also be no global economy. As well as being essential for basic human needs, water plays a critical role in the world's key economic sectors, from agriculture and food processing, to oil and gas production, to semi-conductor manufacturing. Water literally fuels the economy.

And the more the economy grows, the greater the demand for water. Over the course of the 20th century, growth in water use outpaced population growth. Per capita water usage has increased from 467 to 634 cubic metres per person per year. For each incremental million dollars that is added to the global GDP, an additional 22,000 cubic metres of water per year is needed (Lux Research, 2008).

By 2030, global withdrawals for agriculture alone could match current global withdrawals for all purposes (2030 Water Resources Group, 2009). This projection does not include withdrawals for municipal, domestic or industrial purposes, all of which are also on the rise, with industrial demand growing at the fastest rate (2030 Water Resources Group, 2009). It is estimated that 40% of this additional industrial demand will come from China, much of it for thermal power generation (2030 Water Resources Group, 2009). The omnipresence of water in our economy is hardly surprising when one considers that water is part of the manufacturing process for nearly every product that is consumed – for cooling, for cleaning, for extraction purposes, or as a direct ingredient. Every time a good is bought or sold, there is a virtual exchange of water which is accounted for through the volume of water that has been used to manufacture a product (Allan, 2011). One estimate from the UK shows that although average household water use, defined as water taken from the tap or flushed down the toilet or sink, is around 150 litres per person per day, the amount of water actually consumed – which includes the water in the goods that are bought – is more than 30 times that much (Chapagain and Orr, 2008).

If the market value of water is more significant than most people realize, water's non-market values are simply staggering. Watersheds provide benefits that literally enable, and enrich, life on Earth. The non-market value of a watershed includes water supply, water treatment, ecosystem support, hydrologic stabilization, carbon storage, pest control, climate regulation, cultural benefits to indigenous communities, and recreational benefits and opportunities for a wide range of land users. Many consider these benefits to be priceless, but by placing a dollar value to them, environmental economists are able to reveal values that are generally hidden from common decision-making metrics, and these values are of larger magnitude than ordinary market values. For example, the non-market value of Canada's Mackenzie River Basin is estimated to be CAD $570.6 billion per year, over 13.5 times the economic value of the extraction industries in the watershed (Anielski and Wilson, 2010).

# 2. The Economic Opportunity in Addressing Water Risks

## 2.1. Risks

As contamination, unsustainable withdrawals, and climate change are threatening the global supply of fresh water, population growth, urbanization and rising incomes are steadily increasing the global demand. Many countries are now facing the reality of a sizable gap between the amount of water they can reliably supply to their economies, and the amount that is actually needed. By 2030, given average economic growth and assuming no efficiency gains, global water requirements could exceed the current accessible, reliable supply by 40% (2030 Water Resources Group, 2009). The situation will be worse in some developing regions, where it is expected that one-third of the global population will be living in basins with a water deficit greater than 50% (2030 Water Resources Group, 2009).

The greatest increase in water demands will come from China, the US and India due to population growth, increasing irrigation for food production, and growth in GDP (Lux Research, 2008). By 2030, demand for water in India and China, the most populous nations on Earth, will exceed their current supplies (2030 Water Resources Group, 2009). The strain on the world's agricultural and industrial sectors will be substantial, as these countries' populations move towards middle-class diets and consumption patterns. The lack of available water will be compounded by issues of water quality. Pollution in China is already so widespread that 21% of available surface water resources are unfit even for agriculture (2030 Water Resources Group, 2009).

In addition to risks to global and national economies, individual sectors are now beginning to identify water as a substantial risk to their bottom-line (Carbon Disclosure Project, 2011). The power-generation, mining, semi-conductor manufacturing, and food and beverage sectors are particularly exposed to water-related risks (JP Morgan, 2008). Many businesses are already suffering water-related impacts. In 2011, Kimberley-Clark reported a US $2 million loss at a facility in Malaysia, while The Southern Company reported US $200 million in unanticipated electricity costs in the US (Carbon Disclosure Project, 2011). The first case resulted in curtailment of production; the second, compensating for reduced hydroelectricity production. Ultimately, both impacts were the effects of drought (Carbon Disclosure Project, 2011).

Risk management is complicated by the fact that exposure to water scarcity and pollution is not limited to onsite production processes, but extends all along supply chains (JP Morgan, 2008). It will be further complicated by climate change, which is making the prediction of key climate variables increasingly difficult and exposing all sectors to the impacts of floods and droughts.

## 2.2. Opportunities

Where there is risk, there is often opportunity. Financial analysts are now predicting tremendous growth potential for the water sector, particularly for those businesses focused on efficiency, re-use and source diversification (Lux Research, 2008). In fact, revenues of the world's water-related businesses are forecasted to rise from US $522 billion in 2007 to nearly US $1 trillion by 2020 (Lux Research, 2008). The challenge to meet rising water demand presents myriad opportunities, in several key areas, including the following:

- ***Upgrading current water infrastructure.*** Domestic water use currently accounts for about 14% of global water withdrawals (2030 Water Resources Group, 2009). The growing global population will need an additional 300 billion cubic metres of water per year by 2030 (2030 Water Resources Group, 2009). Meanwhile, the global water infrastructure deficit – the costs required to upgrade water treatment and distribution systems – is estimated to be a staggering US $26 trillion (Doshi *et al*., 2007). Fixing this infrastructure gap will require substantial investment in maintaining and extending the life of existing infrastructure through leak detection, *in situ* pipe replacement and optimizing water treatment facilities. Water supply and metering companies are therefore well positioned to benefit, as are pipe, valve and pump manufacturers. In developing countries, this market is predicted to grow at 8-10% per year for several years (UBS AG, 2011).

- ***Rethinking future water infrastructure***. Fixing existing infrastructure will help manage existing water demand, but meeting new demand for water will require different approaches to water infrastructure that move away from large-scale centralized engineering projects to decentralized, small-scale technologies and practices that can be deployed at the household or multi-residential scale. These technologies and practices will focus on on-site water and wastewater treatment, re-use and recycling, rainwater capture, water-efficient product design and cooling systems, and supporting green infrastructure such as urban wetlands to slow run-off and filter pollutants (McKinsey Quarterly, 2010a). These solutions will create economic opportunities and jobs for a wide range of innovators from plumbing to landscaping, to manufacturing to urban design and planning. One economic study in the US indicated that direct investments in the order of US $10 billion in urban water efficiency could boost US GDP by US $13-$15 billion and employment by 150,000 to 220,000 jobs, and save between 6.5-10 trillion gallons of water (Alliance for Water Efficiency, 2008).

- ***Getting to closed-loop industrial systems.*** Industrial processes currently account for about 16% of global water withdrawals, increasing to a projected 22% by 2030 (2030 Water Resources Group, 2009). Moving and treating these huge quantities of water in industrial processes such as power production, oil and gas development, or manufacturing of steel is extremely energy intensive. As the price of both energy and water increases, the market for solutions that maximize the efficiency of water is predicted to grow dramatically in just a few years (McKinsey Quarterly, 2010a).

- ***Treating wastewater as a resource***. Increasing attention is being paid to wastewater re-use, recycling treated wastewater, and the possibility of generating revenue from industrial and municipal wastewater streams, such as through energy generation and recovery of metals, fertilizers or other materials. It is believed that new technologies have the potential to convert every municipal wastewater plant into a renewable energy generator (Bloom and XPV Capital Corporation, 2010).

- ***Enhancing water productivity in agriculture***. Agriculture currently accounts for about 71% of global water withdrawals, and more than 80% of total withdrawals in the developing world, so the water challenge is closely tied to food provision and trade (2030 Water Resources Group, 2009; McKinsey Quarterly, 2010b). Companies that develop productivity-enhancing seeds, drip irrigation systems, no-till farming techniques and other agricultural technologies are well positioned to benefit (McKinsey Quarterly, 2010b).

- ***Information technology to enable smart decisions.*** All key water-dependant sectors can be positively affected by information technologies (IT). IT solutions will lead to better data collection and management, real-time monitoring of and responding to dynamic systems, and more efficient use of input materials. The ability to measure, standardize and report metrics is key to sound management. Knowing, for example, the probability of rainfall and the soil moisture of a region and the water and fertilizer requirements of specific crops will enable precision agriculture, which will yield 'more crop per drop' (WWF-UK & SABMiller plc, 2009).

Establishing a global Blue Economy is not just about technological innovation. As the examples in the following section demonstrate, there is substantial policy, human, and financial innovation required in order to create an appropriate enabling environment for solutions such as those outlined above to flourish. Governments need to show leadership and make water innovation a political priority; public education programmes need to be supported to create the necessary public awareness and support; universities and training institutes need to be encouraged to generate the necessary human capacity to innovate, demonstrate and implement; and, financial institutions and investors need to develop knowledge of the opportunities, current and future.

# 3. Pioneers in the Blue Economy

The economic risks and opportunities for water are only just beginning to register for most government and business managers. However, a number of pioneers in the Blue Economy have emerged and are leading the way in the development of new approaches, innovative technologies, and ways of working together to confront the challenge.

## 3.1. Leading jurisdictions

A handful of countries and geographic regions have established themselves as leaders in the 'innovation ecosystems' that lead to the creation of new water technologies, services and practices. For example, despite a lack of abundant local source water, Singapore has recognized the growing opportunities in the water sector and is investing to become a global 'hydro hub' (2030 Water Resources Group, 2009; IBM, 2009). The country's national water agency, PUB, is working to reduce reliance on imported water (from Malaysia) and costly desalinated water by increasing the supply with reclaimed water and driving down demand through a conservation plan. The reclaimed water, called NEWater, involves separating the collection and redirection of wastewater and run-off rainwater and treating used water with advanced-membrane filtration. Through its innovative efforts, Singapore aims to generate roughly 11,000 professional and skilled jobs by 2015 (2030 Water Resources Group, 2009).

Israel is another country with scarce water supplies that has turned a vulnerability into a major asset. Since 1964, the Israeli population has nearly tripled; however, Israeli farmers have succeeded in producing nine times the amount of food with a mere 3% increase in water consumption (IBM, 2009). This productivity is typically attributed to the sector's technological prowess, and indeed Israel is a global leader in precision agriculture. However, this technological advancement was made possible by placing proper valuation on water, investing in advanced education, creating platforms for new business ventures, and developing programmess to attract private funds (Cleantech Group, 2011; IBM, 2009). Israel's Novel Efficiency Water Technologies (NEWTech) programme has produced 26 government-funded water technology incubators, which have attracted nearly US $700 million in private investment (Cleantech Group, 2011). Israel boasts more than 250 water technology businesses, which, when combined, exported US $1.4 billion worth of goods in 2008 (2030 Water Resources Group, 2009).

Scarcity is not the only driver of innovation in water. The need to remove pollutants, to reduce energy and other costs associated with water distribution, and to replace or repair aging water infrastructure, is common to many regions of the world, wet or dry. Governments that share the North American Great Lakes basin, a region that contains 20% of the world's fresh surface water supplies, have identified water as a key economic asset. The region faces challenges related to water pollution concerns, crumbling water infrastructure, and water stress in urban areas located away from the lakes. It is also a region that has gone through economic decline due to a loss in its traditional manufacturing base, particularly in sectors such as auto manufacturing. Meanwhile, it has produced some major technological innovations in water and wastewater treatment, such as the ground-breaking treatment technologies of Trojan Technologies and ZENON Environmental (purchased by General Electric in 2006).

To build on the successes of Trojan and ZENON and as part of a broader push towards a green economy, the Ontario Government in Canada recently passed the Water Opportunities and Water Conservation Act, with the goal of making Ontario the North American leader in the development and sale of water conservation and treatment technologies. To achieve this goal, it has created the Water Technology Acceleration Partnership (WaterTAP) to support research, development and commercialization of new technologies and innovations in the water sector. Similarly, the Milwaukee Water Council in Wisconsin, USA was created to convene and build partnerships between the research clusters and more than 130 water technology companies in the region. The Council aims to establish the Milwaukee region as a 'World Water Hub' for water research, economic development, and education. Another water hub is emerging just south of the Great Lakes basin in southwest Ohio, southeast Indiana and northern Kentucky, USA where, in 2011, the US Environmental Protection Agency (EPA) launched the Water Technology Innovation Cluster (WTIC). WTIC aims to establish the region as a global leader in sustainable, environmental technology innovation, with an initial emphasis on water.

Innovation is not limited to highly developed jurisdictions. The city of Durban, South Africa is working to provide adequate drinking water and sanitation to each resident of its growing population, whether wealthy or impoverished. Low pressure delivery reduces the amount of drinking water lost to leakage. More than 60,000 urine diversion toilets and nearly another

60,000 ventilation improved pit latrines require less water for flushing (IBM, 2009). Yellow waste could one day be used for fertilizing urban crops; black waste, for urban agroforestry (IBM, 2009).

### *3.2. Innovative businesses and partnerships*

Governments have a key role in stimulating the Blue Economy by fostering innovation, supporting commercialization of new solutions, reversing perverse subsidies and establishing the right price signals. But to seize these opportunities, the world is also going to require pioneers that are ahead of governments and can show the way forward.

One pioneer that is establishing itself in this space is IBM. IBM has launched the Global Innovation Outlook (GIO) to convene diverse actors and explore a variety of pressing topics, including the future of the world's water resources. The company is active in promoting advanced information gathering and analysis as a key part of environmental decision-making. And in 2011, it pledged CAD $20 million of technology investment in the Southern Ontario Water Consortium in Canada to partner with eight universities and over 70 companies to create a new platform for innovation in watershed, wastewater and drinking water management.

Examples of pioneering companies can be found throughout the world:

- APTwater: A US company that has developed a revolutionary technology that can remove nitrates and other oxidized contaminants from agriculturally-impacted source water without producing waste.
- TaKaDu: An Israeli company providing software for water utilities to monitor their networks, detect leaks and address inefficiencies in delivery.
- AquaZ: a Danish company making sea water desalination economically viable through the use of biotechnology and nanotechnology.
- Water Health: a decentralized water utility that is delivering access to clean drinking water in underserved communities in India, Bangladesh, Ghana and the Philippines for less than US $10 per person.
- Ostara: a Canadian company that recovers nutrients (nitrogen and phosphorus) from municipal and industrial wastewaters and transforms them into fertilizer.

Business clusters are also beginning to work together to collect, share and standardize data on water conservation and protection (IBM, 2009). For example, a group of 12 international corporations, including Nestlé Waters and The Coca Cola Company, has formed The Beverage Industry Environmental Roundtable to share best practises concerning water resource management. Other businesses have forged partnerships with environmental organizations. SABMiller plc, one of the world's largest brewing companies, has partnered with WWF-UK to address the issues of water scarcity and pollution faced by SABMiller's local businesses and surrounding communities. The partnership has yielded ground-breaking 'water footprints', indicators of water use that consider both the direct and indirect water use of a consumer or producer, and enable the assessment and reduction of water risk (WWF-UK & SABMiller plc, 2009). Another creative partnership, Aqueduct, was formed by several private companies, the Dutch Government and The World Resources Institute, a global environmental think tank. The Aqueduct partnership is a tool that measures and maps water-related risks, and can be used by companies, investors, and others to track water risks at a scale appropriate for developing sound business and investment strategies.

### *3.3. Non-governmental collaborations*

A number of non-governmental organizations are also taking a strong interest in water risk and opportunity. The Carbon Disclosure Project is now producing an annual Water Disclosure Global Report, designed to provide data that informs decision-making, to increase investor and business awareness of the financial risks and opportunities around water, and to report on global standards and corporate practices related to water (Carbon Disclosure Project, 2011). The 2030 Water Resources Group was formed in 2008 to contribute new insights to the issues of water resources scarcity. Its members include McKinsey & Company (a global management consulting firm), the World Bank Group, and a consortium of business partners. In 2009, the Group, guided by hundreds of specialists and public sector practitioners, published the report *Charting Our Water Future: Economic Frameworks to Inform Decision-Making* (2030 Water Resources Group, 2009).

Other non-governmental collaborations, such as The Blue Economy Initiative in Canada, are national in scope. The Blue Economy Initiative is a project founded by the Royal Bank of Canada, the Canadian Water Network and the Walter and Duncan Gordon Foundation. The initiative seeks to catalyze Canadian leadership in the Blue Economy by illuminating the economic benefits of sustainable water management, including risk avoidance, improvements to efficiency and productivity, and the employment and economic opportunities arising from innovation in the water sector (Blue Economy Initiative, 2011).

### *3.4. Investors*

One sign that the Blue Economy is beginning to materialize is the growth of venture capital investment. According to Lux Research, 2007 was water's breakout year as a venture investment category, with 59% of the US $1.12 billion invested in water by venture capitalists coming after this date (Lux Research, 2008). Some venture capital firms, such as XPV Capital, based in Canada, have developed portfolios entirely around the water opportunity. Yet when compared to the broader clean-tech sector, water still garners a relatively modest share, only about 3% of total clean-tech venture investments (Cleantech Group, 2011). Further investment is likely being slowed by concerns about when to market, slow adoption processes, uncertain regulatory environments, and the threat of large competitors (Cleantech Group, 2011).

## *4. Key Principles for the Blue Economy*

To close the growing gap between global water supply and demand, innovations like those mentioned above will need to become increasingly mainstream. For this to happen, successful players in the Blue Economy will be those governments, businesses, organisations and partnerships that heed the following key principles:

- ***Knowing and understanding the value of water***. The world has entered a knowledge-based economy, but many gaps still remain in most countries' basic understanding of water. The starting point needs to be the creation of detailed water accounts that track water systems – rivers, lakes, and aquifers – within a country, including which ones are stressed, how much water is being withdrawn and by whom, which are the dependent ecosystems, and what the requirements are for sustainability. These accounts need to reflect water's many values, including non-market environmental and social benefits, and be incorporated into a full cost pricing of water for all water use sectors.

- ***Adhering to a conservation ethic that underpins the Blue Economy.*** Augmenting the current global water supply will not close the growing gap between supply and demand. Boosting water efficiency and focusing on re-use, recycling and supporting green infrastructure should be the bedrock for the Blue Economy. Increasing water productivity in agriculture will be a fundamental part of the solution as farmers use more than 70% of current global water withdrawals.

- ***Getting the public on board.*** With the exception of countries facing severe water scarcity, the general public has continued to believe that fresh water is abundant. In order to create a public and political appetite for innovation and new approaches, this myth has to be broken. Governments, non-governmental groups and businesses should work together to raise the water literacy of their citizenry.

- ***No one can do it alone***. To date, the brightest innovations have involved active collaboration between governments, the private sector, research institutions, non-profit organizations and communities. Making progress on the Blue Economy requires these creative partnerships to bring together diverse knowledge and expertise necessary to address increasingly challenging water issues.

- ***It's about people, not technology***. The most innovative water technologies will have no value unless the human capacity exists to install, operate and manage them. Moreover, much of the innovation required to stimulate appropriate water solutions will need to come from the people designing the governance frameworks that embed policies, pricing structures, new institutions and incentive programmes to support the Blue Economy.

## 5. The Bottom Line

It is widely acknowledged that water is essential for life, and yet water availability is still being taken for granted. This must change. It is time for all sectors of society to take seriously its role for unearthing and implementing the water solutions necessary to maintain life and well-being. It is time to harness the combined powers of government, business and civil society to reward sustainable approaches to water management and discourage the polluters and profligates. It is time to recognize the true value of water and the importance of a global Blue Economy.

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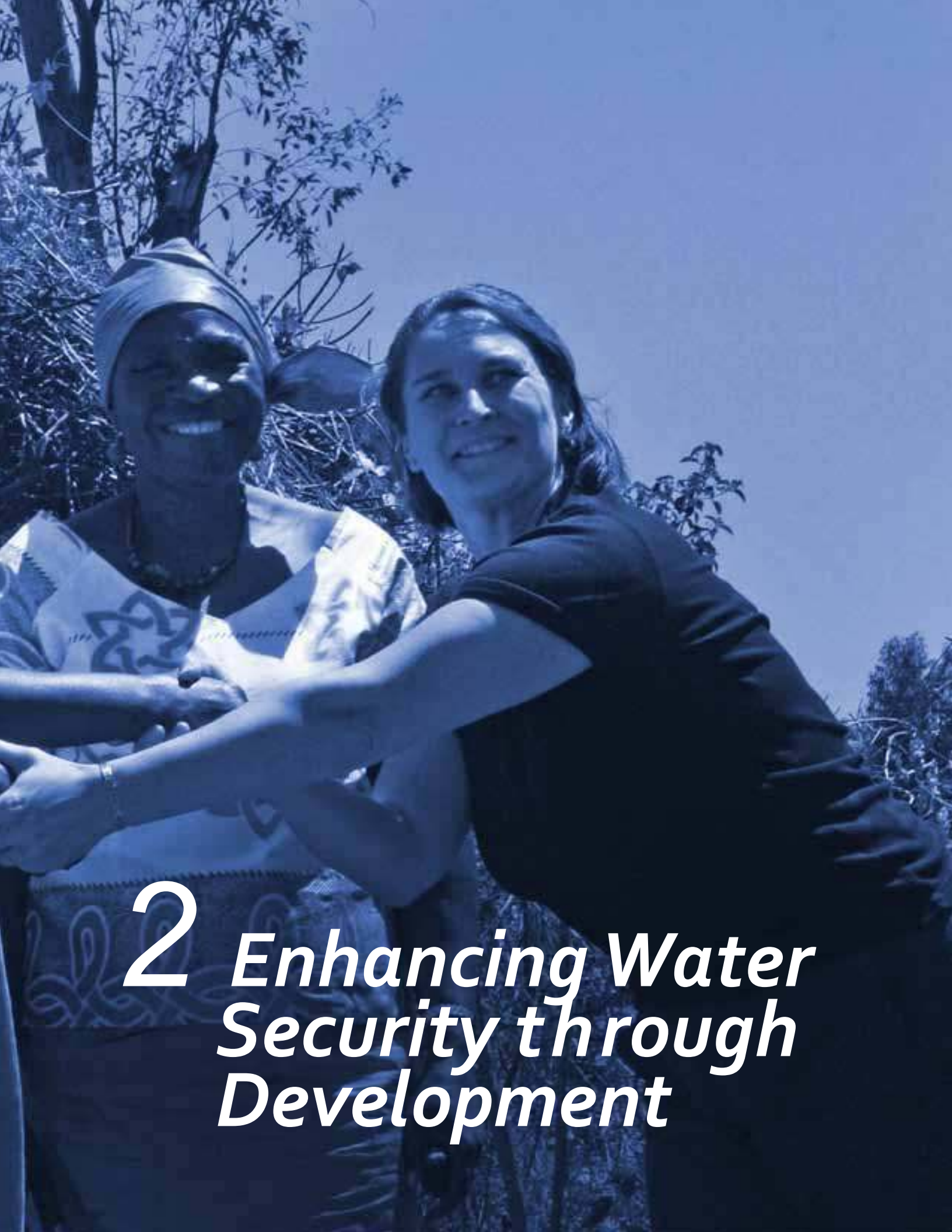

# 2 Enhancing Water Security through Development

# 2.1 A Human Development Approach to Water Security

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## Introduction

The notion of water security has received an increasing level of interest from the international development community as well as research and academic groups. It appears to take vastly different meanings in different groups, audiences and contexts. It is also intertwined with the broader ongoing dialogue around the notions of human security versus national security. Not only does security relate to the more conventional concepts of protecting a country against external threats to its territorial integrity, but also includes non-conventional elements such as human security, economic security, social security, environmental security and protection of infrastructure (Liotta, 2002).

There are two broad interpretations of water security, as follows:

First, it is a matter that relates to the security of nations, their peoples and natural resources. A lack of such security can then be correlated to the potential for armed conflict, civil unrest and outright wars, with countries as the primary players. This territorial- and sovereignty-focused approach has received some credence due to the statements offered by some prominent politicians, statesmen and researchers. The most prominent amongst these is the former United Nations Secretary-General, Mr. Boutrous-Boutrous Ghali, who famously declared in the early 1990s that the next set of wars will be fought over water and not oil (Bencala and Debalko, 2008). Even a superficial analysis debunks this theory, particularly when one considers that the recent major wars in Afghanistan (2001- ), Iraq (2003 -), and Libya (2011) were not motivated by water security. Nonetheless, the notion of water security as one tied to armed conflict has persisted and is often considered as a valid approach in the political science arena.

A second approach has emerged more recently, which defines water security in a more anthropocentric context. It is argued that water security should be construed as a basic and fundamental element of 'human well-being'. Human well-being was defined more broadly in the Millennium Ecosystem Assessment (MA, 2005: v), as follows:

> *"Human well-being is assumed to have multiple constituents, including the basic material for a good life, such as secure and adequate livelihoods, enough food at all times, shelter, clothing, and access to goods; health, including feeling well and having a healthy physical environment, such as clean air and access to clean water; good social relations, including social cohesion, mutual respect, and the ability to help others and provide for children; security, including secure access to natural and other resources, personal safety, and security from natural and human-made disasters; and freedom of choice and action, including the opportunity to achieve what an individual values doing and being."*

The declaration by the United Nations General Assembly in July 2010 of the access to drinking water and sanitation as a basic human right is an explicit manifestation of this latter approach. It recognizes that a lack of access to drinking water and sanitation services is a global human development challenge, and the numbers to support this are staggering: 780 million of those without access to improved sources of drinking water and 2.5 billion without adequate sanitation (UNICEF and WHO, 2012). The worldwide death toll associated with this problem is around 3.5 million each year, about half of whom are children under the age of five. Women and children are the primary victims; in particular, the lives and educations of girls are impacted the most.

It is interesting to note that if we start with the anthropocentric approach to water security and place value on the importance of human well-being, we still arrive at the former approach of securing water resources at the national and international (basin-wide) levels, and minimize the potential for armed conflict as a result. It provides a different lens through which conflicts amongst competitive water users, including nation-states, could be viewed. To take the argument a bit further, it may be argued that water security for the individual has to be one of the ultimate goals for economic and social development and efforts to reduce poverty.

## 1. The Human Development and Security Nexus

The United Nations Development Programme (UNDP) provides a fundamental argument that human security in general can be achieved through an enhanced focus on human development (UNDP, 1994). This is a significant departure from the conventional and dogmatic thinking that security can only be built through strong military apparatus: development of armed forces, acquisition of arms and ammunition. This conventional paradigm further argues that a strong military

apparatus assists nation-states in achieving a strong negotiating position, and ultimately, favourable treaties and conventions. Emerging thinking in the development community increasingly argues that human well-being is tied to having politically viable and economically stable states, which eventually does more to ensure the security of nations as well as individuals in comparison to the more conventional approaches.

The question then emerges: what elements of the international development agenda need to be modified to achieve human security? UNDP (1994) indicates that success in such a development paradigm is contingent on revamping traditional development cooperation so that it encompasses all economic flows within a country. This approach would essentially create a strong link between poverty reduction, economic development and the focus of overseas development assistance. Development of the *Poverty Reduction Strategy Papers* by many developing countries in the late 1990s, with the assistance of the World Bank, International Monetary Fund and other development partners, were manifestations of this thinking (World Bank and IMF, 2005). The main idea remains that the 'development assistance envelope' should be cast wide enough to include national economic flows in addition to the foreign ones. Some have argued that this needs to be taken a step further, with certain fractions of the national budget, say 20% as an aspirational target, set aside in order to directly serve this development agenda. In other words, this 20% of national budgets as well as 20% of foreign aid should be allocated to serving the human security agenda.

Implementing this notion of human security through economic and human development, however, faces a number of roadblocks. In most democracies and almost all dictatorial governments, there are often a number of competing political interests. These political counter-interests typically operate on shorter cycles, whereas successful implementation of a development and human security agenda may require anywhere from 5 to 20 years to be achieved. Politicians, therefore, are inclined to invest more in what are perceived as short-term gains. Reversing this trend requires some detailed policy analysis and documenting evidence in support, as well as ensuring that some short-term benefits are also clearly available.

Another related challenge is the shortage of capital for investment in human development initiatives. Lack of prioritization by governments and insufficient allocation of budgets is typically echoed in the private sector as well as in foreign aid. Private capital investments are typically absent in situations where returns on investment are perceived to be insecure; ironically, this is the case for societies and communities where the need is most often the greatest. This shortage of capital is further exacerbated by the siphoning-off of national funds and foreign aid; corruption remains a major element of this adverse development environment.

Yet another major challenge in effective implementation of the development agenda is the lack of institutional capacity. The gaps in human and technological capacity are further amplified by the absence of institutional structures. In the context of governance, capacity entails the ability of governance institutions – including the legislature, executive, judiciary, civil society and the private sector – to undertake and perform their mandated functions efficiently and effectively. In the context of scientific and knowledge institutions, this capacity entails the ability to understand, analyze and recommend corrective actions based on scientific evidence. In the absence of these institutional elements, best-designed programmes for economic and social development can and have gone astray. Therefore, institutional capacity development must also be a central element of a successful human security, and development, agenda.

## 2. Water as a Building Block for Human Security

Access to safe drinking water and sanitation lies at the heart of human well-being and it is central to developing an international development agenda based on human security. Most prominently, it is now documented that provisioning of safe drinking water and adequate sanitation services can form the basis for reducing poverty – by improving livelihoods, creating jobs for local communities in developing countries engaged in the initiative, removing the cycle of disease that reduces productivity of those without access to these services, and by re-directing the savings in the health sector to other imperatives (UNDP, 2006). Ensuring access to water for human consumption often requires balancing off against other consumptive uses – the most critical being water for agriculture and food production, which presently consumes 70% of global water resources and relates to the Millennium Development Goals around hunger (UN-Water, 2012). Water, thus, gains the center stage in the development agenda.

It is argued in this paper that the following four components must be put in place for water to effectively transform the international and national development agendas.

First, there has to be tangible short-term gains. Such gains are essential to purchase political viability on the one hand, and to create a positive momentum on the other. Political viability can usually be described in the form of economic benefits. Increased economic activity, particularly for the so-called 'base of the pyramid' poorest segment of population, can lead to the creation of new jobs and opportunities for local entrepreneurs. This job growth and enhanced economic activity could be viewed in the context of the emerging 'Green Economy', and more generally as a part of the economic recovery from the financial crisis of 2008 and 2009. Most political and policy players would readily accept creation of jobs alone as a positive and significant public relations element.

Second, there should be mobilization of financial capital and resources for on-the-ground implementation and deployment of services. Presently, the majority of capital emanates from the public sector and is provided as either overseas development assistance or as part of national budgets (UN-Water, 2010). Given the fact that 780 million people are without access to an improved drinking water source and 2.5 billion are without access to adequate sanitation services, the current *modus operandi* of depending on public sector financing is clearly insufficient (UNICEF and WHO, 2012). Additional capital needs to be mobilized through effective engagement of the private sector, while providing adequate and effective oversight for it through the public sector. Such capital mobilization requires a policy environment that is conducive to protecting investments from the private sector; political stability itself plays a key role in providing assurance to investors. While there are many models and examples of public-private partnerships, the rate of successes and failures are likely comparable, pointing to the need for a careful analysis of private sector engagement and involvement of all stakeholders in designing initiatives around public service provisioning.



Third, there must be a mechanism in place that can minimize corruption and graft, which lead to the loss of a significant amount of resources. Systematic statistics on corruption are difficult to come by; Transparency International estimates that about 20 to 40% of official development assistance gets siphoned off due to corruption (Transparency International, 2009). This leads not only to the loss of critical financial resources, but also in overall ineffectiveness of solutions and services that are eventually provided; many donor agencies and development banks now impose constraints around 'good governance' as a counter-measure. Overcoming corruption is a great challenge for most developing countries, but a number of broad approaches have led to significant improvement. Wide stakeholder engagement, particularly of the communities that are to be recipients of a development initiative, can lead to greater transparency and public pressure – both critical in minimizing corruption. Greater transparency in information flow on the one hand and enabling watchdog organizations on the other can also significantly reduce the impacts of corruption.

Fourth, institutional capacity development must be centralized into all development initiatives. These institutions range from enabling and strengthening community-based organizations to national legislations to those involved in undertaking applied research, analysis and development. Enabling institutional development presently receives scant attention from the international development community; that needs to change drastically if truly sustainable and long-term development solutions are to be successful. Such change requires a major re-prioritization of overseas development assistance. We can argue that the United Nations system can play a central role in such capacity development efforts. Through its various organizations and agencies, the UN system collectively possesses the technical resources, the human resources, and the linkages with national and sub-national governments that are needed for institutional capacity development. Coordination mechanisms like UN-Water, including the United Nations Water Decade Programme on Capacity Development (UNW-DPC), must play a central role in bringing together the resources for assisting UN country teams and the responsible government agencies.

## Conclusions

A broader perspective around water security is essential for bringing about a positive change – and such change has to relate to economic and social development, and must eventually lead to improvements in human well-being. Water security is also closely tied to other elements of security: national security, human security and security against calamities caused by a multitude of factors including terrorism, climate-related extreme events and natural disasters, among others. The UN Security Council already considers climate change to be an issue that falls under its purview, and even those climate change issues are manifest as extreme water-related events: floods, cyclones, hurricanes and droughts. Similar and augmenting arguments can be made that water also relates to all dimensions of security, and recognizing and addressing it as such can help to achieve international and national security overall.

By ensuring that the international and national development agenda is addressing the fundamental issues around water – not just drinking water and sanitation services, but also including issues pertaining to competitive uses of water by various sectors – we can ensure that human security is achieved. This holistic view also helps to address other pressing concerns around human development: the creation of green sustainable jobs and reducing poverty, including in the agricultural sector; reducing impacts on human health and the burden on the public health sector; improving maternal and child health; increasing sustainability of ecosystems; helping to increase the education level in developing countries, particularly for girls; and, ensuring that proper institutions are in place for effective governance and development.

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# 2.2 Water and Health Security

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# Introduction

Clean and safe water is an important resource in building healthy and progressive communities. By widening and enhancing access to clean and safe water, nine percent of the global burden of disease can be alleviated and 3.5 million deaths can be prevented annually (Prüss-Üstün *et al*., 2008). The socio-economic impacts from the prevention of water-related deaths and diseases are tremendous; for each US $1 invested in improving access to water, communities reap benefits in productive time and avoidance of treatment costs worth between US $2-$12 (Edwards, 2011).

Today, safe water supply evades some 780 million people, or approximately 11% of the world's population (UNICEF and World Health Organization, 2012). From an overall perspective, this is a marked improvement from 1990, where almost one-quarter of the global population did not have access to clean and safe water. However, these improvements were mostly made in East and South Asia; countries in the sub-Saharan Africa and Pacific regions still lack adequate access, with each region registering water supply coverage of 61% and 54% respectively (UNICEF and WHO, 2012). It is no coincidence that cholera, a disease that thrives where there are deficits in water and sanitation, is prevalent in both these regions[1].

As efforts continue to connect the growing global population to safe water supply, considerations need to be afforded to demographic, economic and social pressures. These pressures not only affect access, but also the quantity and quality of water supplies. Mounting pressures could cause increases in a country's virtual water need, that is, the water used to produce goods and services. Higher consumption of virtual water not only affects the sustainability of access of communities already linked to water supplies, but also the availability of water to communities that have not gained access to water as resources are diverted to meet other existing demands (see Box 1 on Water Shortages in China).

This paper examines the linkages between water security (in terms of quantity and quality) and human health, summarizes potential health impacts from water deficits, and examines the implications for socio-economic development.

**Box 1. Water Shortages in China**

China faces water shortages from the singular and interactive effects of high water losses through supply infrastructure, effluent contamination, and rising water demand from the agricultural sector. These shortages greatly affect food production, the largest water user in China (constituting 71% of China's total freshwater demand) (Amarasinghe *et al*., 2005).

As a workaround solution to fulfill domestic demand for food, China has begun to establish farms in Argentina, Australia, Brazil, Kenya, Russia and Zimbabwe (Economy, 2011). China's virtual water consumption has clearly grown, but the burden of meeting this demand has been shifted to other countries.

# 1. Water Quality and Health

Rivers, lakes, and aquifers are vulnerable to pollutants, which intensify the occurrence of water-related diseases by impairing water use, and introduce new health risks associated with the presence of pollutants in the human body. Pollutants can be broadly categorized as human-induced, or naturally occurring. Human-induced pollutants enter waterways through unmitigated discharge of untreated or insufficiently treated domestic and industrial wastewater (point sources), and agricultural run-off (non-point source). Pollutants that occur naturally, also termed geogenic pollutants, are usually found in groundwater. The concentration of geogenic pollutants in groundwater resources may be aggravated by human activities that infiltrate or fracture the surrounding rock or substrata.

[1] In 2009, of the 206,183 cases of cholera reported worldwide, 98.7% cases occurred in sub-Saharan Africa, with the remainder occurring in the Pacific (World Health Organization, 2011b).

### *1.1. Human-induced Pollutants*

Domestic wastewater comprises dissolved and suspended impurities from households. Untreated or insufficiently treated wastewater is typically contaminated with human excreta, which can cause traditional health risks. In recent years, domestic wastewater has been observed to contain trace quantities of pharmaceutical and narcotics, which would present health risks over prolonged exposure. However, in studies conducted in Australia, the United Kingdom and the United States, scientists assure that such risks are highly unlikely as the level of contaminants do not approach significant levels (WHO, 2011a).

Pollutants found in industrial wastewater can be broadly classified into three categories: chemicals and heavy metals, organic matter, and fouling substances such as oil. The release of these pollutants into waterways varies by industry, which runs the gamut from manufacturing to mining to power generation. In most countries, there exists standards guiding the treatment of wastewater for release into waterways; however, these standards may not always be observed or implemented. Thus, water sources that receive industrial effluents may become tainted, and present health risks when used for drinking water or irrigation (see Box 2 on Contaminated Crops in India).

**Box 2. Contaminated Crops in India**

In Varanasi, a suburban middle-sized city in India, treated and untreated wastewater is used to irrigate crops. Over the long term, heavy metal pollutants (cadmium, copper, lead, zinc, nickel and chromium) from the wastewater have leached into the soil, and can be detected in significant amounts in the vegetables grown in these farms.

While concentrations vary depending on the type of vegetable grown and the part of the vegetable that was sampled, some of the detected amounts greatly exceed allowable limits, rendering these vegetables unsafe for consumption. Figure 1 below illustrates lead concentrations in spinach grown in Varanasi.

Source: Singh *et al.,* 2010

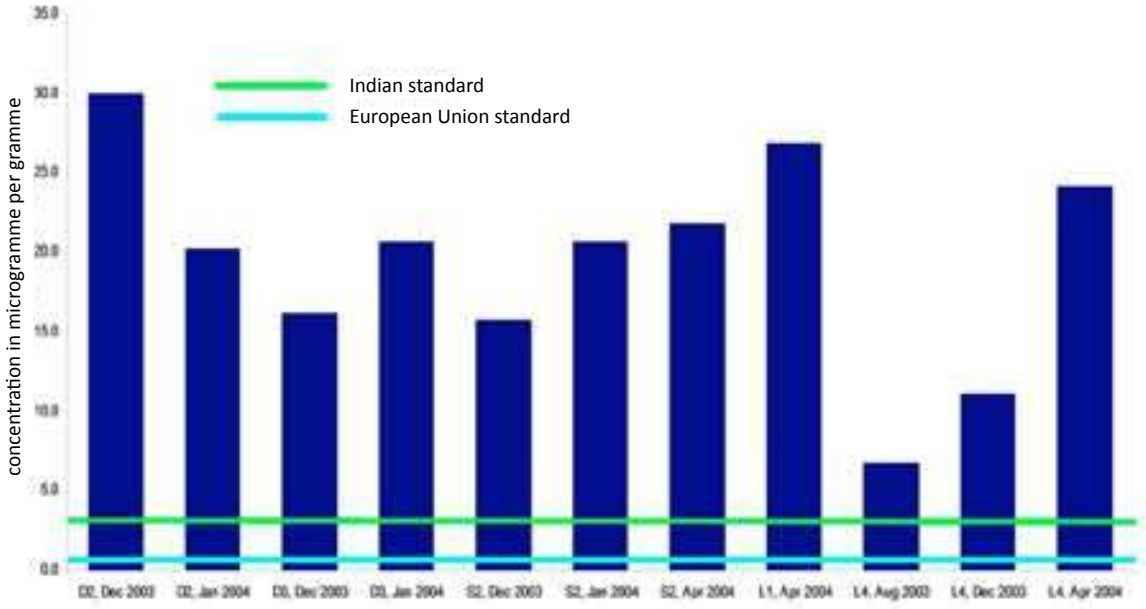


*Figure 1. Concentration of lead in spinach grown in different seasons at different sites across Varanasi, India (Source: Singh et al., 2010)*

Agricultural pollutants include chemical compounds from fertilizers and pesticides, and animal waste. Run-off from farmland washes away into open water sources, causing contamination, oxygen depletion and eutrophication (see Box 3 on Eutrophication in Lake Tai, China). Pesticides, which can leach into aquifers through soil, are also at risk of entering the food chain through bio-accumulation.

**Box 3. Eutrophication in Lake Tai, China**

The Lake Tai basin, which hosts Wuxi and Shanghai among other cities, generates more than 20% of China's gross domestic product (GDP). Lake Tai, the main water source of the basin, nourishes more than 30 million residents.

In 2007, Lake Tai experienced a blue-green algal bloom, thought to be facilitated by phosphorus-rich agricultural and industrial run-off from the 1,300 industries situated within the basin. Blue-green algae release a chemical substance called microcystis, which causes vomiting, diarrhoea, headache, muscle pain, paralysis, respiratory failure or even death when consumed. Realizing the detrimental effects of this incidence, the Chinese government has since implemented efforts to clean Lake Tai by 2012.

*(Source: Pangare et al., 2012.)*



### *1.2. Naturally-occurring Pollutants*

In some regions, geogenic elements such as arsenic, fluoride and iron can be found in groundwater resources. While naturally occurring, human activities such as mining and groundwater extraction can cause these elements to accumulate further in groundwater (see Box 4 on Groundwater Resources in Bangladesh). Prolonged exposure to these elements may result in serious health problems and deformities.

**Box 4. Groundwater Resources in Bangladesh**

In low-lying Bangladesh, surface waters are rife with organic contaminants, and are unfit for consumption. Large-scale programmes were introduced by aid agencies to introduce the use of groundwater, thought to be relatively safer than untreated surface water sources.

However, in the past three decades, it was discovered that aquifers in Bangladesh had high concentrations of naturally-occurring inorganic arsenic. The high concentrations observed are thought to be triggered by the short period in which groundwater extraction was undertaken (Pangare *et al.*, 2006). It is estimated that 60% of the wells established throughout the Ganges-Brahmaputra river basin are abstracting water with arsenic levels exceeding WHO limits, leading scientists to conclude that between 35-77 million Bangladeshis are at risk of arsenic poisoning (Smith *et al*., 2000).

*Table.1. Water pollutants and human health impacts (adapted from Pangare et al., 2006).*

| Pollutant | Pathway into water | Impacts |
|---|---|---|
| Arsenic | • Natural occurrence in groundwater | • Cancer of the bladder, lung and skin<br>• Birth defects<br>• Skin lesions<br>• Gangrene<br>• Respiratory ailments |
| Fluoride | • Natural occurrence in groundwater<br>• Artificial introduction to groundwater through mining | • Dental and skeletal fluorosis<br>• Gastrointestinal disorders<br>• Infertility<br>• Kidney impairment |
| Nitrate | • Artificial introduction to surface water through use of fertilizers and industrial wastewaters<br>• Nitrate-based fertilizers applied excessively leaches into groundwater | • Methemoglobinemia in infants<br>• Oral and gastrointestinal cancers<br>• Vascular dementia<br>• Absorptive and secretive functional disorders of the intestine<br>• Neural tube defects |
| Persistent organic pollutants (POPs) | • Surface run-off contaminated with herbicide and pesticides<br>• Herbicide and pesticide leaching into groundwater | • Acute poisoning causes skin and eye irritation, respiratory problems, systematic poisoning and death<br>• Continuous exposure causes nervous disorders, anaemia, sterility, mental deterioration, birth defects, premature birth, neonatal deaths and cancer |
| Heavy metals | • Natural occurrence<br>• Discharged as effluent from manufacturing, mining and thermal power plants | • Multiple health impacts including but not limited to organ damage and failure, impairments in human development, genetic disorders, cancer |

Water-related diseases are caused by consumption or contact with water contaminated with pathogens such as bacteria, parasites or viruses. Contamination may occur at source, en route while passing through poorly laid and maintained pipelines, or at water storage facilities that have not been effectively secured. Source contamination occurs at unimproved open water sources, such as lakes and rivers. These open sources are used for multiple purposes, including *in situ* bathing and washing, which facilitates the transfer of germs from infected individuals to the water bodies. Poor water infrastructure allows pathogens from the surface or the surrounding substrata to enter the water supply; this is especially critical when sewer systems are similarly inadequate as sewage may mix with drinking water. Stored water that is left uncovered and stagnant provides vectors such as mosquitoes with breeding grounds, and encourages the proliferation of pathogens.

Health risks related to poor water and sanitation facilities are termed 'traditional risks' (WHO, 2009), and are typically associated with poverty. These risks are commonly seen in developing countries, but permeate developed countries as well, particularly in marginalized communities such as those living in slums or in rural areas. The World Health Organization in 2009 estimated that in low-income countries, water-related diseases are the second leading cause for loss of healthy life, and the fourth leading cause of death (WHO, 2009).

About half of all water-related diseases are linked with pathogens found in human excreta (Pangare *et al.*, 2006). These diseases are categorized as diarrheal diseases, and are responsible for 2 million deaths each year. Other diseases related to water are those that are vector-borne, or water-washed (related to person-to-person contact) (see Table 2).

*Table 2. Water-related diseases (adapted from Lvovsky, 2001; Pangare et al., 2006; and Prüss-Üstün et al., 2008).*

| Disease category | Diseases | Disease type | Transmission |
|---|---|---|---|
| Diarrheal diseases | Diarrhea, cholera, dysentery, typhoid, amoebiasis, giardiasis, rotavirus gastroenteritis | Gastrointestinal infection | Faecal-oral route; drinking water contaminated with faecal matter |
| Vector-borne diseases | Lymphatic filariasis, malaria | Parasitic infection | Borne by black flies and mosquitoes which breed in stagnant water |
| | Dengue, Japanese encephalitis, yellow fever | Viral infection | Borne by black flies and mosquitoes which breed in stagnant water |
| | Schistomiasis | Parasitic infection | Borne by aquatic snails |
| Blindness | Onchocerciasis | Nematode infection | Borne by black files |
| | Trachoma | Bacterial infection | Person-to-person contact; water deficits result in poor personal hygiene and increased risk of transmission |
| Cutaneous diseases | Dracunculiasis | Nematode infection | Drinking water contaminated with nematodes |
| | Scabies | Parasitic infection | Person-to-person contact; water deficits result in poor personal hygiene and increased risk of transmission |
| Paralysis | Poliomyelitis | Viral infection of the central nervous system | Faecal-oral and oral-oral routes; drinking contaminated water |
| Liver disease | Hepatitis A and E | Viral infection | Faecal-oral route; drinking water contaminated with faecal matter |



## 2. Implications for Social and Economic Development

Water is required for human and domestic consumption and for productive purposes at different levels, from household to national. There are minimum standards of water quality required for different uses. However, increasing global water scarcity and deteriorating water quality as a result of pressures and demands and competition for water resources from different sectors often necessitates the use of water which may not meet the quality standards for particular uses. The problem is aggravated due to inadequate disposal of polluted or contaminated water in water bodies such as rivers, lakes and wetlands. In addition to increasing health risks for nearby populations from contact with these water bodies, the toxins that accumulate in these water bodies have a negative impact on the environment, destroying aquatic plant and animal life. Consumption of fish from these contaminated water bodies can also be harmful for humans and animals.

Greater use of poor-quality water for consumption and production purposes increases health risks in the community. For example, over-extraction of groundwater for drinking, agriculture and industry has increased the incidence of fluoride and arsenic in these water sources. Many people are forced to drink fluoride-contaminated water due to the scarcity of safe fresh water. In India alone, more than 90 million people are at risk from fluoride-related health problems (Pangare *et al.*, 2006) (see also Box 4 on Groundwater Resources in Bangladesh).

In many urban and semi-urban areas, treated or partially treated wastewater is used for irrigation. The UN World Water Development Report 2003 estimates that approximately 10% of total irrigated land in 50 countries is irrigated with raw or partially diluted wastewater (UNESCO, 2003). Untreated wastewater contains pathogens, many of which can survive in the environment, on crops and soil, and enter the food chain posing health risks to farmers and their families and consumers in nearby communities (see also Box 2 on Contaminated Crops in India). But wastewater also contains nutrients that are beneficial for crop production, reduces the requirement for adding chemicals and fertilizers, and contributes to water and nutrient conservation. While it is true that the use of wastewater for irrigation has its advantages in terms of providing a low-cost source of water for food production and for use in urban and peri-urban areas in water-scarce regions, it is important to ensure that the costs of the health risks do not outweigh the benefits.

Water-borne or water-related diseases such as diarrhea, which is widely prevalent, can cause long-term damage to households and the local economy. Individuals suffering from these illnesses are unable to work, study or provide for their dependents. Illness in the household also increases the work burden of caretakers, particularly women. Chronic or long-term water-related diseases are aggravated by poverty, and in turn cause heavy economic and welfare losses to the individual and the household. At an aggregated level, particularly in developing regions or in countries that have limited or inadequate health care provisions, the local or national economy could be adversely affected by the loss of productive manpower and public health costs. The Economics of Sanitation Initiative[2] of the Water and Sanitation Programme of the World Bank estimates that the annual economic losses from inadequate sanitation amount to between 1%-2.5% of GDP, with the majority of these costs coming from premature deaths, including in children under the age of five (Water and Sanitation Programme, 2012).

## *Conclusion*

The implications of inadequate water security, whether in terms of access, quantity or quality, are of great concern. Clean and safe water is the keystone to healthy ecosystems and healthy communities as prolonged exposure to pathogens and toxic elements will negatively affect human populations and ecosystem biota. An important step towards improving and safeguarding public and ecosystem health would be to include and monitor health-based targets, for both humans and ecosystems, along with economic targets in political and government agendas. Government leaders and finance ministers need to understand the relationship between clean and safe water, improved health and GDP. Political will combined with behaviour change of users and consumers and a change in attitude and mindset of decision-makers is necessary to ensure that national priorities for water use and allocation take into account public and ecosystem health.

[2] The Economics of Sanitation Initiative studies conduct quantitative and qualitative assessments of the impacts of poor sanitation on health, water, tourism, and other welfare impacts. The impacts stem from well-established links between: sanitation and disease incidence; water pollution, which also affects the productivity of water resources by way of lower fisheries output; productivity in work and school; and a country's attractiveness as a tourist destination. Health and water resources contributed most to the overall economic losses estimated in the study. Poor sanitation, including hygiene, caused at least 180 million disease episodes and 100,000 premature deaths annually. The resulting economic impact totalled more than US $4.8 billion per year (Water and Sanitation Programme, 2012).

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# 2.3 Water, Sanitation, Hygiene and the Millennium Development Goals

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# Introduction

In September 2000, world leaders came together to commit their nations to a new global partnership to reduce extreme poverty. They set out a series of time-bound targets – with a deadline of 2015 – that have become known as the Millennium Development Goals (MDGs):

Goal 1: Eradicate extreme poverty and hunger
Goal 2: Achieve universal primary education
Goal 3: Promote gender equity and empower women
Goal 4: Reduce child mortality
Goal 5: Improve maternal health
Goal 6: Combat HIV/AIDS, malaria and other diseases
Goal 7: Ensure environmental sustainability
Goal 8: Develop a global partnership for development



Perhaps no set of interventions underpins the attainment of these Millennium Development Goals more critically than water, sanitation and hygiene (WASH). Water supply and sanitation targets were included under MDG 7, calling on the world to reduce by half the proportion of people without access to water and sanitation. However, the impact of water and sanitation is felt across many sectors, cutting across several MDGs (Table 1). Water scarcity, degrading water quality, lack of access to both adequate sanitation and clean drinking water, and poor hygiene increase disease, contribute to malnutrition, disadvantage women, undermine economic growth, and threaten development, peace and security.

*Table 1.The Impact of water, sanitation and hygiene on development goals.*

| Sector and related MDG | Impact of Water, Sanitation and Hygiene (WASH) |
|---|---|
| **Health, Nutrition, HIV/AIDS (MDGs 4, 6)** | ▪ 88% of diarrheal deaths are attributable to poor WASH (WHO, 2002; UNICEF, 2006)<br>▪ Nutritional status is compromised by frequent episodes of diarrhea and intestinal worm infestations<br>▪ Hand washing is linked to reductions in acute respiratory infections (Ensink, 2008; Jefferson *et al.*, 2009; Luby *et al.*, 2005) and reduced infant mortality (Rhee *et al.*, 2008)<br>▪ Improved WASH helps reduce helminths, guinea worm, fluorisis and arsenicosis (Fewtrell *et al.*, 2007)<br>▪ Good hygiene helps people living with HIV/AIDS avoid opportunistic infections |
| **Education (MDG 2)** | ▪ It is estimated that 443 million school days are missed every year due to water and sanitation related diseases (UNDP, 2006)<br>▪ Improving WASH in schools has an impact on enrollment and retention, especially for girls (IRC, 2007; UN-Water, 2009; Njuguna *et al.*, 2008) |
| **Poverty (MDG 1)** | ▪ 5.5 billion productive days per year are lost due to diarrhea and the burden of water collection (Fewtrell *et al.*, 2007) |
| **Gender Equity (MDG 3)** | ▪ Women and girls, who are most commonly the primary water collectors in families, spend many hours collecting water (WHO/UNICEF, 2010)<br>▪ Lack of sanitation in schools is a barrier to girls' attendance |

# 1. The Impacts of Poor Water, Sanitation and Hygiene on Health, Nutrition, Gender Equity and Poverty

## 1.1. Health

The disease burden caused by poor water, sanitation and hygiene is significant. For instance, soil-transmitted helminthes (hookworm, roundworm, ringworm) infest approximately 2 billion people worldwide. Shistosomiasis infects and debilitates 200 million people. Trachoma, a disease related to poor sanitation and hygiene which can cause blindness, infects 5 million people. However, the most serious health impact of poor WASH is diarrheal disease, particularly on children. It is estimated that there are 2.5 billion cases of diarrhea every year, mostly among children under two, and that this results in 1.5 million child deaths every year, of which 88% are attributable to poor water, sanitation and hygiene (WHO, 2002; UNICEF, 2006).

## 1.2. Nutrition

WASH conditions are also a determinant of nutritional status. One multi-country analysis showed that improvements in sanitation were associated with height increases among children (Esrey, 1996), and it is estimated that 25% of all stunting in 24-month old children is attributable to having five or more episodes of diarrhea (Checkley *et al.*, 2008). Furthermore, it is hypothesized that a key cause of child under-nutrition is a subclinical disorder of the small intestine known as tropical enteropathy, caused by faecal bacteria ingested in large quantities by young children living in conditions of poor sanitation and hygiene (Humphrey, 2009).

## 1.3. Gender equality

Inadequate access to water and sanitation also hinders progress on achieving gender equality. In most households, women and girls are the primary carriers of water, and often need to travel more than 30 minutes round trip to collect water (see Figures 1 and 2); this is particularly true in sub-Saharan Africa. The resultant 'time poverty' of women and girls reinforces inequalities within households and communities, creating barriers for women and girls in terms of schooling, time to care for young children, literacy, rest, leisure, and opportunities to participate in the development of their communities.

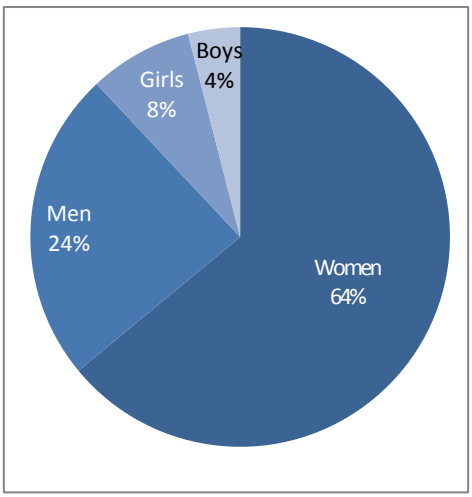


*Figure 1. Distribution of those in the household who usually collect drinking water, from surveys in 45 developing countries, 2005-2008 (WHO/UNICEF, 2010).*

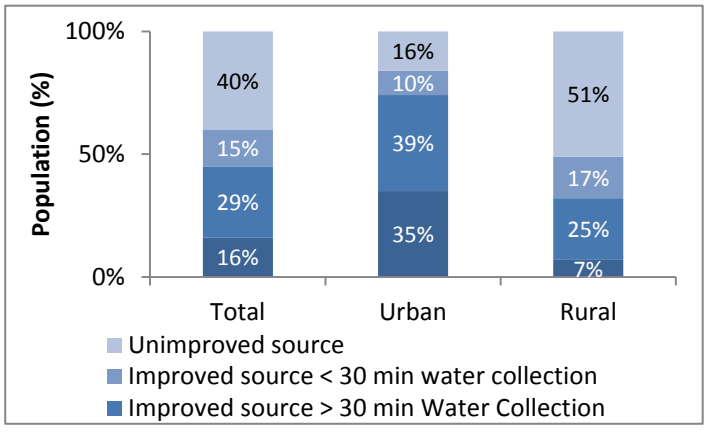


*Figure 2. In sub-Saharan Africa, one-third of the improved drinking water sources that are not piped on premises need a collection time of more than 30 minutes (WHO/UNICEF, 2010).*

Girl children risk being deprived of the opportunity to attend school because of their water collection responsibilities. Girls are also more likely to drop out of school and their parents are more likely to withdraw them if schools lack appropriate sanitation facilities that offer privacy and dignity (Redhouse, 2004; UNGEI, 2003). The barrier to girls' education created by a lack of safe and private school toilets is particularly tragic in light of the enormous development impact that educating girls has been shown to have.

### *1.4. Poverty*

Investments in sanitation and drinking water lead to increased economic productivity, while underinvestment is known to slow progress. For instance, inadequate sanitation imposes a high economic cost through impacts on health and tourism, as well as on the time and treatment costs as a result of distant access to facilities and poor water quality. In India alone, it has been estimated that inadequate sanitation has an economic impact of a staggering US $53.8 billion per year – equivalent to 6.4% of India's GDP in 2006 (WSP, 2011). It is estimated that for every US $1 invested in sanitation, an average of US $9 is returned in increased economic development (UNDP, 2006). Meeting the sanitation and drinking water targets by 2015, which would still leave millions un-served, would have an annual economic benefit of US $38 billion to developing countries (Hutton *et al.*, 2007).

Water, sanitation and hygiene have also been shown to be highly cost-effective investments. For instance, an analysis of the cost-effectiveness ratio of a number of interventions against diarrheal disease shows that WASH interventions, particularly those based on promotion, have low costs per DALY[1] compared to vaccination interventions, or treatment, such as oral rehydration, once diarrhea has been contracted (Jamison *et al.*, 2006) (see Table 2).

*Table 2. Cost-effectiveness ratio of various interventions against diarrheal disease (Jamison et al., 2006).*

| Interventions against Diarrheal Disease | Cost-effectiveness ratio (US$ per DALY averted) |
|---|---|
| Cholera immunizations | 1,658 to 8,274 |
| Rotavirus immunizations | 1,402 to 8,357 |
| Measles immunization | 257 to 4,565 |
| Oral rehydration therapy | 132 to 2,570 |
| Breastfeeding promotion programmes | 527 to 2,001 |
| Latrine construction and promotion | ≤ 270 |
| House connection water supply | 223 |
| Hand pump or stand post | 94 |
| Water sector regulation and advocacy | 47 |
| Latrine promotion | 11.15 |
| Hygiene promotion (including hand washing) | 3.35 |

## *2. Slow Progress and Inequities: The Challenges for the Water, Sanitation and Hygiene Sector*

Despite their importance in development, water, sanitation and hygiene still receive insufficient global attention. While progress towards the achievement of the MDG target for water is on track for many regions of the world, the world still lags far behind on the sanitation target, which is predicted to be missed by over 1 billion people (see Figures 3 and 4) (WHO/UNICEF, 2010).

[1] Disability-Adjusted Life Year, a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.

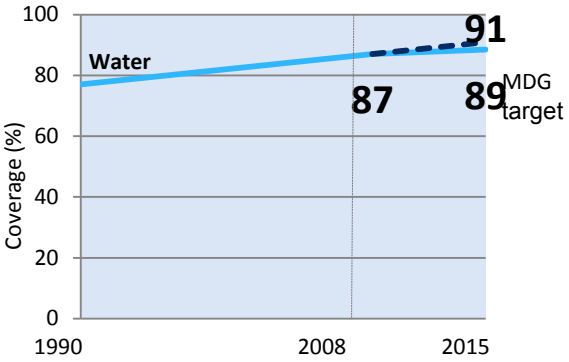


*Figure 3. Progress towards the MDG target for water (WHO/UNICEF, 2010).*

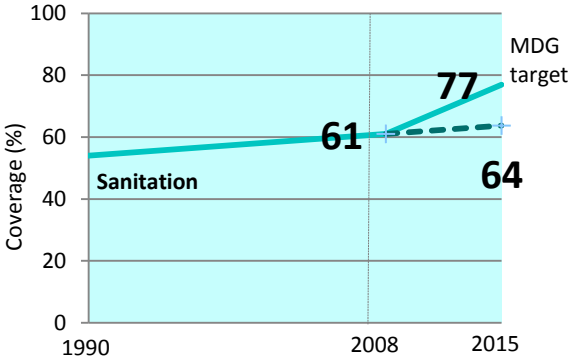


*Figure 4. Progress towards the MDG target for sanitation (WHO/UNICEF, 2010).*

However, if we examine the apparently good progress made towards the MDG target on water supply more carefully, we see that it is very uneven (Figure 5). Rural water supply lags significantly behind urban supply, and in certain regions, particularly sub-Saharan Africa, rural coverage is very low.

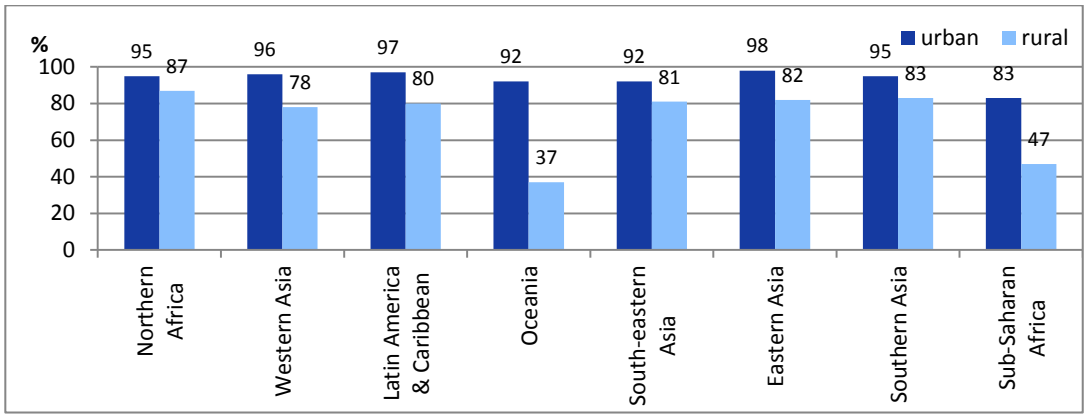


*Figure 5. Use of improved drinking water sources in urban and rural areas by region (WHO/UNICEF, 2010)*

Likewise, there is significant variation in sanitation coverage by region (Figure 6). South Asia, one of the world's most populous regions, has only 57% sanitation coverage in urban areas, and 26% coverage in rural areas. In India, there are 880 million people who have no sanitation at all and practice open defecation.

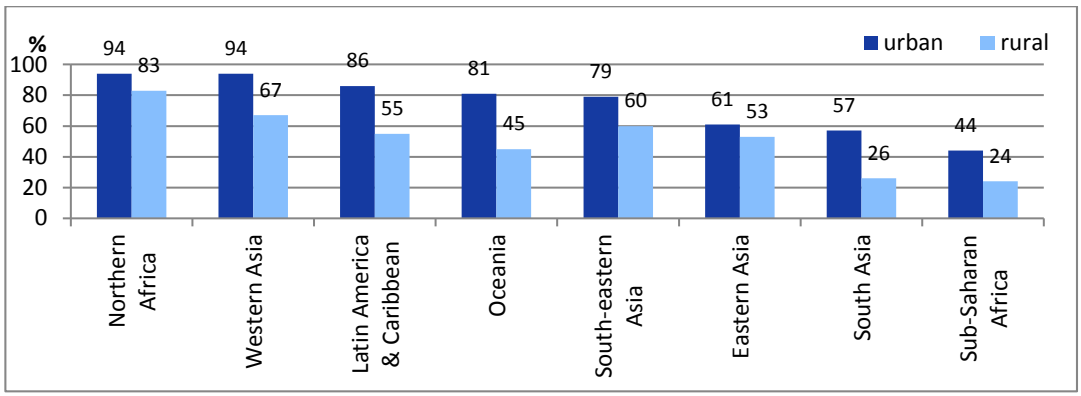


*Figure 6. Use of improved sanitation in urban and rural areas by region (WHO/UNICEF, 2010).*

As well as geographic and gender disparities, stark disparities exist based on wealth, particularly for sanitation. For example, as Figure 7 shows, in sub-Saharan Africa, 63% of the lowest wealth quintile, that is, the poorest fifth of the population, practices open defecation, compared to only 4% of the richest. This is even more pronounced in South Asia, where 86% of the poorest quintile practices open defecation, compared to only 2% of the richest and 21% of the second richest. In many countries, open defecation is the norm for the poor, and is in fact one of the defining characteristics of poverty.

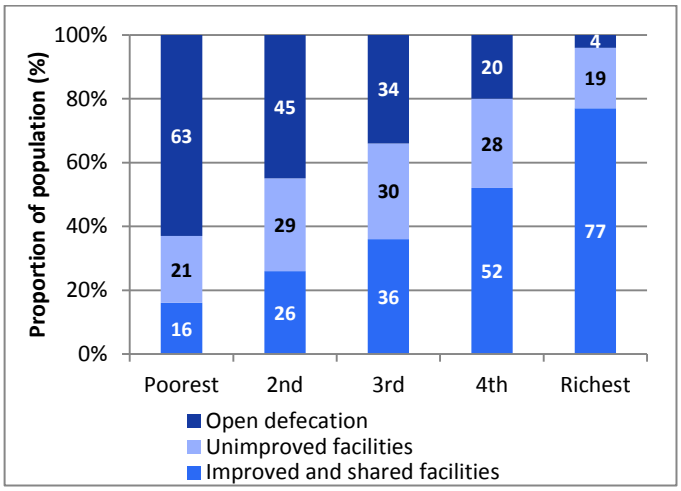


*Figure 7. Proportion of the population using an improved, shared or unimproved sanitation facility or practicing open defecation, by wealth quintile, sub-Saharan Africa (WHO/UNICEF, 2010).*

While water supply is not as inequitably distributed as sanitation, in sub-Saharan Africa, the richest quintile is twice as likely to use an improved drinking water source as the poorest (Figure 8). It must also be noted that availability of piped water on the household premises is largely the privilege of the rich, with very few poor people having access to this level

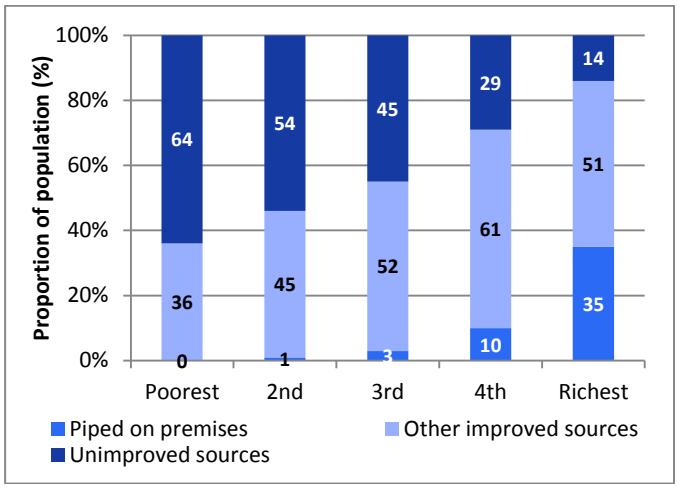


*Figure 8. Proportion of the population using drinking water piped on premises, other improved drinking water source or an unimproved source, by wealth quintile, sub-Saharan Africa (WHO/UNICEF, 2010).*

of service that offers so many health and time-saving benefits (WHO/UNICEF, 2010).
People without access to water supply and sanitation are thus caught in a vicious cycle in which lack of access leads to poverty, which in turn prevents people from having the ability to gain access to services. Lack of access to water and sanitation is thus both a cause and an effect of inequity, poverty and underdevelopment.

## 3. The Neglect of the WASH Sector and the Need for Global Attention

So what is needed? We need low-cost interventions that reach the poorest and most vulnerable, and we need them at an enormous scale. We need to improve access to safe water supply, increasing the number of water supply points and reducing their distance from people, in order that the health benefits can be realised, and that the burden of water collection can be lifted from women and girls. But even more urgent is the need to vastly increase sanitation coverage.

However, despite its importance, the experience of the sector has been that water, sanitation and hygiene are often neglected by donors and governments.

Recent analyses of investment flows show that both donor aid and developing country national budget allocations in the sector are not well targeted to achieve the MDGs. For example, despite significant increases in investments going into the sector, only 42% of sector aid goes to low-income countries (Figure 9), and only 16% is invested in 'basic' systems that primarily serve the un-served (Figure 10) (WHO, 2010). The flow of assistance into the sector thus matches the outcomes – the poorest countries receive little assistance, and the poorest people within those countries continue to be excluded.

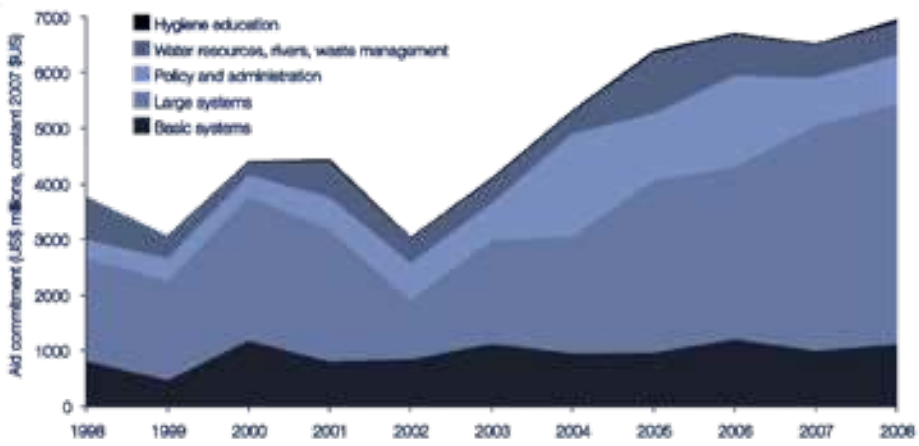


*Figure 9. Trends in aid commitments to sanitation and drinking water, among purpose types, 1998-2008 (WHO, 2010).*

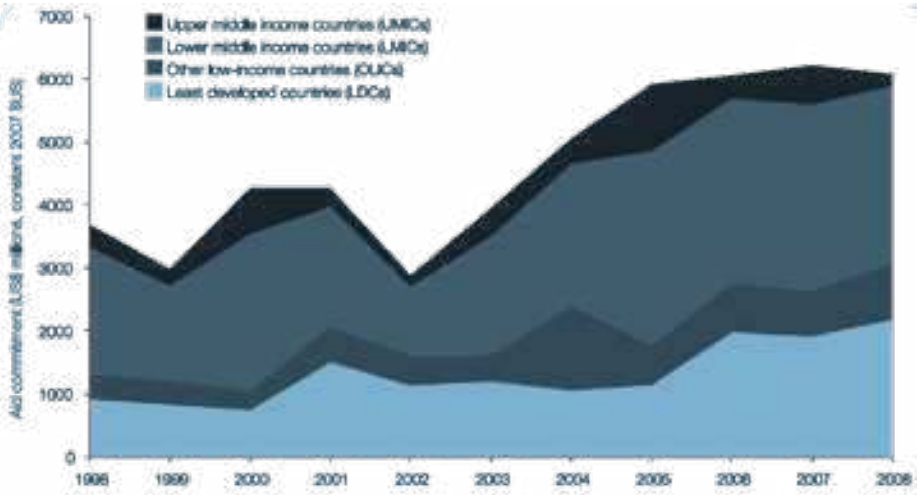


*Figure 10. Trends in sanitation and drinking water aid commitments by recipient income category, 1998-2008 (WHO, 2010).*

Developing country governments also often lack the institutions and political will to make water, sanitation and hygiene a priority. Sanitation in particular tends to be an 'institutional orphan', with many ministries (health, rural development, water resources) sharing – and often avoiding – responsibility for a sector that many feel uncomfortable discussing. Likewise, for water supply, there is often inadequate coordination between the government ministries responsible for the sustainability of water as a resource, and those tasked with designing delivery systems. Many governments lack robust plans for developing their water and sanitation sectors, and for attracting investments by donors and development banks.

The pressing need to prioritise the scaling up of appropriately designed and targeted investments in the WASH sector is the broad aim of Sanitation and Water for All (SWA), a global partnership of developing countries, donors, multilateral agencies, civil society and other development partners. The partnership has agreed that its immediate focus will be on meeting the MDGs in the most off-track countries. Launched in 2010, SWA has already convened its first high-level meeting of global decision-makers. Hosted by UNICEF, the meeting established the partnership's broad approaches: to improve mutual accountability for delivery on sector commitments; to improve sector information to facilitate evidence-based decision-making; and, to facilitate the provision of technical assistance in the sector (Sanitation and Water for All, 2011).



## Conclusion

Due to the links with health, nutrition, equity, gender equality and economic progress, water, sanitation and hygiene underlie not only the achievement of the MDGs, but also overall long-term social and economic development. Clean water is thus a pre-condition for development, but so is abundant water close to home, sanitation which facilitates not just health but also dignity, and hygiene education that is empowering. Without these, progress in development will falter, people will not be given opportunities to exercise their rights, and investments in other sectors will be lost.

Countries in the developed world made huge investments in environmental and living conditions in the last two centuries, and reaped the benefits. But in the developing world, these advancements are happening too slowly, and water, sanitation and hygiene are often overlooked in favour of larger investments in specific diseases. In order to optimize the investments made in health, and also in education, it is necessary to make the fundamental investments in the humble realm of taps, pumps, pipes, toilets and the promotion of handwashing. A resurgence of interest is needed in water, sanitation and hygiene as a firm foundation for development.

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# 2.4 Water, Food and the Development Challenge

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## Introduction

The implications of water scarcity on development are clear. At a fundamental level, water scarcity affects our capacity to grow food. Agriculture uses the largest share of the earth's freshwater resources, and it is obviously needed to supply food to all. But agriculture is also critical as a pathway out of poverty for rural producers and as a means to supply low-cost food to the urban poor. As water scarcity starts to constrain agricultural output, not only will the total volume of agricultural products required for food and to feed livestock be affected, but the communities that depend on farming for livelihoods will also face hardship in securing a living. There have already been two global food crises in the past five years (in 2007-2008 and again in 2011), with soaring prices that have impacted producers, consumers and cities, especially the urban poor. The long-term impact of unsustainable water use, together with increasing water variability caused by climate change and manifested as floods and droughts, means that humans' capacity to continue using agricultural water the way it has been used in the past simply will not sustain humanity in the future. There is little doubt that putting water on the global agenda is critical not just in order to feed 9 billion people in 2050 with less agricultural water than what is available today, but also to address the critical development challenge of doing this in a safe, sustainable way while protecting the livelihoods of the vast number of rural poor (Brown, 2011). This paper outlines some of the trends that are intensifying the competition for agricultural water and presents the challenges of balancing environmental concerns with those of human well-being. Future investments in water need to consider a range of options from different perspectives in order to achieve this balance.



## 1. Understanding Scarcity

A common knowledge of water scarcity usually entails an understanding of the physical lack of water. Water-scarce regions are those areas of the world in which water basins no longer exist, and where rivers no longer reach the ocean because they have dried out from over-exploitation of water resources. Water-scarce regions typically encompass drier and more arid agro-ecological zones, where water may have always been scarce. It has now been estimated that 1.2 billion people live in areas of physical water scarcity (as shown in Figure 1). But there is also what has come to be called economic water scarcity. Economically water-scarce regions are those that still have water resources, but where people cannot access them because of a lack of infrastructure (Figure 1).

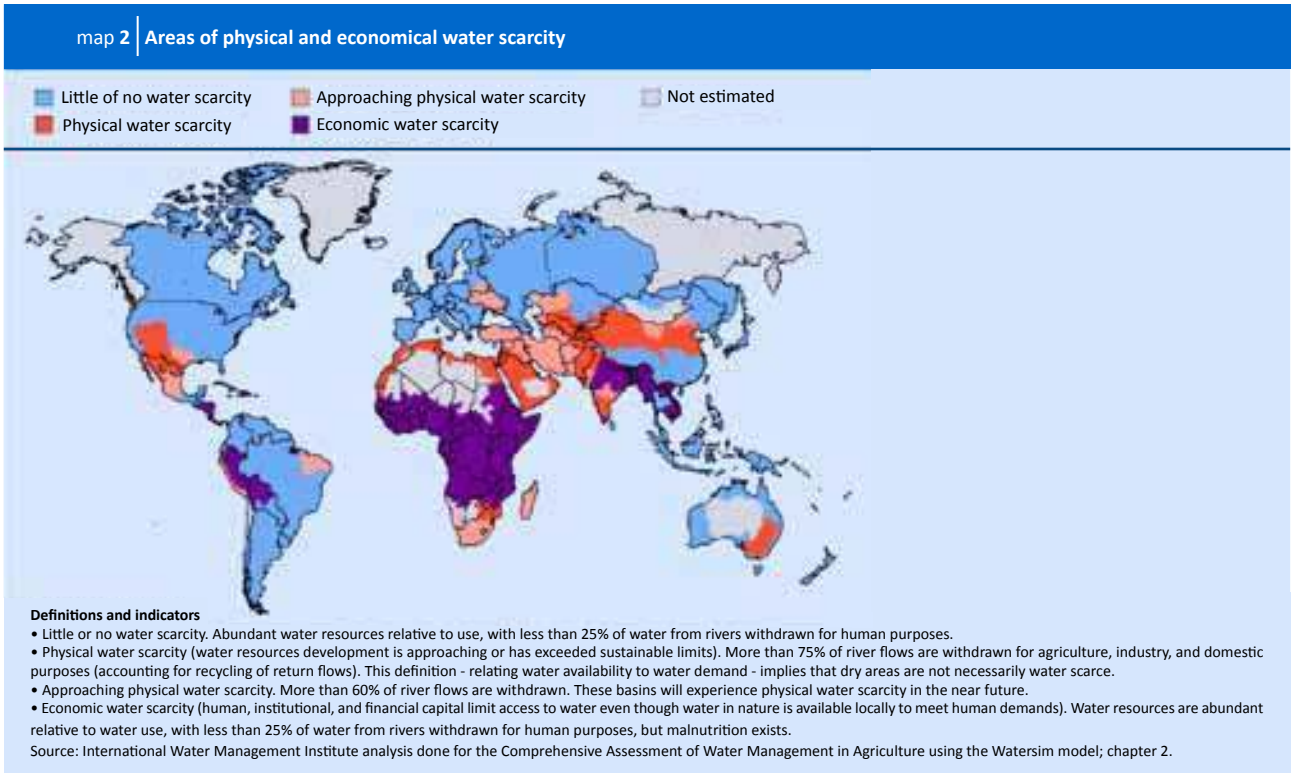


*Figure 1. Areas of physical and economic water scarcity (CA, 2007).*

## 2. Keeping Pace with Change

Since the early 1950s, research and investment in agriculture and water management have been high on the political agenda of many new nations in Asia and Africa. Major advances in agricultural productivity, driven by Green Revolution breakthroughs that introduced more resistant crop varieties, together with an increase in fertilizer use and the development of irrigation infrastructure, made it possible to end famine in Asia and relieve a vast number of people from hunger. Between 1970 and 2000, the average global per capita daily food supply increased from 2,400 kilocalories to 2,800 kilocalories (CA, 2007). However, the current rate of global population growth will put a strain on the earth's natural resources, with another 2.3 billion people likely to be born in the next 40 years (Nature, 2010). The intensity of agricultural production will need to match these growing demands for food; in India alone, the projected demand in 2030 is expected to be 30%-50% greater than current supply (2030 Water Resources Group, 2009).

Another important driver of food demand in the world is the change in wealth, specifically an increase in wealth across the world that has produced along with it a shift in the dietary demands of people. This trend has been most notable in the increase in the consumption of dairy products in India and the consumption of meat in China. It is estimated that it takes over 1,000 litres to produce one glass of milk, and between 15,000-70,000 litres to produce one kilogram of beef. The expected increase in population combined with increasing pressure to cater to changing diets will entail at least a doubling in the quantity of food that will need to be produced, which would require a doubling of all agricultural inputs, including water. This new wealth is also characterized by the expansion of cities and urban growth, and the associated growth in industry, each becoming a growing competitor for agricultural water. Megacities are now a common feature, and the population of the world is now more than 50% urban for the first time in its history, with the largest population of the poor also concentrated in cities. Water will need to be diverted to cities in order to sustain these growing populations, while at the same time no less needed in rural areas for agricultural production and rural populations.

In 2007-2008, the world experienced the first food crisis of this century, which was felt in all regions of the world. The crisis was exacerbated by a fuel crisis, which prompted many countries to invest in biofuel crops to reduce the burden of their dependency on gas and oil. Water resources were withdrawn from food production and redirected towards fuel production as the speculation on the extent of the crisis continued. As a result, biofuel production has now emerged as a new competitor for water resources, with some arguing that meeting food security should be prioritized over the production of biofuel crops, especially in food-aid dependent countries with high levels of poverty (Peskett *et al.*, 2007). Managing competing water uses has always been a challenge for countries at the national level, particularly finding a balance between water allocation for farming, municipal needs and industry; however, many countries are increasingly recognizing the need to allocate water for environmental demands. As sustainability issues become more widely recognized, the recognition of water's crucial role in maintaining fragile ecosystems, repairing polluted or over-stressed rivers, and more generally ensuring ecosystem health, will have greater prominence in national water policies.

New ways must be found in order to maintain sufficient water supplies to meet increasing food demands, but also to free water for new uses. This must come through better use of already developed resources in physically water-scarce areas, or through the development of the needed infrastructure and water services in economically scarce areas. Agricultural water management presents immediate opportunities to do this, however, the development challenge is ensuring that this does not come at a cost to the environment or to the poor.

## 3. Addressing the Development Challenge

Agriculture will continue to be the largest consumer of water over the next 50 years. If the current rates of production continue without change, the implications of water infrastructure development and food production on the environment are potentially devastating. Already the impacts from land degradation, shrinking lakes, and pollution from fertilizers and cities in water sources reveal the negative impacts of agriculture on the environment and reveal the latter's threshold. This will be coupled with the fact that there are a large number of the poor dependent on agricultural livelihoods, and an even larger number of people who live in cities and are dependent on low food prices. The world faces the development challenge of ensuring that food production is met while water resources and the environment are used more sustainably, without a cost to the economic and social welfare of the vast number of rural poor employed in agriculture, and indeed with the aim of improving their well-being. Issues of poverty, equity and environmental sustainability are deeply linked in the rural agricultural setting. Often, it forms a vicious cycle whereby vulnerable communities overuse scarce or fragile

resources, causing degradation, which in turn exacerbates their vulnerability through the slow destruction of the resource base upon which they depend. To further complicate the matter, all of these issues are now compounded by the uncertainty that climate change brings. It will be a significant challenge for countries to balance these growing demands while ensuring the development and well-being of their people.

### *3.1. Sustainability*

The environmental consequences of agricultural water use over the past decades are apparent in the ecological damage seen across the world. Sustainability issues have been raised over issues such as, among others: the overuse of groundwater; the ecological and social damage caused by dams; the loss of habitat and biodiversity around wetlands used for fishing and agriculture; and, pollution. Despite this, water infrastructure development is still a priority in many regions of the world, particularly in Africa where there is still a need to invest in dam construction and other water infrastructure to boost economic development. There is increasing awareness of the need for change around the world. For example, in an announcement on its new water strategy, China recently pledged to protect water resources and use it more sustainably, after over five decades of water infrastructure development resulting in the construction of 86,000 reservoirs, 4 million wells, and the development of 50 million hectares of irrigated land (Yu, 2011). This shift in policy reflects acknowledgment of the toll that has been taken on the environment, as well as acknowledgement of the management challenge of coping with pollution, degradation and other environmental consequences from unsustainable practices of water use.



It is often the poorest people who have the greatest dependency on ecosystem services, with their livelihoods intrinsically linked to the environment. This means that the poorest people are also the most vulnerable to changes in the environment, and with the anticipated effects of climate change, this will have serious impacts. Climate change affects the reliability of water, and from the perspective of a farmer, variable rainfall can mean the difference between well-being and poverty. A recent article in the journal *Nature* cites studies that show that recent catastrophic rainfall events, such as those witnessed in Brazil, Australia and Sri Lanka, demonstrate that climate change and temperature variation can be linked to extreme weather incidences (Schiermeier, 2011). The implications of climate change on poor farming communities is far greater because of the weak asset base of rural communities and the precariousness of agricultural livelihoods.

### *3.2. Equity and poverty*

Three-quarters of the poorest people on the planet, or about 880 million people, live in rural areas and depend on agriculture for their livelihoods. The rural poor face many constraints to productivity because of a lack of assets and access to resources that include land, capital and access to markets; however, despite these already overwhelming constraints, water can be a strong determinant to livelihood security. In 2006, the *Human Development Report* focused on water scarcity and raised the point that "[water] scarcity at the heart of the global water crisis is rooted in power, poverty and inequality, not in physical availability" (UNDP, 2006). The report draws attention to the issues around the access, control and ownership of water resources and the implications of weak institutions that are susceptible to coercion by the powerful over the poor. Access and control of water is determined by a complex system of rules, organizations and processes that are both formal and informal, that in reality reflect the political economy of resource distribution. Customary or traditional law often characterizes the way water is shared in rural communities, and the push to formalize governance of water as a way to address and improve efficiency has disadvantaged poor and marginalized communities who face issues of under-representation or poor agency. The governance of water is a sensitive issue, not only because of the links that water has with almost all other sectors of the economy, but also because of the nature of the resource itself, which can be categorized as public, private or common property. The justification for demand management through supply-side policies or increasingly popular market-based approaches, such as privatization and water pricing, may help overall efficiency and may help to recover the costs of managing water, but such policies are not always pro-poor. For instance, there can be an economic motivation for such policies that favours the production of food or agricultural products for export rather than for small producers.

In addition to giving consideration to the rural poor on issues of equity, equal consideration must also be given to the role of women. Women contribute over 60% of agricultural labour, yet their productive contribution is not matched by equal opportunities to participate in decision-making processes in water management. This point is often raised; however, the task of raising the skills, capacities and voice of women in water management has been a long and difficult

one and has yet to attain widespread achievement. Consistent exclusion of women or other marginalized groups from these discussions, processes and roles means that there is inequity in the outcomes of interventions, and poverty has persisted amongst certain rural communities and marginalized groups. The result is that large numbers of people have not been able to cross the divide out of subsistence agriculture into making a profitable livelihood due to limitations over which they have no control.

## 4. How Should We Invest in Water Today?

Agricultural water is a key aspect of the development challenge, and is an important entry point for addressing poverty and environmental issues. There is potential to greatly reduce the environmental impact of agriculture while improving the livelihoods of rural communities.

Where there is economic scarcity, investments in infrastructure are urgently needed. However, such investments must no longer take the form of large dams, but rather should encompass a wide range of storage options, from better soil and water management to groundwater recharge, from small tanks and ponds to large dams. Improving storage essentially means improving farmers' control of water — a critical way to aid in the adaptation to variability from climate change. By looking at options from a range of perspectives, including costs, it ensures that solutions better match the problems they are intended to address.

In places with physical scarcity, investment is also needed in some similar forms of storage so that farmers have better control of water, as water control is key to increasing agricultural productivity with the same or less water input. It also means investing in new institutions and solutions for demand management (Chartres and Varma, 2010). Investment in innovative water and land management practices that encourage better water use more sustainably would also help to increase agricultural productivity. It is especially important that when policy advocates for a change in practices in areas that are environmentally fragile and support a large number of the vulnerable and poor, it is mindful of the precarious livelihoods of such communities. There are very real trade-offs involved, particularly for the very poor, when change is prescribed on the grounds of sustainability.

While it is easy to propose better institutions and policies, implementation is rarely as easy, as change in water use is often surrounded by a complex political economy. However, this does not mean that change is not possible; it only means that political constraints must also be recognized in crafting new models. An example of this was demonstrated by the Jyotigram scheme in Gujarat in India, in which a power subsidy was created that encouraged groundwater extraction, but later could not be changed due to political lobbies (Shah *et al.*, 2008). Later, an alternative approach was found in which the government separated electricity supplies for agriculture and household use. Although supplies to farmers were rationed, the approach was accepted because the quality of power supply was improved. The end result was a reduction in groundwater overdraft as well as electricity waste (Shah *et al.*, 2008).

## Conclusions

The goal to meet food needs while supporting social and economic development and simultaneously minimizing environmental degradation requires a mainstreaming of water issues. Agricultural water intersects with many other sectors and is also increasingly impacted by competing water use in other sectors. While the world will continue to face the task of producing more food to meet its future needs, there is growing pressure to ensure that business-as-usual approaches to water use in agriculture change. There is vocal concern from both environmentalists about the state of rivers and wetlands, and from governments who are faced with persistent poverty in rural areas where development in water infrastructure has not delivered its promised transformations. Investment in water as a solution to addressing these development challenges presents a new way of looking at agricultural water – as an enabler of wise use and transformation.

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# 2.5 Investing in Women's Participation for Enhanced Water Security: A Practitioner's View from Sri Lanka

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# Introduction

*"Our future looks promising but the way there is devious."*
*- Chinese proverb*

The global debate on climate change has taken on increasingly sharp concern over water security at all levels. Many definitions of water security are currently in use. The following definition from UNEP (2009: 47) will be used as a base for this paper: "Water security represents a unifying element supplying humanity with drinking water, hygiene and sanitation, food and fish, industrial resources, energy, transportation and natural amenities, all dependent upon maintaining ecosystem health and productivity."

Within this definition, both ecosystems and social well-being are held as being equally essential, and humanity implies the inclusion of both men and women. As such, and as with many other similar statements, it implicitly carries within it gender neutrality. However, the reality in the water sector is that often it is not gender neutral at all; and any attempt to enhance water security needs to be viewed within a gendered perspective, which calls for the study and incorporation of the differential access of women and men to water resources for productive and domestic use.

In recent decades, the acceptance of participatory water management methodologies and the greater acceptance of much needed reforms, especially in the water and sanitation sector, have led to attempts to ensure greater involvement of stakeholders, specifically women. This paper draws from experiences of field-based advocacy by civil society and observations of water sector initiatives mainly in Sri Lanka.



# 1. International Recognition for Women in the Water Sector

The dialogue emphasizing the centrality of women to water resources management and water security was initiated in the International Decade for Clean Drinking Water (1981-1990), intensified by the global acceptance of the four Dublin Principles presented at the 1992 Rio Earth Summit (Global Water Partnership, 2012), and further extended by the establishment of the International Water for Life Decade (2005-2015) through a resolution adopted by the United Nations General Assembly (UNGA, 2004). The central role played by women in the water sector has been enunciated at many international fora, such as the Stockholm Water Symposium, and has been the focus of many international deliberations. Numerous attempts have been made to address gendered issues and engage development through a gendered perspective. Many achievements have especially been made in accepting and promoting the role of women in the water supply sector, but the same level of success cannot be claimed for the irrigation and irrigated agriculture sector. The United Nations Human Rights Council's affirmation in 2010 of the right to water and sanitation as human rights has further assured water security in a legislative sense (UN Human Rights Council, 2010), but is in itself insufficient to ensure a gendered perspective. The women and water dialogue will continue at the upcoming Rio +20 event in June 2012, at which a Women's Vision for Sustainable Development will be presented by the Women's Major Group[1], highlighting once more the need for greater consensus and concerted action.

# 2. Water and Women in Sri Lanka

In the 21st century, Asia is expected to face extreme negative impacts from climate change, including: decreased freshwater availability; loss of landscape and natural resources; a substantial reduction in crop yields from rain-fed agriculture, directly affecting food security; all of which come with resultant increasing malnutrition and related diseases. As primary caregivers in the domestic context and major contributors to a predominantly agricultural Asian society, it has therefore become increasingly necessary to review and identify ways of ensuring and optimizing the effective participation of women in water- and climate-related activities.

Water and women's work is synonymous in most parts of Asia. The traditional gendered division of labour in the domestic and the productive sectors has in some instances given way to new developments due to factors such as the feminization

[1] The core organisers of the Women's Major Group for Rio + 20 currently consists of the following: Voices of Africa Women (VAF), Women in Europe for a Common Future (WECF), Women's Environment and Development Organization (WEDO) and ENERGIA International Network on Gender and Sustainable Energy. See: http://www.womenrio20.org/index.html.

of agriculture resulting mainly from male out-migration or as a result of post-conflict situations. This dynamism, however, is not reflected in most Asian water agencies and water management structures. Both traditional and modern Asian water organizations are still largely masculine spaces, where women's roles have limited opportunities.

In Sri Lanka, women play a key role in the water sector: in water supply and sanitation, ecosystem management, irrigation and irrigated agriculture. This has become increasingly apparent, especially since the female population in Sri Lanka at 51.8% now outnumbers the male proportion of the population (CIA World Factbook, 2012), with female-headed households rising to 23% (Department of Census and Statistics, 2011a). As such, women are bearing the brunt of the costs related to water insecurity. The problems incurred by women due to water insecurity include shortages of water for domestic, agricultural and productive uses, loss of time spent for water collection, health issues due to a limited intake of good quality water, and loss of educational opportunities for girl children. Overall, however, women's productivity is constrained due to limited access to and involvement in decision-making related to water. As women are more easily identified as being located in the traditionally invisible domestic area, their decision-making role is best recognized in the water supply sector and insufficiently recognized in the irrigation and environment sectors (Athukorala, 1996).

This lack of recognition has implications for water security and especially for food security. Schultz and Uhlenbrook (2007) underline that the need to double global agricultural yields in the next 25-35 years to meet global food demands can only be possible with "a more efficient use of the water resources and a substantial improvement and extension of water management systems" (Schultz and Uhlenbrook, 2007: 3). This calls for a more efficient optimal use of available human resources, namely women, which has hitherto been sidelined.

## 3. Agriculture in Sri Lanka

Agriculture is the most important sector of the Sri Lankan economy, even though its contribution to the country's gross domestic product (GDP) has declined substantially, to 11.2% in 2007 (Department of Census and Statistics, 2011a). However, it still remains the most important source of employment for the majority of the Sri Lankan workforce, with approximately 32.7% of the total labour force engaged in agriculture in 2010 (Department of Census and Statistics, 2011b). The majority of people in rural areas depend on agriculture-related activities, and development of the agricultural sector is central to poverty reduction for rural communities. In the subsistence sector, rice is the main crop and rice farming provides the most important economic activity for the majority of the people living in rural areas.

The rehabilitation of Sri Lanka's extensive ancient irrigation systems, and new investment in construction and maintenance of irrigation infrastructure in the post-Independence era led to a large increase in the land area under rice cultivation, which has traditionally had a strong women's family labour component. Between the years 1950-2004, the area used to grow rice increased from 296,000 hectares to 632,000 hectares (Imbulana *et al*., 2006). Women's unpaid labour made a substantial contribution to this expansion. The related modernization of farming methods, such as the use of high-yielding seeds, tractors, and chemical fertilizers, also led to increased productivity in the irrigated rice farming sector. However, it is also gradually eroding women's traditional labour contribution (such as transplanting, weeding and infilling work), and the related incomes they receive.

In addition to rice, various other food crops are being produced for local consumption that buttress family food security as well as provide an additional source of income, mainly for women. These include yams, pulses, grains, vegetables, greens and fruits cultivated mostly in family-run home gardens (Navaratne, 2003). Home gardens provide food security especially during the dry seasons, with pulses and grains stored to be used throughout the year, and augment off-system incomes earned mostly by men. Once the family's needs are met, the surplus fruits, pulses and vegetables are sold, with women taking the lead in food processing and selling. All these are essential components of family food security.

Sri Lanka has just emerged from a 30-year civil conflict that has seen major disruptions in society. One such result is a large number of war widows located throughout the country that depend on agriculture for their livelihood. The former conflict areas in the northern and eastern provinces especially need to see an economic and agricultural resurgence that takes into consideration the prevailing social dynamics and gendered labour participation.

### 3.1. The Role of women in agriculture in Sri Lanka

Sri Lankan women in the informal work sector are mainly engaged in agriculture, of which over 86.5% of the labour force is in the informal sector; women also account for 55% of the rural labour force (Department of Census and Statistics, 2011b) and provide substantial contributions in unpaid family labour. Women are engaged in agricultural pursuits as wage labourers to help supplement family income, but they receive a lower daily wage compared to men for the equal value of work (Jayaweera, 2007). Poverty studies elsewhere in Asia have revealed that women are progressively getting more involved even in non-traditional tasks in the rural sector, as men with greater mobility frequently respond to lowered agricultural returns by migrating (Soni, 2002). There is a paucity of such gendered data in Sri Lanka (where dry season migration has so far been the observed norm). Sri Lanka too may currently be experiencing a feminization of agriculture, as is seen in some other Asian countries such as Nepal and Laos, but this has not yet been substantiated with adequate quantitative and qualitative research.

On the other hand, the mechanization of agriculture and the planting of market-oriented crops have mostly benefitted men, with women left responsible for unpaid family labour mainly in traditional home gardens. However, the importance of home gardens as supplementary income and the need for required specific modes of water management for them should not be underestimated.



### 3.2. Climate change impacts on women and agriculture

The impacts of climate change in the form of higher temperatures, an increase in variable precipitation and in extreme weather events threaten millions of people living in Sri Lanka. Sri Lanka is highly vulnerable to droughts and floods that not only devastate lives and livelihoods, but also undermine progress on economic growth and poverty alleviation. The risks associated with water-related climate variability are likely to intensify and worsen, especially in terms of agriculture, which leads to food insecurity.

The impending and ongoing climate-induced changes will have major consequences for water security, thereby placing additional burdens on women as major providers of food for families. There is thus a need to build capacity and productivity at the household level, to strengthen or create water management fora where women have a larger role in decision-making, and to build a critical mass of empowered women who can engage in decision-making in water user associations at the local, district and national levels.

With the looming impacts of climate change threatening both water and food security in rural Sri Lanka, home gardens become increasingly important in serving the needs of the poor. Traditionally a domain where women have ownership, home gardens are an adequate instrument for increasing women's self-reliance and encouraging economic empowerment. They are furthermore a socially and culturally accepted way for women's (semi-) public contribution, to be supported within the current context, with the underlying need for large-scale policy support for women's involvement in the water sector remaining a long-term goal.

## 4. Women and Decision-making in Water and Agriculture

Though global slogans have touted "Making Water Everybody's Business" (Cosgrove and Rijsberman, 2000), at the national level, especially in Asian countries where women traditionally hold a low social status, it has remained very much the purview of senior bureaucrats, hydrocrats and politicians. Civil society initiatives involving women and water are few in number, poorly funded and have not been scaled up. Women's activism tends to concentrate on issues such as domestic violence and health and children's issues rather than on agriculture, water supply and irrigation-related empowerment.

In particular, in Sri Lanka, where women form the majority of the population, there has not been any significant outreach attempts to present critical development information related to water management to women, or to devise systems which will give them a more equitable share in the decision-making process, even at the lowest level in water-related field organisations (Athukorala, 2002). Data related to women in water supply consumer societies and farmer organisations is not available in most cases. Irrigation systems with decision-making based on user groups often have culturally and institutionally limited participation by women (see Table 1; this is the only source of gender desegregated data currently available in any of the major Sri Lankan water-related agencies), partly because women do not own land and partly because

their substantial contribution is poorly recognised by agency staff. Efforts of incorporating women into decision-making processes, in particular those related to irrigated agriculture, is seen as either unnecessary or at best, an unaffordable luxury for agencies already experiencing budget constraints.

*Table 1. Women's participation in decision-making through farmer organizations in the Mahaweli System in Sri Lanka (Elakanda, 2011).*

| System/ Area | No. of Farmer Organizations | No. of Members | | | No. of Women Officials | | |
|---|---|---|---|---|---|---|---|
| | | Male | Female | Total | Chairman | Treasurer | Secretary |
| **B** | 126 | 15,108 | 3,154 | **18,262** | - | 5 | 3 |
| **C** | 224 | 17,186 | 4,050 | **21,236** | - | 9 | 4 |
| **G** | 41 | 4,419 | 248 | **4,667** | - | 4 | 1 |
| **H** | 299 | 21,619 | 5,143 | **26,762** | 1 | 7 | 3 |
| **L** | 11 | 2,608 | 856 | **3,464** | 1 | 1 | 1 |
| **Uda Walawe** | 232 | 19,267 | 4,128 | **23,395** | 2 | 10 | 14 |

If some attempts at gender mainstreaming or promoting benefits for women in the water sector have happened at all, it is mainly due to promotion by donor-funded projects and the initiative of some concerned individuals within water agencies; but there has been no related policy change that will sustain such efforts in the long term. This lacuna has contributed to a continued denial of information and access to an informed decision-making process, and continues to be an obstacle to women's access to water for productive uses, and to their equitable input into food and water security. It will also ultimately impact negatively on a country's ability to reach the poverty-related targets of the Millennium Development Goals.

The minimum requirement that needs to be fulfilled in order for women to become informed decision-makers in water management is an increase in water literacy, defined here as enhancement of knowledge on technical, legal and social aspects of water management and current institutional structures. This builds a foundation of information which, coupled with their own traditional knowledge systems, can be used by women to make informed choices, define options and apply pressure for equitable access to water-related decision-making within their own environment and communities.

In view of climate-related changes and resultant challenges, it is critically important that women not only be afforded opportunities to better understand the technical processes of water management and the supporting institutional framework, but also that adequate capacity building programmes are designed to support them. An increased water literacy and water management awareness for rural women, filtered down through women's organisations to the grassroots level, can enhance women's capacities as domestic water users and in their agricultural initiatives with wide-scale impacts on community well-being.

Along with this, there is a need to build a profile for gender and water issues within countries such as Sri Lanka among different stakeholders, especially among political decision-makers and agency staff, so as to facilitate and create an enabling environment for future women and water-related policy decisions. Building up in tandem a critical mass of women water practitioners through an informed group of women water professionals at different levels can also have a positive, long-term impact on policy and institutional change, and can support women's entry into system-level decision-making.

## 5. An Advocacy Initiative for Supporting Women's Role and Participation as Water Professionals

NetWwater (Network of Women Water Professionals) is a registered group of volunteer women that was set up as an advocacy and action initiative in 1999 in Sri Lanka to support integrated water resources management (IWRM) and women's enhanced participation in the Sri Lankan water sector (Athukorala, 2001).

NetWwater takes an integrated approach to water resources management by:

- Raising women's awareness on their potential contributions to socio-economic development, and providing them with the skills and opportunities necessary to reach that potential;
- Sensitizing local leadership to women's potential in the water sector, and making women's active role acceptable in the community;
- Developing women's leadership by building their capacity and knowledge on water and related issues;
- Advocating for women's participation in decision-making at all levels in the water sector;
- Enabling women water professionals to improve their own management and social ability so as to act as a conduit for accessing and empowering community women; and,
- Informing women and other stakeholders on issues related to climate change adaptation and water literacy through awareness, advocacy and action programmes that support and uphold inter-generational equity.

NetWwater programmes in the rural sector aim to stimulate and facilitate women's leadership in rural Sri Lanka by working on two levels simultaneously:

- At the community level, in order to build a women's movement from the bottom up, so as to enhance water and food security at village level; and,
- At the professional level with women water professionals, in order to educate them in the social dimensions of effective water governance and to build capacity to work with local women on climate-smart solutions which are socially and culturally feasible.

NetWwater has been engaged since 2003 in supporting women farmers through capacity-building programmes for women in selected sites. District-based 'Gender and Water Dialogue Workshops' have been key fora for introducing and assessing gender and water concepts for mid-level government officers and civil society activists based in the specific regions. In these workshops, multi-stakeholder participants review local water-related issues (ranging from water governance to water quality) relevant to their day-to-day work and make use of the knowledge gained for formulating solutions in dealing with local communities. Encouraging women to take up leadership positions in farmer organizations and community-based water supply organisations, promoting home gardening to women, and disseminating women's local knowledge in climate adaptation strategies are some of the interventions made during these workshops.

Sri Lankan (and Asian) water agencies need to include more women water professionals in their organizations as women water professionals are a critical link to getting community women on board by buttressing agency efforts. Including women in decision-making and developing a cadre of women water professionals to act as a conduit of information in conservative rural societies where male catalysts cannot easily function is an essential area for future resource allocation. In order to achieve this long-term goal, a number of prior activities are seen as essential. Women's inclusion in the formal water education system needs be proactively encouraged and sustained with appropriate policy guidelines and adequate resource allocation.

A path-breaking example of a proactive South Asian effort to build a critical mass of women water professionals in Sri Lanka and three other South Asian countries is found in the 'Crossing Boundaries – Gender and Water in South Asia' SaciWATERs project (SaciWATERs, 2012). This four-year activity supported women water professionals with grants for post-graduate studies in IWRM while developing relevant university curricula in four South Asian countries (SaciWATERs, 2010). Since conservative communities, which are the norm in Asia, generally frown upon or prohibit open interaction between men and women, these women water professionals will have a key role to play as a critical interface between water agencies and these communities (Athukorala, 2010).

Although cultural constraints still continue to impinge upon entry of women in water management courses, and the discrimination of women water professionals at entry points in water agencies and their upward mobility within the sector continue, it is seen in some cases (such as in the Department of Irrigation Sri Lanka) that women's entry and contribution into the formal water management sector is increasing (Kamaladasa, 2012).

However, these positive changes cannot happen on their own; they need to be proactively facilitated and need high-level political, administrative and legal mechanisms to create an enabling environment in order to benefit both women professionals and women in grassroots communities. More than any other factor, adequate resource allocation is necessary (UNESCO, 2012a).

At the Fourth UN Conference on Least Developed Countries held in Istanbul in 2011, UN Women's Executive Director Michelle Bachelet questioned the continued low investment in rural women while reiterating that "investments in rural women's access to productive resources and financial services can have critical multiplier effects on rural development" (UN Women, 2012). The FAO *State of Food and Agriculture Report 2010-2011* states that investing in women in agriculture could increase yields and decrease global hunger by 12-17%, or by between 100 and 150 million people (FAO, 2011). At the launch of the Fourth World Water Development Report in March 2012, UNESCO Director-General Irina Bokova reiterated the need for a new leadership in water which can "acknowledge, integrate and strengthen the role of women" (UNESCO, 2012b). It is time these global statements are operationalised at the local and national levels by all concerned stakeholders.

## Conclusions

Twenty years after the Dublin Principles were first enunciated at the Rio Earth Summit and upheld the critical role of women in the international water sector, this area is yet to be fully recognised, accepted and operationalized, especially in the irrigated agricultural sector of many Asian countries, including Sri Lanka.

Investment in women's capacity development for achieving water security needs to focus on empowering women, especially those from disadvantaged communities. To ensure that women's leadership and expertise feed into thematic areas of work, such as guidelines and initiatives related to land and water allocation, investment in financial and human resources, and food processing and food security, calls for a higher degree of research into women's roles and activities than is available at present. The question of research into women and water, however, is a vicious circle: because there are no (or minimal) funds allocated to research in this area, there are no data; and because there are no data available, there is little evidence to substantiate the need to strengthen the role of women in management and decision-making in the water sector. An essential facilitating factor, the lack of gendered databases, has to be speedily addressed through appropriate resource allocation.

In order to support women's participation for generating positive impacts on community water security, a gendered allocation of necessary resources from budget lines of water agencies is essential. The adoption and implementation of policies that protect women's rights to land and other productive resources, which ensure access to markets, finances, information and capacity development, are also critical supporting factors.

There is also an urgent need for states and water agencies to remain conversant with a fast changing reality on the ground by regularly engaging with women civil society leaders, including networking with community-based organizations of women in rural areas. State agencies and civil society organizations working in rural settings, especially in the Asian region, need to hire more women experts in all areas of work to create more gender-equitable institutions that focus on women's empowerment.

As stated at the recently concluded World Water Forum 6 in Marseilles: "After all the rhetoric, the time for solutions must really come now. Beyond speeches and statements, our planet needs concrete and credible acts" (World Water Council, 2012). This urgency is most keenly felt in the women and water sector. Women are the most affected by threats to water security, and this will be especially true as water security becomes increasingly contested due to the impacts of climate change. Women are as yet an under-utilized invisible force, and given an enabling environment coupled with a greater democratization of the water sector, have the potential to become effective agents of change, a force without whom change is not possible. If there is to be a global move towards a more inclusive, dynamic development supporting water security for all, then the focus of global water initiatives has to be on mobilizing the hitherto sidelined resource, the Major Group of Women.

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# 2.6 Water Governance Reform in Afghanistan: Early Lessons for a Water-secure Future

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# Introduction

Despite being a water-abundant country, Afghanistan still struggles to make the best of its natural resources and to achieve water security for its citizens. A reform of the water sector was initiated as early as 2002, yet the 'good governance' principles, enshrined in the recently passed Water Law of 2009 (Islamic Republic of Afghanistan, 2009) and the Water Sector Strategy (Islamic Republic of Afghanistan, 2008), have yet to demonstrate results on the ground. More noteworthy, early signs of a lack of buy-in for a new model of governance introduced by the international community are now emerging.

In fact, while a drive towards a more infrastructure- and technically-oriented development is seemingly prioritized by the government, this paper argues that in Afghanistan, a choice cannot be made between developing infrastructure or better governance and management: it is about developing both in an integrated way. Additionally, in order to improve governance, it is now necessary to take an adaptive approach to adapt and fine-tune imported models in order to better fit the realities on the ground, and to build on already existing water management institutions.



# 1. Salient Figures of Water Insecurity

## 1.1. Failing to meet essential needs: safe drinking water

Afghanistan is among the countries with the lowest accessibility to safe drinking water sources and hygienic sanitation. Despite massive interventions by the international community – US $19 billion has been spent by the U.S. alone, the largest donor of Afghanistan's reconstruction (Christian Science Monitor, 2011) – the most recent national survey shows that only 27% of the population has access to protected water sources, while only 5% has access to improved sanitation (MRRD and CSO, 2009). Furthermore, the current trend of progress at 1% per year indicates that Afghanistan will be delayed in meeting its water targets of the Millennium Development Goals (MDG) of reducing the number of the Afghan population without access to safe drinking water by half by 2020, by more than 20 years (Figure 1). As a result, every hour, six children under the age of five die because of the effects of diarrhea (CPHD, 2011).

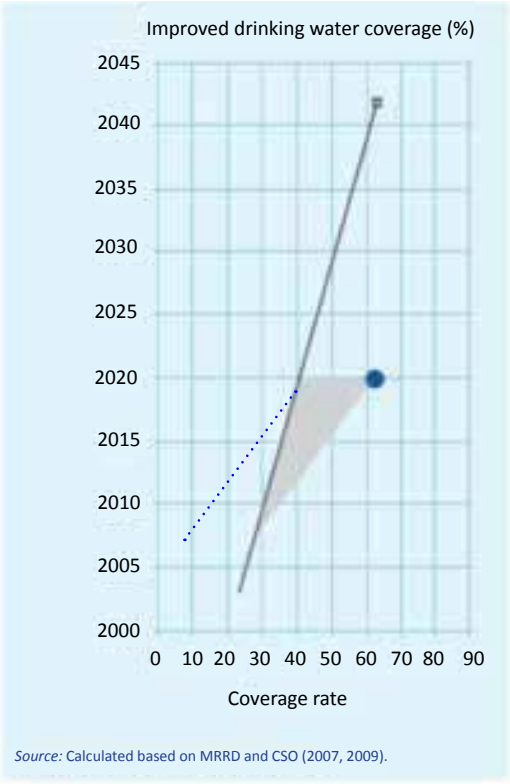


*Figure 1. The projected trend for meeting the MDG target for access to safe drinking water in Afghanistan (CPHD, 2011).*

### 1.2. The Extreme risk of food security

Large populations of Afghans are also confronted with food insecurity, which is partly linked to the poor performance of irrigated agriculture. According to *The Food Security Risk Index 2010*, Afghanistan is ranked among the top nine countries in the 'Extreme risk' category of food security (Maplecroft, 2011). Unfortunately, the potential of irrigation is not being embraced in Afghanistan, and land cultivation is low mainly due to poor irrigation systems. According to the *Afghanistan Human Development Report* (AHDR) 2011, the country has the capacity to mobilize over 7.5 million hectares of cultivated land, of which 60% could be irrigated. By the mid-1970s, over 3 million hectares were being irrigated. Today, only an estimated 1.8 million hectares are irrigated. It is estimated that over 90% of the canal systems in Afghanistan are farmer managed, with water being distributed by one or more community-based water service providers, or *mirab*[1]. As mentioned in the *AHDR* 2011, however, the performance of community-based water management institutions involved in distributing water for agriculture has deteriorated due to the decades of war in the country, with issues of equity in water sharing.

Rehabilitating infrastructure, improving governance and management, and increasing efficiency of water use at the farm level are some of the areas that have been the focus of the government over the past years to address the issue. A comprehensive monitoring of performance is however missing.

### 1.3. Vulnerability to droughts

High dependence on the agricultural sector, at 37% of the country's total GDP, combined with an under-developed water storage infrastructure (see section 2.2. below) makes Afghanistan one of the most vulnerable countries to droughts, which contributes heavily to food insecurity. The droughts of 1998-2002, 2008 and 2011 were considered the most severe in Afghanistan's recent climatic history. In 2008, an estimated 4.5 million people required food aid (USDA, 2008).

The next section will consider whether resource availability is a critical constraint to addressing the challenges mentioned above.

## 2. Water Resources in Afghanistan: Large Availability but Multiple Constraints

Although there are regions of Afghanistan that are physically water scarce, most people who lack secure access to water are deprived because of inadequate infrastructure and poor management rather than insufficient resources (CPHD, 2011). Afghanistan's annual renewable surface water resources are estimated at 57 billion cubic metres, which is distributed along five river basins (Figure 2). With an estimated average water availability of 2,775 $m^3$ per capita per year, Afghanistan's water availability is 60% above the 1,700 $m^3/s$ threshold[2], the amount of water which is considered sufficient for a country to fulfill its needs for food production, energy, industries, domestic and environmental uses. Nevertheless, there are a number of natural constraints which hamper the ability to fully harness this potential, which are discussed here.

[1] According to AHDR 2011, the *mirab* is responsible for the following tasks: ensuring water distribution according to local water allocation norms; organizing collective maintenance; and, assisting in the prevention and resolution of conflicts over water distribution and maintenance. Traditionally, local elders in the *shuras* – village-based community organizations – have usually played the main role in electing mirabs and in conflict resolution. However, in recent decades, new actors, including local commanders, have started influencing the process in parallel with the shuras. Water-related line ministries and other relevant entities are present along the canals, although their influence has diminished since the beginning of the war in the early 1980s.

[2] According to the Falkenmark indicator, 1,700 cubic metres of water are required per capita per year to satisfy the water demand of a given population for domestic, food production, industrial, energy and environmental uses. The indicator provides a measure of the extent to which the resource is available relative to the required demand.

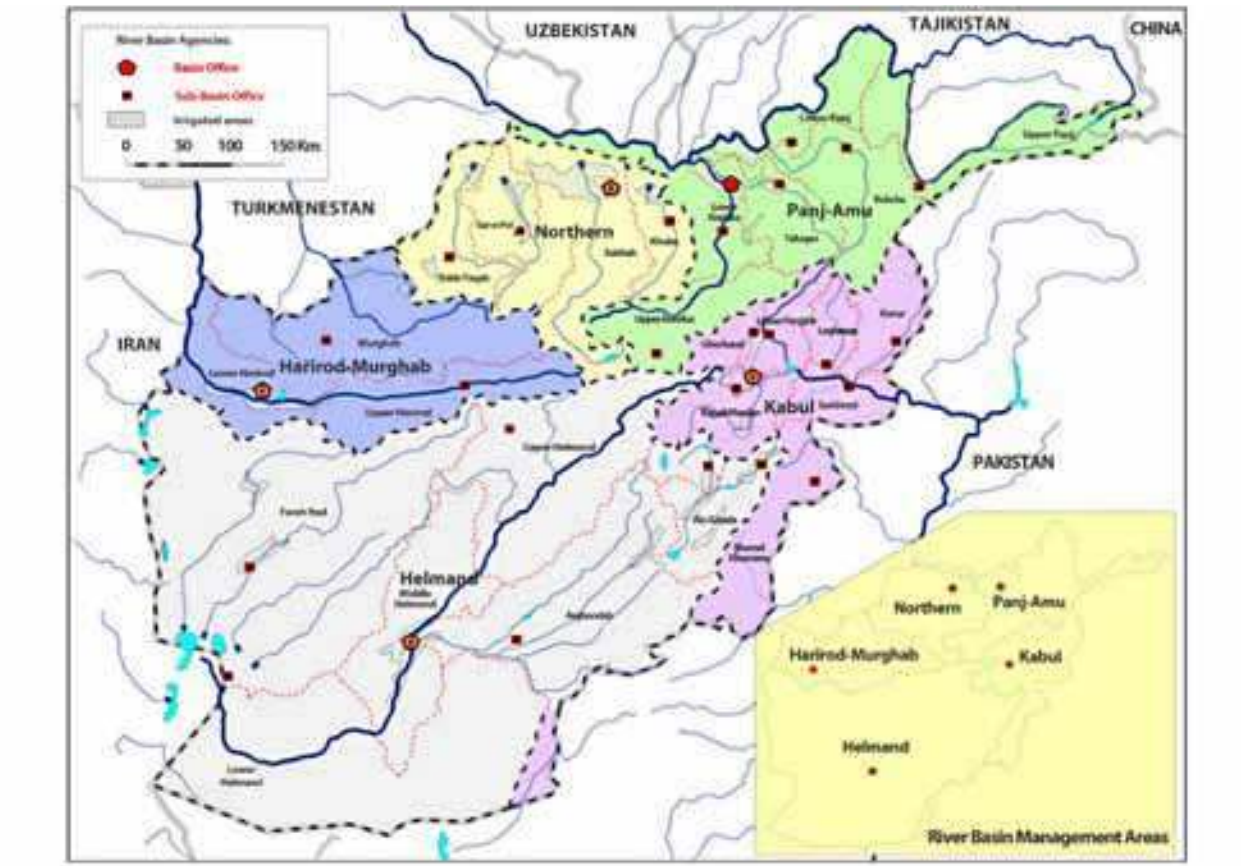


*Figure 2. Map of Afghanistan's five river basins (CPHD, 2011).*

## *2.1. Uneven distribution of water resources*

The first constraint is that the resources are unevenly distributed within and across the country's five river basins (Figure 3).

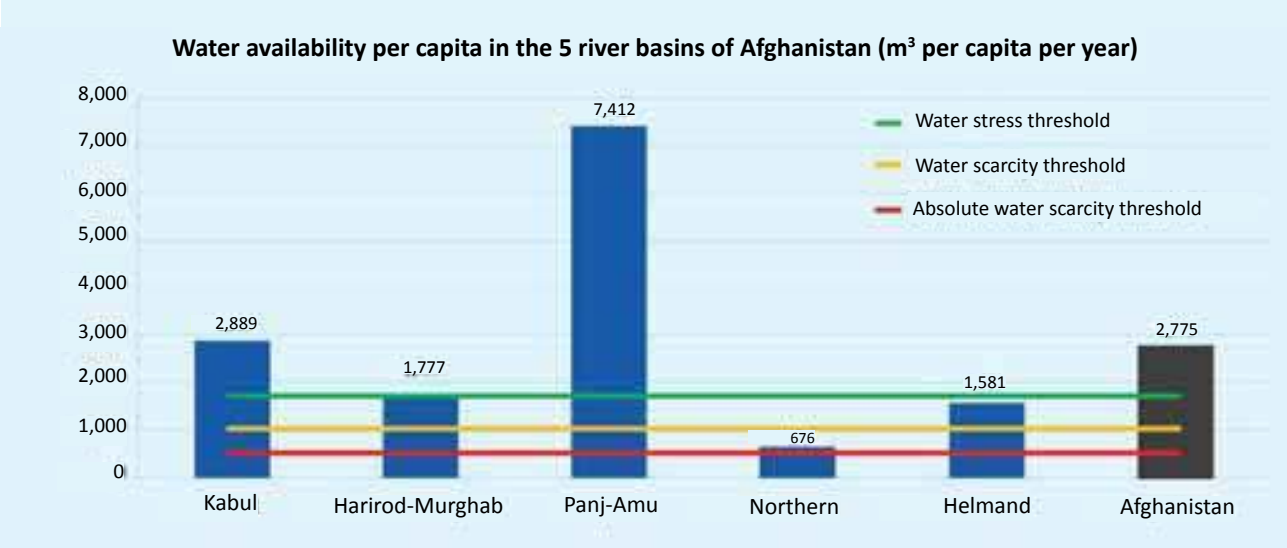


*Figure 3. Water availability in the five river basins of Afghanistan (CPHD, 2011).*

Furthermore, within each basin, land, water resources and population settlements across river basins are in clear imbalance (Figure 4). Basins that contain the greatest amounts of water, such as the Panj-Amu or the Kabul river basins, are not necessarily associated with the highest shares of irrigable land or population. Meanwhile, river basins such as the Helmand or the Northern that are associated with high shares of available irrigable land do not benefit from proportionate shares of water.

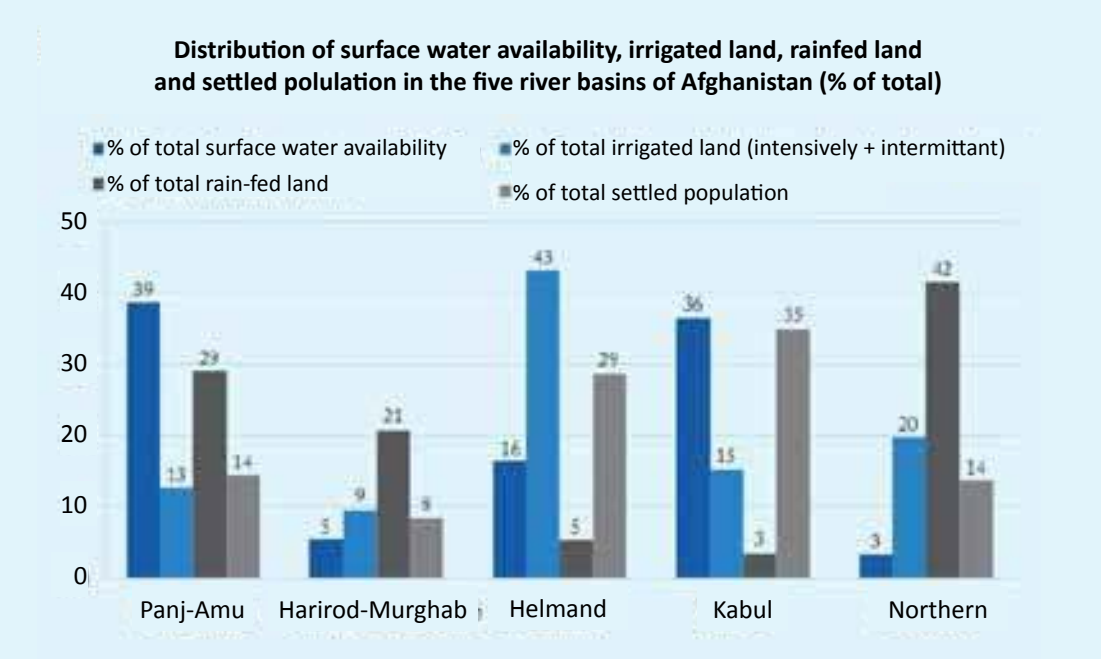


*Figure 4. Distribution of land, resources and populations across the five river basins of Afghanistan (CPHD, 2011).*

### *2.2. High seasonal variability, low storage capacity*

The amount of surface water varies from year to year and season to season. A country with a semi-arid climate, Afghanistan is prone to periods of droughts. Furthermore, most of its rivers get their water within only three months of snowmelt periods. In the absence of adequate water storage facilities, water cannot be controlled and used when required, making the country particularly vulnerable to droughts.

Afghanistan lacks both the technical and financial means to utilize the full potential of its available water resources due to low water storage capacity. The country has the lowest storage capacity in the region and one of the lowest in the world (CPHD, 2011).

## *3. Water Governance Reform*

Since 2002, the Afghan water sector has been under reform with the aim to address the challenges and constraints mentioned above. Under the influence of the international community, the emphasis has been on a complete review of its governance and legislative structure. The following section provides recent lessons learned from this trend.

### 3.1. Imported models of 'good water governance'

As key milestones in the 10 years of water reform that have occurred in Afghanistan, the Water Sector Strategy (WSS) (2008) and the Water Law (2009) both adopt an Integrated Water Resources Management (IWRM) approach together with a River Basin Management (RBM) approach as core principles for land and water management. The development of an IWRM approach for the purpose of sustaining supply and conserving water resources and protecting the environment is carried out through a river basin approach in accordance with Article 4 of the 2009 Water Law (Islamic Republic of Afghanistan, 2009).

Furthermore, the Water Law provides a legal framework within which the duties of the decentralized Multi-Stakeholder Platforms (MSP) at the river basin level are defined. The Water Law promotes the formation of Water User Associations (WUA) and Irrigation Associations (IA) at the local level (i.e. irrigation canals command areas)[3]. The overarching principle is that decision-making over water resources management would be in the hands of water users, while the government would play the role of a technical advisor (Figure 5).

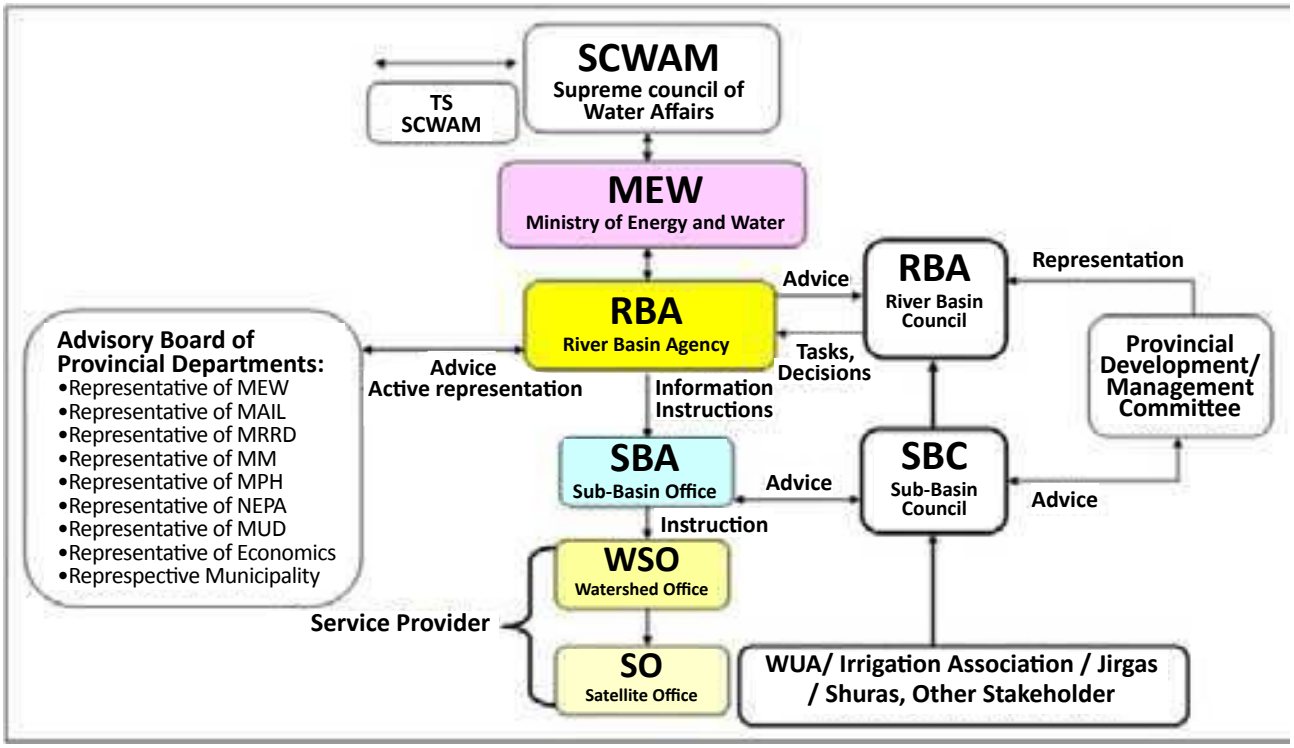


*Figure 5. Organizational set-up for Multi-Stakeholder Platforms within the framework of River Basin Management, according to the 2009 Water Law Procedure on the framework for water resources management in the river basins (Ministry of Energy and Water, 2011).*

[3] At the canal level, recommendations have been made for a balanced approach between respecting traditions and introducing new governance and water allocation procedures (Thomas and Ahmad, 2009).

### 3.2. Early doubts vis-à-vis progress and achievements

The *AHDR* points out that in 2010, the targets proposed in the Water Sector Strategy for 2010 have failed to be achieved, owing to an over-optimistic and flawed analysis (CPHD, 2011).

*Table 1. Afghanistan's Water Sector Strategy 2008, targets and progress (CPHD, 2011).*

| Target | Progress (2011) |
|---|---|
| *Water resources management:* Provide 30% of irrigation water from large water works by establishing river basin organizations (for example, river basin councils, sub-basin councils and related agencies) in Balkh, Kunduz and the western region by the end of 2010. | Not achieved. No river basin agency or river basin council has been established. WUAs have been established, but only informally; they lack legal status. |
| *Urban development:* In conformity with the Millennium Development Goals, greater investment in water supply and sanitation will ensure that 50% of households in Kabul and 30% of households in other major urban areas will have access to piped water and improved sanitation by the end of 2010. | Herat (85%), Kunduz (50%) and Mazar-i-Sharif (70%) have met the target. Kabul, Kandahar and Nangarhar have not. |
| *Rural development:* By the end of 2010, access to safe drinking water will be extended to 90% of villages, and access to sanitation to 50% of villages. | Current rural access to safe drinking water sources is 20%.<br>The current rate of progress of 1% per year means that the target will not be reached within the next few decades. |

For instance, concerning water resources management, the *AHDR* (2011) expresses doubt regarding the expected buy-in of local and national actors in the new water governance concepts at the sub-basin level. A key argument is the absence of a comprehensive analysis justifying the relevance of IWRM, RBM and MSP approaches in the specific context of the post-Taliban era. The authors of an earlier study in 2008 were already skeptical about the significance of the achievements of new organizations – seen as precursors for new river basin management institutions – whether in terms of learning experiences or tangible outputs (Varzi and Wegerich, 2008).

Furthermore, resolving the overarching issue of capacity[4] – whether institutional, human resources or knowledge based – reinforces the suspicion vis-à-vis IWRM and RBM as a feasible option in the current development status of Afghanistan. Last but not least, the proposed reform requires a strong enforcement capacity (Islamic Republic of Afghnistan, 2007), something that is still lacking in the country's current situation.

### 3.3. Limited effectiveness in the adoption of River Basin Management principles and participation

A recent study (Thomas *et al*., forthcoming) covering the 2011 drought in northeastern Afghanistan highlights the disparity that seven years after the launch of the government's pilot programme aimed at introducing the principles of good governance promoted in the Water Law, local institutions still address their water allocation issues at the sub-basin level through procedures which fall far from the sanctioned discourse on 'good' water governance. For instance, while institutional reform includes the devolution of decision-making power to water users, with the government taking a more advisory and facilitation role, the reality in the Lower-Kunduz Sub-Basin (LKSB) shows that local government actors still play a major role in decision-making, and are keen to skip participatory processes when the power balance is in their favour.

Similarly, although the Water Law discusses translating existing water rights into permits, it is the traditional system of *abandâz* – which does not formally recognize the rights of downstream communities within the sub-basin – which remains firmly applied. Additionally, the governance model behind the Water Law praises decentralization in decision-making; however, the reality in the Taloqan Sub-Basin (TSB) shows that Parliament, central Ministries and even the President's

[4] The capacity challenge was already highlighted in an early draft of the WSS in 2007 (Islamic Republic of Afghanistan, 2007).

Office can still be driving forces behind water allocation. This has been materialized for instance, through a Presidential Decree[5] denying the core principles of the Law.

Thus, there are early indications that the state may not be as dedicated to changing governance in the water sector as it is inclined to resume its own hydraulic agenda of building dams and improving canal infrastructures. Likewise, early signs indicate that local institutions do not adapt swiftly and smoothly in accordance with the spirit of the Law (Thomas *et al.*, forthcoming).

However, what the field results also indicate is that despite defying the governance principles of the Water Law, the institutional arrangements at work in 2011 led to relatively positive, although limited, outcomes in terms of water access for downstream water users. An analysis of the factors that triggered these positive outcomes even suggests that a strict application of the promoted policy models (i.e. decentralization and devolution of decision-making power to water users) may be counter-productive for water access in downstream areas, at least in the short term. In other words, what may be gained in terms of 'good water governance' may come at a cost in terms of water access results (Thomas et al., forthcoming).



An overarching criticism is that most of the efforts have been focused on the development of national strategies, laws, policies and regulations in a country where the impact of national law is limited at the local level when it comes to water management. Thus, in their endeavour, the government and its foreign advisors have largely failed to appear as a relevant and legitimate actor to resolve practical water management issues. Consequently, not only do traditional institutions continue to function or evolve independently along their own path, often outside the realm of the reform framework, but their buy-in vis-à-vis new governance mechanisms is also still very limited.

One recommendation would be to start working more closely with existing institutions on the resolution of practical problems related to water allocation rather than superimposing new organizations and regulations. And although it may be too early to begin critiquing the effectiveness of the efforts invested for improving governance in river basin management, it may however be wise to start questioning whether the governance principles forming the pillars of the Water Law are genuinely endorsed by local actors.

While the Water Law may in theory promote integration, what can be observed in reality is rather a turf-battle between ministries. As a case in point, the Ministry of Energy and Water (MEW) and the Ministry of Agriculture and Irrigation and Livelihoods (MAIL) could not agree under which ministry Water User Associations would fall. As a result, each Ministry has its own association (Irrigation Association under MAIL, and Water User Association under MEW) following different regulations and creating confusion both on paper and in practice. This separation does not respond to practical considerations for farmers on the ground. In fact, it may find its motivation elsewhere. As a senior and key informant from the MEW points out: "The only interest of MEW and MAIL in having water user associations under their responsibility is because they can have associated infrastructure projects. Most people in these ministries have construction companies involved in the rehabilitation and construction work of different projects" (as quoted in Thomas *et al.*, forthcoming).

### *3.4. Infrastructure first, governance later? Diverging from the imported model*

In the 1960s-1970s prior to the Soviet invasion, Afghanistan was engaged in a hydraulic mission with priority given to developing water resources through large-scale infrastructure projects, including dams and irrigation schemes. This era was put to a stop in the early 1980s. In the early 2000s, under the influence of international donors, a strong shift towards 'good water governance' principles was initiated (Thomas *et al*., forthcoming).

Yet, if on paper IWRM, RBM and participation in management is put forward, the MEW has yet to let go of its ambitions of dam construction, irrigation expansion and hydropower generation. For instance, in 2008, the Water Sector Strategy (2008) listed no less than 45 programmes and projects for the Water Sector for a total cost of almost US $3.8 million. Close to 80% of the costs are attributed to dams (mainly medium- to large-sized) and canal infrastructure rehabilitation. Multilateral donors have so far been reluctant to support these large-scale infrastructure ambitions (in part due to

[5] This document has not been published. It is an order (n°1406) signed by President Hamid Karzai and endorsed by the Ministry of Energy and Water (MEW), the Ministry of Agriculture, Irrigation and Livestock (MAIL), the Independent Directorate for Local Governance (IDLG), the Supreme Court and the Ministry of Interior (MoI). For a detailed description of the content and for an analysis of the process of making this decree, see Thomas *et al.*, (forthcoming).

transboundary water management concerns) and have focused rather on institutional reforms. This included developing new laws and regulations as well as piloting programmes for their application (see section 3.1.). Nevertheless, in recent years, Afghanistan has successfully found bilateral support (including from India) to initiate its dam projects. In an effort to increase water storage capacity, the government of Afghanistan has planned to construct a number of dams, some of which have had construction work initiated over the past few years. This includes for instance the Salma Dam in the Harirod-Murghab River Basin and the Kamal Khan Dam in the Helmand River Basin.

There are strong arguments in favour of dam construction. This includes meeting the challenge of food security and reducing vulnerability to floods and droughts (CPHD, 2011). Nevertheless, it may become an issue when improving governance and management aspects become less of a priority. Issues such as equity in water access, which are prominent in Afghanistan, may be forgotten (CPHD, 2011). The impact that such developments may have on riparian countries sharing rivers originating in Afghanistan, and the subsequent strain it might place on diplomatic relations, needs to be fully examined and understood. Efforts for securing appeased management of transboundary water sources have so far been limited both in scope and impact. In the case of Afghanistan, it is not about choosing between infrastructure or better governance and management; it is about developing both in an integrated way.

### *3.5. Under-funded ambitions for 'good governance' and water resources development*

Even when applying a soft governance approach, donor contributions are vital to achieving the country's vision for the water sector, including meeting the targets and benchmarks for the water sector that have been included as part of the Afghanistan National Development Strategy (ANDS) and the MDGs for Afghanistan. In this regard, allocation of aid to the water sector raises skepticism with regards to the seriousness of the government's and donors' commitments to the development of the Afghan water sector.

Of the total aid disbursed for the development of Afghanistan through the government's financial system, the water sector received only US $579 million, which is equivalent to 5% of total development aid. This amount is proportionally similar to or somewhat lower than the corresponding aid provided to other developing countries for the water sector (CPHD, 2011). However, in terms of per capita water sector allocation, Afghanistan receives one of the lowest shares. Between 2005-2006, Iraq, Palestine and Tunisia received US $26.50, US $25.00, and US $6.20 per capita, respectively, while, Afghanistan received only US $3.30 (CPHD, 2011). Because Afghanistan is lagging well behind the rest of the world in access to improved water sources, sanitation facilities infrastructure, and storage facilities for irrigation and drought mitigation, the AHDR 2011 points to this low level of aid to the water sector in Afghanistan to question whether water is seriously considered a priority in the country's recovery and development.

## *Conclusions: Lessons Learned and Recommendations*

Although efforts and progress have been made on the legislative and policy levels, there is still little buy-in and enthusiasm, whether at local or national level, for what is largely perceived as an imported model of governance. The international community needs to review its approach to water governance to take into account local customs in order to adopt an adaptive governance approach. This could start, for example, with a comprehensive participatory assessment of the existing institutions from the village to sub-basin level and their performance. Based on this, an improved model of governance may be proposed to help respond to the specific shortcomings of the local institutions. In this manner, the legitimacy of the new reform will be strengthened from within the country as opposed to the current imported model.

The funding support has so far been insufficient to comprehensively address the overarching issue of water security. Currently, government interest remains predominantly fixed on infrastructure development and technical interventions. Donors need to support the legitimate intent to address water security challenges through infrastructure development. The international community must support both large-scale infrastructure initiatives as well capacity-building efforts for better planning and management of infrastructure projects. Furthermore, financial and technical support for data management are also crucially required. Infrastructure is not the only solution to water sector development and to ensuring food security and deterring water-related risks and vulnerabilities. In this regard, there is a need to consider improving governance as an important element in dealing with the country's water insecurity.

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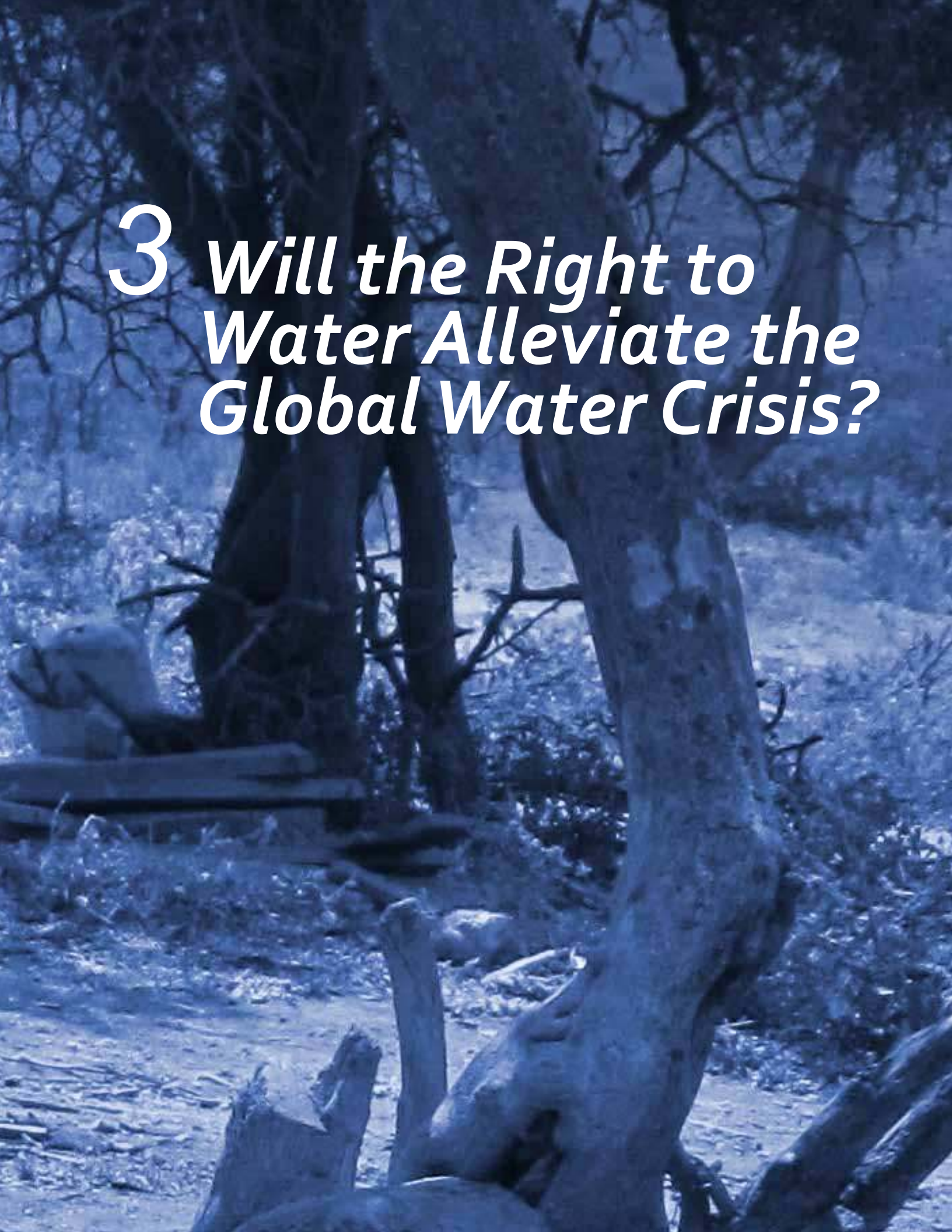

# 3 Will the Right to Water Alleviate the Global Water Crisis?

# 3.1 Legal and Ethical Dimensions of a Right to Water

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## Introduction

A growing number of arguments are being made to suggest that safe drinking water and adequate sanitation services are an essential pre-condition for the enjoyment of many fundamental human rights, such as the right to life and the right to a healthy environment (see Gleick, 1998; Barlow, 2007; and Boyd, Chapter 3.2 in this volume). In recent years, this recognition has incited discussion at the international level about the expected benefits of explicitly categorizing access to water and sanitation as a human right, and formalization of this debate has taken place through the United Nations system. An early recognition came in 2002 when the United Nations Economic and Social Council (ECOSOC) indicated that the right to water was essential (UN Economic and Social Council, 2002). A landmark report by the United Nations Development Programme (2006) recognized for the first time that access to drinking water and sanitation services was a human right. This dialogue concluded in July 2010 with a UN General Assembly resolution (64/292) that formally recognized the "right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights" (UN General Assembly, 2010: 2). The same resolution urged member states to devote sufficient financial resources and to build capacity and technology transfer, particularly in developing countries, in order to ensure that this right is served (UN General Assembly, 2012).

In September 2010, the UN Human Rights Council also passed a resolution of its own that endorsed the General Assembly resolution and offered some additional detail (UN Human Rights Council, 2010). In particular, it asked member states to develop comprehensive plans and strategies to address drinking water and sanitation challenges. Moreover, it duly recognized the need for a review of existing legislation, and in many cases, the creation of new legislation. An analysis of the current legislation, included in this volume (see Boyd in Chapter 3.2), shows that the right to water is increasingly being recognized in new constitutions. At least 18 countries, including Kenya, South Africa, the Dominican Republic, and Morocco, have drafted new constitutions that explicitly recognize this right. However, in the absence of explicit constitutional protection, the right to water can still be implicitly protected in light of its inherent quality as a prerequisite condition for the enjoyment of other explicitly recognized rights, such as the right to a healthy environment. Indirectly, however, what this analysis shows is that there still exists a large gap between the total number of countries providing a formal recognition and those that still need to review their legislation.

Given the recent nature of these developments, the need for further clarity is obvious. For instance, there is a need for greater specificity in the literature with respect to the legal framework within which the human right should be taken up, since it arguably can be legally integrated within different frameworks. Moreover, given the fact that different manners of legal assimilation can each have different associated costs and benefits, the lack of clarity on these has the potential to hinder the ongoing analysis of legalizing the human right to water. A further obfuscation is introduced due to the fact that a large number of countries (41) abstained from voting in favour of the UN General Assembly resolution, indicating the underlying disagreements and challenges (UN General Assembly, 2012).

For any discussion on water as a human right to be effective, it is first necessary to have a basic understanding of the different kinds of legal frameworks available, and the different kinds of legal standards by which the enactment of human rights may occur in order to understand how and whether water can be considered a legal right.

## 1. Human Rights, Available International Frameworks and Norms

Let us begin with clarifying and establishing a conceptual background around human rights. It is important to distinguish between law and morality as representative of two distinct kinds of normative frameworks. On the one hand, morality represents the naturally occurring terms of proper conduct. Legal frameworks, on the other, represent the socially adopted standards of government, that is, those standards that are employed as organizing principles within a civil society.

According to Griffin (2008) and Nickel (2009), it seems clear that human rights necessarily comprise a class of moral rights. More specifically, human rights represent the minimum standards of acceptable treatment to which individuals have a natural entitlement (Nickel, 2009). However, it is also clear that these rights can be taken up within legal frameworks, as legal rights. When this happens, issues of fundamental moral concern become translated into a paradigm where citizens become rights-holders and governments become duty-bearers.

Discussions of the costs and benefits of legally enacting basic human rights, such as the right to water, must be undertaken in the context of the above dynamic. But it is worth noting that all human rights that are integrated into legal frameworks do not share the same legal authority, normative force, jurisdiction, or even the same ability to effectively govern. Within the debate over the legal right to water, the most important of these distinctions is the difference between domestic and international law. For, as highlighted by Bruce Pardy (see Chapter 3.3 in this volume), the rule of law cannot exist without a basic architecture that has the capacity to enforce compliance through "independent courts; separation of power between legislatures; executive officials and judiciary; representative democracy; accountable bureaucracies; and so on". However, international law, unlike most of its national counterparts, lacks these foundational components. This absence of institutional structure, in turn, raises many questions about the effectiveness of legal integration at the international level, which would not be relevant to the enactment of a right to water at the national level.

As illustrated in Figure 1, the picture is still more complex than this. For, just as human rights can be adopted into different kinds of legal frameworks, they can also be accorded different levels of institutional force. This is to say that legal norms, such as the right to water, can be established as actionable or non-actionable standards. Put simply, an actionable standard is one whose violation gives grounds for legal action. Conversely, the violation of a non-actionable standard does not provide such grounds. Thus, the implications of incorporating a human right as one or the other are dramatic. While actionable rights are used to directly organize a society, non-actionable rights tend to have a symbolic function. To understand this, one only has to think of the difference between the role of constitutional rights within domestic legal systems and those contained in the non-binding *Universal Declaration of Human Rights* (United Nations General Assembly, 1948). Further, a human right can be legally established as one of two different sorts of norm: as a statute or as a customary standard. Statutory norms have content that is formally constructed and that is authoritatively enacted by a legislature or other governing body. On the other hand, customary norms are identified with the substance of community attitudes and are generally adopted into law in a way that is readily open to revision and adjustment. An appreciation of this distinction is key to debates about the legal introduction of the human right to water. For, the choice to legally establish the human right to water as a matter of statute or as customary law depends upon what group has the final say on the content of the right, the degree of its institutional entrenchment, and even the ability to clearly identify its contours. With all of the above distinctions in mind, it is clear that arguments for or against the legal incorporation of the human right to water must be constructed carefully and must take into account the variety of ways in which this might be achieved.

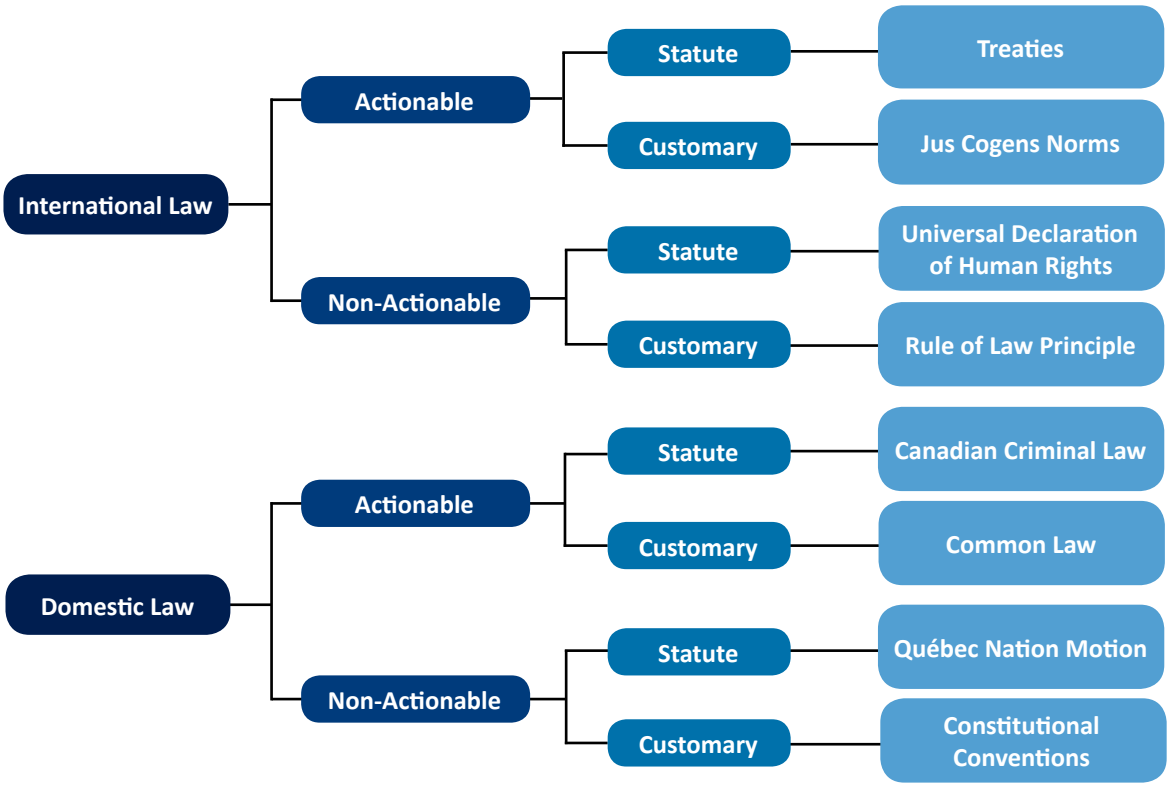


*Figure 1. The various ways that norms can be incorporated into law.*

## 2. Ethical Perspectives on State Obligations

A challenge to understanding state obligations regarding the human right of access to drinking water and sanitation is understanding the underlying ethical considerations that accompany it. These considerations are most often either consequentialist or deontological in nature.

### 2.1. Consequentialism

Consequentialism associates the maximization of positive consequences and the minimization of negative consequences with moral correctness, so that the net positive effects are used to morally justify an act. When put into practice, this approach imposes an obligation on the state to maximize the general welfare.

Utilitarianism is the predominant form of consequentialism, which maintains that we ought to act in such a way so as to achieve the greatest possible happiness for the greatest number while reducing unhappiness for the greatest number (Mill, 1871). More than a normative standard for interpersonal conduct, this approach can be used to assess the moral correctness of governmental institutions and social policies and their effects on human happiness. More importantly, it can be used to establish binding obligations on the state. For, as illustrated by Jeremy Bentham, "…over the long run, in human circumstances as we know them, making rules and assigning rights to people is most likely to conduce to happiness overall" (Bentham in Ripstein 2009: 8).

One can thereby argue that utilitarianism provides a justification for the human right to water and sanitation as long as respecting this norm would lead to greater human happiness. Put differently, provisioning of safe drinking water and adequate sanitation services could arguably lead to the maximization of positive consequences in society.



### 2.2. Deontology

Deontology, on the other hand, is not concerned with the consequences of actions. This approach considers conformity with moral principles as more important than calculations of happiness, or for that matter, of any other consequentialist good.

Immanuel Kant (1724-1804) was a philosopher and deontologist. His moral theory focused on the importance of human reason and its ability to align itself with the supreme principle of morality. This process serves to test the underlying principles of human action, and moreover, serves as a revelatory function by making one's moral duty apparent in any situation.

Associated with a person's ability to exercise their moral capacities are certain key values: autonomy, freedom, and human dignity. From these values, Kant identifies one innate human right, the right to freedom. Some have suggested that Kant is further committed to certain positive rights, known as welfare rights, which comprise a class of norms that entitle one to state assistance in light of the need to safeguard human dignity. The right to water and sanitation is by definition a welfare right, and many have used Kantian standards to argue for having such access as a pre-condition to both human dignity and the exercise of autonomous agency. Both the UN General Assembly and the UN Human Rights Council resolutions both state this premise explicitly (UN General Assembly, 2010; UN Human Rights Council, 2010).

Each of the above approaches provides a basis for placing duty on the state to respect the individual need to access safe drinking water and adequate sanitation services as a moral norm. Further, one could argue that a reliance on ethical norms would positively influence the conduct of individuals by imposing constraints on societal behaviour. This, in turn, might mitigate the negative effects of competitive water use. Moreover, one could also argue that the legal recognition of the human right to water as an actionable standard under either national or international law imposes an absolute moral imperative on governing bodies – an imperative that cannot be subordinated to goals of industrial production, or other forms of economic activity that require the use of water.

While, more often than not, the aims of morality are aligned with the aims of law, morality does not necessarily inform the content of law. For this reason, moral solutions to legal problems – despite their intuitive appeal – cannot be solely relied upon to be effective in practice, in every case. Other challenges also exist, which must be considered if a right to water is to have legal implications. A few of these challenges are explored in the next section.

## 3. Challenges in Legal Implementation

There are a number of roadblocks to achieving a universal recognition and enforcement of the human right to access to drinking water and sanitation. These challenges can be categorized into three broad categories: ground realities, perceptional roadblocks and insufficient legal instruments. Let us consider each of these.

Ground realities pertain to both the physical and the institutional environments. Examples of ground realities in the physical environment include water scarcity due to climatic conditions, challenging topography in mountainous areas that defies traditional delivery infrastructure, and national imperatives to produce food that require major diversion of water to agricultural activities. Examples of ground realities in the institutional environment include corruption and graft, weak governance and a weak legislative environment prevalent in most developing countries, and lack of institutional capacity. The declaration of human rights through a UN General Assembly resolution does not address any of these ground realities. In order to bring about a change in these, a massive and drastic change in paradigms of human and economic development may be required. Alternatively, Boyd (see Chapter 3.2 in this volume) argues that entrenching this human right as an actionable standard within both the international and national domains would be of benefit to the global community, which may require a different action from the UN General Assembly.

Numerous perceptional roadblocks have also emerged. For example, Pardy (see Chapter 3.3 in this volume) contends that the constitutional recognition of the human right to water embodies a false panacea in that constitutional enactment represents an impotent attempt to address the conditions that underlie the global water crisis. Several human rights organizations are also now forwarding claims that water, being a human right, cannot be priced or commoditized and should thus be available free of cost to everyone, everywhere. They further extend this fallacy by claiming that if we pay for water today, governments may ask us to pay for the air we breathe tomorrow. This argument, though it may sound ethical on the surface, can potentially halt many significant efforts to provide water and sanitation services to those who need it most, because it puts a block on any rational discussion of water pricing to recover the costs of service-provisioning and simply scares away financial capital that is critical.

The legal instruments available in both national and international normative environments are insufficient at the moment; countries like South Africa may be the exception to this situation. Considerable legislation, and even litigation, may be needed to establish sufficient and actionable norms. Additionally, there is a concern that a literal constitutional enactment of the human right to water may have a significant adverse impact on practices of indigenous populations (see Ávila, Chapter 3.4 this volume). A forced legal integration, as an extreme form of implementation of the human right, would allow the state to forcibly dismantle indigenous water management systems for the purpose of pursuing public (and private) water management interests.

## Conclusions

We believe that we find ourselves at the beginning of a much larger discourse around the ethics, law and norms surrounding the declaration of access to drinking water and sanitation as a human right – one that has only begun to be explored. As the legal ramifications of the UN resolution are fully understood and new legislative responses are created, better implementation will follow. It is not yet clear what kind of timeframe will be needed for these transitions to take place.

In a broad sense, the UN resolution provides a number of tools and concepts that will help improve the provisioning of these fundamental services. It provides a framework that can enable resource prioritization both internationally and at the national level. This resource prioritization not only includes financial capital but also encompasses natural resources – most importantly and prominently, prioritizing water as a resource. Future discussions around human water consumption and that for agricultural production would help clarify the relative priority for this human right in different settings. The UN resolution also provides potential remedies to communities and individuals who feel that their human right has been deliberately denied. This automatically empowers communities to better engage in decision-making around trade-offs in water consumption. Finally, recognition of water and sanitation as a human right allows the international community to consider it as an extension of the 'Responsibility to Protect' (also commonly referred to as 'R2P') paradigm to act in cases in which this human right is threatened by malicious actions of governments.

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# 3.2 The Right to Water: Moving from International Recognition to National Action

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## Introduction

It is widely recognized that a minimum supply of potable water is a vital prerequisite for life, health, dignity, and the realization of other human rights (Gleick, 1996; Howard and Bartram, 2003; UN High Commissioner for Human Rights, 2007). Yet there are approximately 1 billion people who currently do not enjoy safe drinking water, there are thousands of children who die every day from water-related illness, and climate change is expected to exacerbate these crises (United Nations Children's Fund, 2006; World Health Organization and United Nations Children's Fund, 2010). Even in the wealthiest nations on Earth, such as the United States and Canada, there are thousands of people who lack access to clean water and adequate sanitation (de Albuquerque, 2011; Boyd, 2011).

Many experts agree that legal recognition of the human right to water is a significant step towards increased access to safe drinking water (Smets, 2006; United Nations Development Programme, 2006; World Water Council, 2010; Sultana and Loftus, 2011). Therefore, prominent individuals, governments, and civil society organizations have campaigned vigorously for recognition of this right at both the international and national levels (Dubreuil, 2006; Barlow, 2007; Gorbachev, 2010). Examples include Mikhail Gorbachev, the Government of Bolivia, and NGOs such as Green Cross International, the Council of Canadians, WaterAid, Rights and Humanity, and the Freshwater Action Network. Given recent progress in recognizing the right to water as a fundamental human right (described below), the focus must now shift to implementing and fulfilling this right (Barlow, 2011; World Health Organization, 2011).

## 1. Defining the Right to Water

The right to water requires that all persons have affordable access to a supply of safe water in quantities adequate for essential personal and domestic uses, which include drinking, sanitation, clothes washing, food preparation, and personal and household hygiene (UN Committee on Economic, Social, and Cultural Rights, 2002). An adequate supply requires a minimum of 50 to 100 litres per person per day (Gleick, 1996; Howard and Bartram, 2003).

Establishing the right to water requires governments to satisfy three aspects, namely, to respect, protect, and fulfill the right. Respecting the right requires states to refrain from interfering directly or indirectly with the right (e.g. government cannot deny water services to individuals who cannot afford to pay). Protecting the right means ensuring that third parties do not interfere with or violate the right (e.g. through enacting and enforcing legislation that prevents water pollution). Fulfilling the right requires positive state action, such as investment in water treatment and distribution infrastructure, to ensure that the right is universally enjoyed (de Albuquerque, 2010).

The benefits, for people and states, of recognizing that water is a legally protected human right include:

- Triggering stronger water laws, regulations, and policies;
- Prioritizing resources for investment in water infrastructure, governance, and management;
- Empowering citizens and communities to take part in decision-making processes related to water;
- Clarifying the appropriate priorities in allocating scarce water supplies;
- Providing a potential remedy for those whose right is being or may be violated;
- Protecting water from pollution and other adverse impacts;
- Preventing discrimination or neglect of under-privileged or marginalized communities; and,
- Providing a means of holding governments and corporations accountable (Bluemel, 2004; McCaffrey and Neville, 2009; Sultana and Loftus, 2011).

It can be argued that the right to water does need not to be explicitly recognized because it is implicit in other widely acknowledged rights, such as the rights to life, health, a healthy environment, and an adequate standard of living (Tully, 2005). However, a more compelling argument is that ensuring sufficient attention and resources for the right to water requires that it be given the prominence and visibility of an explicit and distinct right (Langford, 2006; Khalfan and Kiefer, 2008).

There are many misconceptions regarding the right to water (Center on Housing Rights and Evictions, 2007). It does not entitle everyone to an unlimited supply of water at all times, in any place, under any circumstances. It may be limited by the concept of progressive implementation, i.e. that a state's obligation is contingent on the availability of adequate

resources, and such reasonable and just limits as are necessary in a free and democratic society. The right to water does not obligate nations to share their water resources with other nations, as state sovereignty is unimpaired by recognition of the right. The fact that water is a human right does not mean that it should be free, any more than health care is free. Charging a price for water that reflects its full costs is justifiable on grounds of ecology, equity, and efficiency, although a basic quantity of free or subsidized water must be offered for economically disadvantaged communities and individuals.

## 2. International Recognition of the Right to Water

Although mention of the right to water dates back to the Mar Del Plata Action Plan that emerged from the United Nations (UN) Conference on Water in 1977, there is not yet a global human rights treaty establishing this right in explicit, universal and legally-binding terms. Almost all nations have endorsed non-binding political declarations that mention the right to water, such as the Programme of Action of the 1994 Cairo International Conference on Population and Development, endorsed by 179 States (United Nations Department of Public Information, 1995). Article 14(h) of the *Convention on the Elimination of Discrimination Against Women* provides for the right "to enjoy adequate living conditions, particularly in relation to … water supply" (United Nations General Assembly, 1979). Article 24(2)(c) of the *Convention on the Rights of the Child* sets forth children's right to "adequate nutritious foods and clean drinking-water" (United Nations General Assembly, 1989).

The right to water is not explicitly included in the *Universal Declaration of Human Rights* (United Nations General Assembly, 1948) or the *International Covenant on Economic, Social, and Cultural Rights* (ICESCR) (United Nations General Assembly, 1966). However, implicit rights to water and sanitation are arguably included in Article 25 of the *Universal Declaration* through "the right to a standard of living adequate for the health and well-being of himself and of his family" (United Nations General Assembly, 1948: 5) and Articles 11 and 12 of the ICESCR through "the right of everyone to an adequate standard of living and health" and "the right of everyone to the enjoyment of the highest attainable standard of physical and mental health" (United Nations General Assembly, 1966: 7-8). The UN Economic and Social Council published *General Comment No. 15* on the Right to Water in 2002, providing guidelines for the interpretation and implementation of the right (UN Economic and Social Council, 2002). *General Comment No. 15* identifies a suite of core obligations related to the right to water for immediate implementation, as follows:

(a) To ensure access to the minimum essential amount of water that is sufficient and safe for personal and domestic uses to prevent disease;
(b) To ensure the right of access to water and water facilities and services on a non-discriminatory basis, especially for disadvantaged or marginalized groups;
(c) To ensure physical access to water facilities or services that provide sufficient, safe and regular water; that have a sufficient number of water outlets to avoid prohibitive waiting times; and that are at a reasonable distance from the household;
(d) To ensure personal security is not threatened when having to physically access water;
(e) To ensure equitable distribution of all available water facilities and services;
(f) To adopt and implement a national water strategy and plan of action addressing the whole population;
(g) To monitor the extent of the realization, or the non-realization, of the right to water;
(h) To adopt relatively low-cost targeted water programmes to protect vulnerable and marginalized groups; and,
(i) To take measures to prevent, treat, and control diseases linked to water, in particular ensuring access to adequate sanitation (UN Economic and Social Council, 2002).

An earlier *General Comment* published by the UN Economic and Social Council confirmed that governments have a core obligation to ensure the satisfaction of, at the very least, "minimum essential levels" of each of the rights enunciated in the *International Covenant on Economic, Social, and Cultural Rights* (Section 10, UN Economic and Social Council, 1990: 3).

Momentum towards explicit and binding international recognition of the right to water has accelerated in recent years. In 2007, the UN High Commissioner for Human Rights concluded "that it is now time to consider access to safe drinking water and sanitation as a human right [necessary] to sustain life and health" (UN High Commissioner for Human Rights, 2007: 26). In 2010, the UN General Assembly passed a non-binding resolution recognizing the right to water, with 124 nations voting in favour, none against, and 41 abstaining. The resolution stated that "the right to safe and clean drinking water is a human right that is essential for the full enjoyment of life and all human rights" (UN General Assembly, 2010: 2).

Later in 2010, the UN Human Rights Council issued a similar resolution, confirming that "the human right to safe drinking water and sanitation is derived from the right to an adequate standard of living and is inextricably related to the highest attainable standard of physical and mental health, as well as the right to life and human dignity" (UN Human Rights Council, 2010: 2).

The recent UN General Assembly resolution on the right to water has already had a demonstrable effect. For example, in January 2011, the Botswana Court of Appeal relied on the resolution in ruling that the constitutional rights of the Bushmen of the Kalahari were being violated by the government's refusal to allow them to access a water source within a wildlife reserve where they resided (*Matsipane Mosetlhanyane et al. v. Attorney General*, 2011).

## 3. National Recognition of the Right to Water

At the national level, the right to water is also gaining broader legal recognition (Langford *et al.*, 2004). In 2007, the UN High Commissioner for Human Rights observed that "an increasing number of States are recognizing safe drinking water as a human right in their constitutions, as well as national legislation, while national courts are enforcing it as a justiciable right" (United Nations High Commissioner for Human Rights, 2007: 26).

### 3.1. Constitutional Protection

Constitutional protection of the right to water can occur through explicit provisions or through recognition that the right is implicit in other human rights. Constitutional provisions explicitly requiring the protection and/or provision of clean water are found in at least 18 nations, and are increasingly prevalent in new constitutions (Wolfrum *et al.*, 2012)[1]. For example, both the Dominican Republic and Kenya enacted new constitutions in 2010 that recognize the right to water, as did Morocco in 2011. In South Africa, the right to water is explicitly articulated in its 1996 Constitution and is enforceable through the courts:

> 27. Health care, food, water, and social security
> (1) Everyone has the right to have access to –
> …
> (b) sufficient food and water …
> (2) The state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realization of each of these rights (Wolfrum *et al.*, 2012).

Explicit constitutional recognition of the right to water has had a significant effect on South African water laws and policies[2]. For example, the Water Services Act of 1997 states that:

> S. 3(1) Everyone has a right of access to basic water supply and basic sanitation.
> (2) Every water services institution must take reasonable measures to realize these rights.
> (3) Every water services authority must, in its water services development plan, provide for measures to realize these rights… (Act No. 108 of 1997).

South Africa's recognition of the right to water has also contributed to major investments in infrastructure (Kok and Langford, 2009; Du Plessis, 2010). In 2000, South Africa also passed legislation implementing the procedural rights entrenched in the constitution (e.g. the right of access to information), which are essential for the full enjoyment of substantive rights[3]. Recognition of the constitutional right to water is credited with spurring the extension of potable water to 10 million South Africans (predominantly black and poor) in 10 years (Smets, 2006). Nelson Mandela describes increased access to safe drinking water for millions of South Africans as "amongst the most important achievements of democracy in our country" (Mandela, 2002). In Uruguay, the constitutional provision guaranteeing the right to clean water also prohibits

[1] Bolivia (Art. 16(I)); Colombia (Art. 366); Democratic Republic of Congo (Art. 48); Dominican Republic (Arts 15 and 61); Ecuador (Art. 12); Ethiopia (Art. 90(1)); the Gambia (Art. 216(4)); Kenya (Art. 43(1)(d)); the Maldives (Art. 23);

[2] National Water Act, No. 36 of 1998, Preamble, Art 4. Local Government Municipal Structures Act No. 117 of 1998. Local Government Municipal Systems Act, No. 32 of 2000.

[3] Promotion of Access to Information Act 2000. Promotion of Administrative Justice Act 2000.

privatization of the water supply. UN data show that 100% of Uruguayans enjoy access to improved sources of drinking water, consistent with their constitutional right (World Health Organization and United Nations Children's Fund, 2010). Empirical data offers a compelling rebuttal to critics of the right to water.

In a number of nations where there is no explicit constitutional right to water, courts have held that the right to water is an implicit but enforceable constitutional right (Boyd, 2012). These nations include:

- Argentina (Picolotti, 2005; *Beatriz Mendoza*, 2008);
- Belgium (Judgement No. 36/98, 1998);
- Brazil (Supreme Court of Justice, 2006);
- Costa Rica (Supreme Court of Costa Rica, Sala Constitucional, 2007);
- Colombia (Defensoria del Pueblo, 2009);
- India (Narain, 2010);
- Indonesia (Judicial Review of the Law No. 7 of 2004 on Water Resources);
- Israel (Zarchin, 2011);
- Nepal (Belbase and Thapa, 2007); and,
- Pakistan (General Secretary West Pakistan Salt Miners Labour Union, 1994).

Courts in these nations based their decisions on the fact that access to safe drinking water is a fundamental prerequisite to the enjoyment of other human rights, including the right to life and the right to live in a healthy environment. The right to life, which arguably includes an implicit right to water, is universally found in national constitutions (Law and Versteeg, 2011). There are more than 90 nations whose constitutions now explicitly recognize the right to live in a healthy environment (Boyd, 2012), and the right to clean water is regarded as an integral element of this broader right. Empirical evidence demonstrates that there is a strong positive correlation between environmental provisions in constitutions and superior environmental performance (Boyd, 2012).

For example, in Argentina, based on the constitutional right to a healthy environment, courts have ordered governments to provide communities with potable water, construct drinking water treatment facilities, provide medical treatment for individuals harmed by contaminated drinking water, and carry out environmental remediation of polluted watersheds. An Argentine case involving Chacras de la Merced, a poor community whose drinking water was being contaminated by inadequate wastewater treatment in an upstream municipality, illustrates the potential for using the right to a healthy environment to advance the right to water (Picolotti, 2005). An environmental NGO brought a lawsuit against the upstream municipality and the province on behalf of local residents, asserting a violation of their constitutional right to a healthy environment. The Court agreed that there was a violation of the right and ordered the government to upgrade the wastewater treatment plant and, in the interim, provide a supply of clean water to the residents of Chacras de la Merced. The court-ordered infrastructure improvements were completed, and in an interesting development, the municipality passed a bylaw mandating that all future sewage and sanitation tax revenues must be reinvested in upgrading and maintaining the sewage system. Similarly, on the basis of the right to a healthy environment, the Supreme Court of Argentina ordered federal, provincial, and municipal governments to clean up and restore the heavily polluted Matanza-Riachuelo watershed, home to millions of people (*Beatriz Mendoza*, 2008). The World Bank has provided US $840 million for water and sanitation infrastructure as a direct result of the Supreme Court's judgement (World Bank, 2009).

There were over 9,000 constitutional cases brought in Colombia between 1991 and 2008 related to the provision of potable drinking water and basic sanitation (Defensoria del Pueblo (Ombudsman), 2009). Pakistan's Supreme Court held that "the right to have water free from pollution and contamination is a right to life itself" (General Secretary West Pakistan Salt Miners Labour Union, 1994). As observed in a recent Harvard Law Review article: "Although justiciability alone is not a panacea, it is a step in the direction of ensuring access to sufficient water" (Harvard Law Review, 2007: 1069).

Constitutional recognition of the right to water does not create an absolute right to water. Courts will take into account the specific circumstances of a case and the challenges facing a government in determining whether the right is being violated (see *Mazibuko et al. v. The City of Johannesburg*, 2010).

### *3.2. Legislative Recognition*

Dozens of countries explicitly recognize the right to water in national legislation or policy[4] (Langford *et al.*, 2004; Smets, 2006). For example, France enacted a new law in 2006 that explicitly recognizes the right to water:

> Art. 1. Water is the common heritage of the nation. Its protection, enhancement and development, in accordance with the balance of nature, are of general interest.
>
> In the framework of laws and regulations previously established, the use of water belongs to every physical person, for food and hygiene, and everyone has the right to access drinking water under conditions economically acceptable to all.
>
> The costs of water use, including environmental costs and the resources themselves, are borne by users, taking into account social, environmental, and economic consequences and geographical and climate conditions (Government of France, 2006).

In nations where the rule of law is respected and there are adequate resources available, it can be expected that laws and policies recognizing the right to water will be implemented and enforced, resulting in greater access and less human suffering.

## *Conclusion*

The right to water is not a silver bullet that will automatically address the world's water crisis. However, it is a powerful tool that can be used to focus attention and resources on improving access to water for those individuals and communities who currently endure the hardships imposed by the absence of safe water. It also has the potential to provide political power and legal remedies for individuals and communities whose right to water is not being respected or fulfilled. Even in the poorest nations in the world, there are adequate resources for fulfilling this basic and essential human right if water services are given the appropriate priority and resources are used efficiently. The immense social, health, cultural, and economic benefits of providing people with clean water and adequate sanitation clearly outweigh the costs.

Over the first decade of the 21st century, civil society worked tirelessly to secure international recognition of the right to water. That legal goal has largely been achieved, providing a strong foundation for renewed efforts to ensure that all people actually enjoy this right in practice and not merely on paper. This must be the focus of civil society and governments in the next decade, to meet the Millennium Development Goals (cutting in half the number of people without access to safe water and sanitation) and then rapidly move towards universal access to affordable, accessible, and adequate water. As well, it must be recognized that the forecast changes resulting from anticipated climate change impacts represent a formidable barrier to future progress and a threat to the gains that have been made in some regions. Efforts to reduce greenhouse gas emissions, protect the world's forests, and build resilience against the anticipated impacts of climate change, among many other environmental challenges, are inextricably linked to fulfilling the right to water over the long term.



[4] Algeria, Angola, Argentina, Bangladesh, Belarus, Belgium, Brazil, Burkina Faso, Cameroon, Central African Republic, Colombia, Costa Rica, Dominican Republic, Finland, France, Germany, Ghana, Guatemala, Guinea, Honduras, Indonesia, Latvia, Luxembourg, Madagascar, Mauritania, Namibia, the Netherlands, Nicaragua, Norway, Paraguay, Peru, Portugal, Romania, Russia, Senegal, South Africa, Spain, Sri Lanka, Tanzania, Ukraine, and Venezuela

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# 3.3 False Panacea: The Human Right to Water[1]

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[1] Some passages are taken or adapted from B. Pardy, 2011, "The Dark Irony of International Water Rights", *Pace Environmental Law Review* 28: 907; and B. Pardy, 2004, "Seven Deadly Sins of Canadian Water Law", *Journal of Environmental Law and Practice* 13: 89.

# Introduction

South Africans have a human right to water. Section 27 of their national Constitution states:

> "Everyone has the right to have access to … sufficient food and water …" (Constitution of the Republic of South Africa, 1996).

It might be surmised that each South African must therefore have access to a clean and secure supply of fresh water. In fact, South Africa suffers from serious and persistent water problems, including a shortage of freshwater resources (Marshall, 2010), water contamination (Brulliard, 2009), and poverty.

Entrenching a constitutional human right to water is not the solution to water problems that it appears to be. Such rights understandably have a seductive appeal. They are simple, grand statements of an admirable intent: that since water is essential to life, all people should be guaranteed a sufficient supply (McCaffrey, 2005; Gleick, 1998). However, human rights to water do not actually guarantee the result that they describe, and indeed, may actually impede the objectives they are intended to achieve.

# 1. Negative and Positive Rights

Technically, all legal rights held by people are 'human rights'. However, the term has come to denote a narrower category of rights, while the criteria for attaching the label is not always clear. Usually excluded from the category are traditional legal rights that empower rights-holders to limit the intrusions of others. For example, property rights allow landowners to exclude others from entering; tort rights prohibit unprovoked attacks and unwanted touching. On the other hand, 'human rights' are often thought to include some constitutional rights that limit the intrusions of government. The right to freedom of expression prevents certain kinds of state censorship, and the right to be presumed innocent prohibits punishment without proof of guilt at a fair trial. These constitutional rights are sometimes called 'negative' rights because they restrict the ability of the state to interfere in the lives of citizens.

The human right to water, such as the one found in South Africa's Constitution, operates differently. It is a 'positive' right, identifying an entitlement to be provided by government. Positive rights to water, food, housing or an adequate standard of living require governments to make policies and take steps towards fulfilling these ends. Positive rights purport to guarantee social or economic benefits, and are more frequently seen in the constitutions of civil law countries than in those of the common law tradition (Boyd, 2012). South Africa has a hybrid legal system that has elements of both (Mireku, 2007).

# 2. Problems with the Human Right to Water

## 2.1. Ignores water's two states as a common resource and a commodity

Water is a common resource, but it is also a commodity, depending on its form and location. In its natural state, water is transient, flowing in surface bodies and underground in a slow journey towards the ocean. This water is wild, belonging to no one, and traditionally may be collected at will. Once captured, water may be consumed, bottled, added to products, used in manufacturing or agriculture, or treated and delivered to customers.

People obtain their personal and household water in one of these two forms: they capture wild water by sinking a well or throwing a bucket into a stream; or they buy commodified water from suppliers who deliver water by pipe or other means. People who live outside cities are more likely to sink a well to draw groundwater or to use a river, stream or communal well. City dwellers tend not to have access to natural sources of water, and must acquire water as a commodity, whether from municipal pipes or wells, or by purchasing water in bottles or trucks from commercial suppliers.

A constitutional right to an adequate supply of water speaks to the provision of water as a commodity, not to the collection of water as a natural resource. Constitutional provisions like the one in South Africa do not provide a private legal right to be free from water contamination, or to the protection of the supply of water in surface bodies or underground. Citizens

cannot rely on constitutional water rights to bring an action against those who pollute or deplete natural sources of water. Instead, they must rely on other legal rights if they exist, such as common law actions in nuisance or riparian rights, or unreliable regulatory actions of government.

### *2.2. Does not increase water resources*

The declaration of human rights to water does not increase the natural amount of water available. A country short of water will still be short after a human right to water is constitutionally declared. Constitutional provisions may bind governments, but they cannot change ecosystems or water cycles. Unlike wealth, which can grow and be multiplied, the amount of fresh water in a country is limited to its natural supply, unless energy-intensive desalination is used or water is imported.

### *2.3. Exacerbates scarcity*

Ideally, the price of commodified water should reflect its market value (Zetland, 2011). Where water is plentiful, supply may exceed demand and therefore can be expected to be cheap. In some places, water may be scarce, and therefore expensive. Human rights to water are usually defined to mean that citizens have the right to be provided with water that is free or is available at nominal cost. Consumers of commodities, including water, respond to price: lower price leads to higher demand. When water is free, there is no reason to conserve or minimize the amount of water used. Where water is scarce, providing water for free will ensure that demand outstrips supply.

Maintaining water markets can be difficult. Water treatment and supply systems are regarded as 'natural monopolies' because constructing multiple sets of parallel pipes underneath cities to compete with each other is not feasible. Competing sources of clean, municipal drinking water are thus unlikely to emerge. However, monopolies do not work well, regardless of whether the monopoly is public or private. They are seldom efficient, effective or responsive to their customers' desires, and may charge excessive prices because there is no competition to set a market price. But going to the other extreme of making water free or artificially cheap is equally distorting.

If there is no market to set price, legislated rules can require price to reflect cost of provision and scarcity, thereby coming as close as possible to reproducing the dynamics of supply and demand. Regulation of drinking water should be arm's-length and free from conflicts of interest. In an ideal system, the operation of water treatment plants and pipelines is separate from the supervision of the system, which in turn is separate from the setting of rules and standards that the system is expected to meet.

### *2.4. Not an enforceable guarantee*

At first glance, the South African right to water appears to guarantee that everyone will be provided with a sufficient supply. However, it has neither that legal meaning nor that practical effect. The full text of the right to water in Section 27 reads:

> *"Everyone has the right to have access to … sufficient food and water … The state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of each of these rights."* (Constitution of the Republic of South Africa, 1996).

Rather than creating an obligation to supply water, this constitutional provision obligates government to develop policies towards that end (*Mazibuko,* 2009: para. 50). Further, the government's responsibility is limited by the resources that are available to it for this purpose (*Mazibuko*, 2009: para. 49). Policies may be designed to achieve the progressive realization of water access, which means that they need not achieve the objective immediately or at any particular time, but gradually and eventually. Moreover, like many constitutional human rights, the South African right to water is vaguely defined. It leaves to the courts the job of determining how much water is sufficient and the terms upon which water is to be provided, questions that courts are not well equipped to answer.

In 2009, South Africa's Constitutional Court decided *Mazibuko v City of Johannesburg*. The applicants were five residents of Phiri in Soweto. The City of Johannesburg, one of the respondents, had established a policy of providing 25 litres of free

water per person per day. The applicants maintained that the policy breached Section 27 of the Constitution because 25 litres of water was not sufficient for daily use. The trial court agreed, concluding that 50 litres of water per person per day was the proper amount. The appeal court reduced this figure to 42 litres. On final appeal, the Constitutional Court found that Section 27 did not require more free water than the City's policy provided, and observed that the constitutional right to water did not require courts to take over tasks that in a democracy should properly be reserved for the democratic arms of government (*Mazibuko*, 2009: para. 161). Constitutional rights to water do not simply guarantee that sufficient water will be provided to each person, but instead are subject to interpretations and qualifications that mean that they are not as straightforward as they appear.

### *2.5. Prioritizes regulation at the expense of individual legal rights*

Regulation has become the dominant form of water governance and, ironically, constitutional water rights confirm state control of water. The human right to water in the South African Constitution provides government with the discretion to develop policies and allocate resources (*Mazibuko*, 2009: para. 50). Legislation typically authorizes officials to balance competing interests, and thereby to approve water pollution when its effects are judged to be less important that the benefits it produces. Manufacturing facilities, farms, and other private commercial enterprises may receive permission to extract large volumes of water and to pollute even when the direct or cumulative effects are detrimental to water quality or quantity, because the benefits are deemed to outweigh these costs. Moreover, regulatory regimes create potential conflicts of interest when government installations such as sewage treatment facilities and power plants themselves pollute.

The alternative to regulation is private legal rights, not of the 'human rights' variety. For example, in some common law jurisdictions such as in Ontario, Canada, surface water is subject to the interests of riparian landowners, who possess certain rights to quality and quantity which may be enforced against upstream owners (*Young v. Bankier Distillery Company*, 1893; *McKie v. K.V.P. Co.*, 1948; *Gauthier v. Naneff*, 1971). Also, in some countries, accessing natural sources of water may be considered an incident of land rights. In *Mosetlhanyane and Matsipane v Attorney General of Botswana*, the Botswana Court of Appeal recognized the right of Bushmen to use an old borehole to extract water for domestic purposes, overturning a government prohibition. The court found that the Bushmen had the right not to be interfered with on the lands that they rightfully occupied. Their right to use the borehole did not consist of a right to be provided with water, or to have the government cover the expense of using the borehole. The case could be interpreted as a vindication of the concept of a human right to water, but that would not be an accurate reading of the judgement. Instead, the court states, "... the appellants as lawful occupiers of the land in question merely seek, at their own expense, permission to use water from a discarded existing borehole for domestic purposes..." (*Mosetlhanyane*, 2011: para. 16).

The success of private rights as a means to protect water resources depends in large measure on citizens' access to an independent judiciary, and on whether their rights are displaced by legislation that creates regulatory regimes in their stead.

### *2.6. Entrenches an ideology*

Human rights to be provided with water are less about water than about ideology. They do not protect water resources from pollution or depletion. They do not preserve ecosystems or the operation of water cycles. Instead, they are declarations about who should pay the costs of providing water. The case for free water rests on the argument that water is essential to life, and therefore it should not carry a cost. But providing water is costly, particularly in urban areas – for regulating and enforcing watershed protection, for treating polluted water, and for infrastructure to deliver clean water and remove waste. A right to free water does not eliminate the cost of providing the water, but instead demands that it be paid by others, such as through general taxes or fees on some other commodity or service. By so doing, a right to be supplied with water incorporates an ideology: water must be provided by government rather than by private means (Bluemel, 2004), and the costs of water systems cannot be borne by those who use them. Positive rights to water demand a socialized system of water provision, subsidized by some for the benefit of others. A constitutional provision of this nature removes the democratic right of citizens to determine the ideological premises of the water system they wish to run.

'Positive' constitutional rights create entitlements governments must actively provide. Governments have an unlimited capacity to provide negative rights, since they require merely that citizens be left alone, while positive rights require governments to take from some to give to others (Cross, 2000-2001). Negative rights place limits on the state's ability to

interfere, while positive rights do the opposite (Sunstein, 1993). Positive rights constitutionalize the political philosophy that government has a permanent and unalterable obligation to provide material well-being to its citizens.

### *2.7. Does not address the real causes of water problems*

Human rights to water do not solve the actual causes of water problems: pollution, depletion, corruption, financing, monopoly, conflict of interest and mismanagement. Countries with the poorest access to clean water tend to be less developed and badly governed (Zetland, 2011). Citizens in developed countries, many of which do not have water rights in their constitutions, generally enjoy good access to water. The shortest route to making clean water available would seem to be economic development and representative government.

People who are extremely poor have difficulty acquiring necessities such as water, food and shelter from competitive markets because they cannot afford to pay even competitive prices. But the existence of poverty is not evidence of systemic flaws with the supply of these goods. If stores are full of bread, the fact that there is a hungry man on the street with no money does not indicate that the price of bread is too high, or that the system of food production requires reform. Instead, it suggests the need for a social safety net to provide the poor with resources to enable them to buy bread from the store. If the poorest people do not have money to pay for water, that is a problem attributable to poverty, not necessarily to a problem with water governance.

## *3. Better Water Rights*

A just and effective legal regime for water governance includes rights that address the real threats to water. Most important are rules and institutions that transcend the subject of water and on which the rule of law depends: independent courts; separation of powers between legislatures, executive officials and judiciary; representative democracy; accountable bureaucracies; and so on. Without the building blocks of the rule of law, rules or rights that relate specifically to water will be ineffective because they cannot be enforced.

Once the basic architecture of the rule of law is established, the following individual legal rights enacted in legislation would transform water governance from an exercise in symbolic measures to a system of meaningful and enforceable legal obligations to preserve and protect natural water sources and to facilitate the treatment and delivery of potable water: (i) The right of land occupiers to be free from water pollution and depletion; (ii) the right to draw water from natural sources, subject to the rights of downstream occupiers; (iii) the right to enforce quality standards against providers of commodified water; (iv) the right to fair market prices for commodified water, or in other words, the right to be protected from monopoly; and (v) the right to arms-length regulation free from conflicts of interest.

## *Conclusion*

The human right to be provided with water is a false panacea for water problems. It does not protect natural sources of water from depletion or pollution, or increase natural supply. Instead, it has the potential to increase demand, thereby exacerbating scarcity rather than alleviating it. It does not establish a system of sound water governance but instead constitutionally entrenches an ideology by declaring that water users must not be required to pay the costs of building, maintaining, and running water systems. Good water governance requires good governance, in the broadest sense of the term. Establishing a human right to water will not accomplish this objective. More coherent reforms are necessary to ensure that water is accessible and available to all.

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# 3.4 Access to Water and Conflict: An Indigenous Perspective from Latin America

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## Introduction

Water conflicts are numerous, and they may arise through the confrontation of two or more cosmogonies and their respective social perceptions of water's value, among other reasons. Such examples exist from the Colonial period in Latin America: while for indigenous people, lakes were a source of multiple material and spiritual assets, for the Spaniards they were a source of disease because of the stagnant and foul-smelling waters. It was this latter conception that instigated the desiccating of the lakes, which in the valley of Mexico was achieved by draining its water to another watershed basin (Musset, 1992; Espinosa, 1996).

Today, this contrast in values is reflected in the dichotomy that exists between institutions and social agreements in the management of water at the community level. The state ignores the water rights of indigenous peoples and introduces new modalities, from supporting individual rights to the public and private management of water.

However, the conflict is more deeply rooted in the free-of-charge and collective access to water, given that the state promotes the re-valuation of water as an economic good that should have a market value and price. In this sense, disassociating or even omitting the existence of the social and cultural dimensions of water is a way of endangering both the basis of contemporaneous civilizations and indigenous regions where there is a culture of sustainable use and management of water. In addition, it is a way of generating water conflicts and of attacking collective rights and forms of management in indigenous territories that since ancient times have supported a sustainable appropriation of water (Ávila, 1996).

## 1. Water and Cosmogony

Throughout history, water has had deep, mythical-poetic and socio-cultural meanings and values associated with cosmogony and with the perception of the world and nature (León Portilla, 1992; Ilich, 1993; Estermann, 2006). This has resulted in cultural ways of managing water within an integrated water-land-forest matrix, and in a social recognition of water as a collective good or common (Robert, 2002).

The relevance of recognising the value of water in its largest sense is a key factor in understanding the past and present existence of water cultures that have been founded on the principles of social and environmental sustainability (Ávila, 1996; Palerm, 1972; Rojas, 1985). Historically, water has been a common good that is socially regulated in order to guarantee a more equitable access to it; and since not being dissociated from the territorial water-land-forest matrix, its appropriation was based on an integrative logic and on the profound knowledge of the cycles of nature (Espinosa, 1996; Robert, 2002).

For Mesoamerican and Andean peoples alike, water was considered a gift from the gods with which they would live and strengthen (León-Portilla, 1992; Estermann, 2006). The availability of water in the territory contributed to the birth of communities and peoples that settled following the land-water-forest patterns along valleys, hills and mountains in which springs and rivers had their source. Conservation and adequate management of water, land and forests enabled life itself and the development of communities. It also was the basis for the flourishing of the Mesoamerican and South American hydraulic societies (Palerm, 1972; Rojas, 1985, Gelles, 2000).

Indigenous peoples created rights, regulations and collective practices about water in order to guarantee its adequate use and appropriation (León-Portilla, 1992; Robert, 1994; Ávila, 1996). As stated by Robert (2002): "In history, water has been the great maker of communities. Always people from diverse origins learned to share the same fountains and to coexist beside the same rivers and, by the act of concluding agreements, set the bases of a community."

Free-of-charge water supply was associated with its divine nature, as water was considered a gift from the gods. This enabled free access to water, which was then regulated by communitarian actions (such as tasks and festivities), and by the creation of rights for collective water use and management. In this framework, water was considered to be a common good contributing to the reinforcement of the territorial links of belonging and identity.

## 2. Water as a Collective Good

According to Gentes (2002), the essential elements of the subsistence strategy of indigenous peoples are collective property and kinship. The advantages of having a common property system is that water resources represent undividable goods that require an integrated management of the catchment, and that access, use and management of these resources become socially controlled and regulated. The regulation of water resources in indigenous territories is carried out by means of rules that are largely structured within concrete practices, beliefs and socio-cultural values. Uses and customs become local regulation systems, in many cases based upon the consuetudinary or ancestral laws of indigenous peoples that were established before the formation of nation-states; in the case of Latin America, corresponding to the pre-Hispanic period. As a result of this social organization, accumulation of goods by families is limited in favour of communitarian reciprocity. Conversely, autonomy of indigenous peoples with respect to state power guarantees access to natural resources present in the territory and establishes that the appropriation of water be based on kinship and cooperation.

However, as stated by Boelens *et al*. (2006), in a scenario of growing scarcity and competition for water resources, water rights become essential in the struggle of indigenous peoples for defending their territory. Control of water resources is both a source of power and of conflicts because it is strategic for productive, social and cultural activities and because it is essential to the identity-building of indigenous peoples. The notion of water as a common good is sustained upon a social organization of it and collective activities that implicate cooperation instead of competition in order to survive, and that ensure water rights in adverse environmental conditions, such as in arid or mountainous zones. These collective actions express a sort of reciprocity that sustains and reproduces both the water resources management systems and the peoples that depend on its use.

Water rights are thus related to access to water and its infrastructure, namely through: the rules and collective obligations regarding the resource's management; the legitimacy of the communitarian authority for establishing and enforcing rules and rights; and, the discourses and policies for the regulation of the resource. In other words, the right to water is more than a relation between access and use or between subject and object: it is a social and power relation that involves participating in and having control over the decision-making process.

## 3. Legal Pluralism and Water Rights

In most Latin American countries, the legal and institutional frameworks concerning water do not recognize the consuetudinary rights and communitarian water management of indigenous peoples. In countries where, nevertheless, there is a formal recognition of the rights of indigenous peoples, it is merely an act of goodwill that is incapable of translating indigenous rights into public policies and local norms. Instead of the recognition of legal pluralism (multiple legal systems within one geographical area), there is a trend of institutionalizing and controlling traditional forms of social organization and communitarian management of natural resources, with the aim of including indigenous peoples, in the pursuit of national goals.

The actions and regulations imposed by the state in the territories of indigenous peoples tend to be vertical and do not consider the existing heterogeneity of socio-cultural and environmental contexts. As a consequence, what is dominant is a legal framework with the state as its single reference and seeking uniformity in the application of public policies regarding water throughout the national territory. As a corollary, there is exclusion of indigenous institutions and of the indigenous use and custom guaranteeing both the communitarian management of water and the resolution of conflicts.

The right to have control of the territory is central among the claims of indigenous peoples because land tenure does not provide the rights over underground resources, water, wetlands and biodiversity. Underground natural resources are recognized as being a property of the state or nation, and their appropriation is made by means of land expropriation by cause of public interest or through concessions and licenses to private owners. Such scenarios of legal defenselessness in indigenous territories has cultural, environmental and economic implications, given that rights become limited by the state's actions or by the presence of private actors seeking, under market logic, to gain beneficial ownership over natural resources for exploiting minerals or for establishing irrigation for commercial crops (Gentes, 2002).

## 4. Water Policies and Their Impact in Indigenous Territories

Neo-liberal policies in Latin America brought about the exploitation of mineral resources, the production of exportation crops, the building of communications and hydraulic infrastructure, and the expansion of urban settlements. Because of these developments, the defense of territory and natural resources became central demands to the indigenous movement (Gentes, 2009). The lack of acknowledgment of indigenous territories by the state and the fragmentation of rights linked to land and water favoured pillage and dispossession in the absence of an inclusive norm. This is due to the indigenous conception of territory as including all associated natural resources such as land, water, wetlands, forests and grasslands; in contrast, the legal conception of land by the state disarticulates these elements in different land tenure regimes and through licenses given to individuals.

During the 1980s and 1990s, Latin American states made structural reforms to give impetus to an economic model based on free-market principles, with a dominant participation of the private sector in strategic areas of the economy and corresponding accordance of legal certitude of private property of natural resources, such as land and water. To give sustenance to the implemented national public policies, changes were made to the relevant legal and institutional frameworks. The implications of these legal reforms in the territories of indigenous people have led to fragmentation and to the private benefit ownership – not by local people – of common goods that are nevertheless part of their land-water-forest socio-cultural matrix.

## 5. Conflicts for Access to Water in Indigenous Peoples' Territories in Latin America

In the presence of the constant violation by states of human and indigenous peoples' rights, the scenario of social conflict for water is intense and complex in the Latin American region. These circumstances have been worsened by structural reforms that have led to a decreased role of states, which are expressed through more flexible legal and normative frameworks that favour the ascension of the private sector to a prominent role, and in increased incentives for private investments in strategic areas such as energy, water, mining and urbanization.

Many of the conflicts occurring at present fall within such a category and are not necessarily the result of a water crisis and its 'feared wars'. Rather, they are an expression of omissions and direct actions of the state and of other actors or economic stakeholders that have made vulnerable the essential rights of the poorest and marginal sectors of the population: the indigenous peoples (Boelens *et al.*, 2006).

Therefore, in the last 15 years a variety of conflicts over water in the indigenous regions of Latin America have emerged, which demonstrate a tension due to the modification of rights (both recognized and unrecognized) over the control of territory and the management of natural resources, as well as negative social and environmental impacts associated with public and private investments undertaken to favour the dominant economic model and the urbanization process.

Among the socio-environmental conflicts connected with water access are those associated with: the expansion of mining in indigenous regions of North, Central and South America (the Huichol, Nahua, and Mixteca peoples in Mexico, Maya peoples in Guatemala, and Andean peoples in Peru); the privatization of water in Bolivia (indigenous peoples of Los Altos and Cochabamba regions); the construction of hydroelectric dams in Brazil (the Amazonian Kayapo peoples), Brazil-Bolivia (the Karitana, Karipuna, Oro Bom, Cassupá, Salamai, Katawixi, Uru-eu-Wau-Wau peoples), Chile (Mapuche Pehuenche peoples), Ecuador (Afro-Ecuadorean peoples), and Panama (the Naso and Ngöbe peoples); the construction of highways in Bolivia (Moxeño, Yuracaré, Chimán peoples); the supply of water from one watershed to another for urbanization purposes in Mexico (the Mazahua, Nahua, and Yaqui peoples) and Peru (peoples of the Huancavelica region); and, the expansion of tourist projects in Mexico (the Maya, Purépecha, and Nahua peoples).

## 6. Conflict Over Access to and Control over Water in an Indigenous Region of Mexico: The Case of the Mazahua People

As an example of such a situation in the Latin American region, the conflict of the Mazahua people for the defense of water is an expression of the tensions between rural and urban areas due to the building of large hydraulic infrastructure in indigenous peoples' territories. The region where the Mazahua peoples are located is important because it provides one-third of the water consumed in the metropolitan area of Mexico City, that is, 15 cubic meters per second. During the 1980s and 1990s, a complex system of water supply known as the Cutzmala System, which implied the transfer of water from one watershed to another, was constructed through dams, canals, tunnels, treatment plants, and pump systems, with a total length of around 300 km and a change in elevation of 1,100 metres.

The problem with the hydraulic works of the Cutzmala System is that they were constructed without considering the interests of the local population (peasants and indigenous people), thereby affecting their rights related to the control of their territory and natural resources (water). All of this was undertaken with federal public funds to favour the urban-industrial expansion of Mexico City in the state of Mexico and the Federal District. The city's interests were put before those of the country and, consequently, the indigenous people's rights were affected.

According to the 2010 census (INEGI, 2011), the indigenous population in Mexico was about 13 million people, representing nearly 10% of the total population of the country. However, because of social exclusion, indigenous peoples live in situations of high poverty and vulnerability: 85% of their municipalities have very high or high indexes of marginality; income levels are among the lowest in the country, as their main activity is subsistence farming. In addition, their access to public infrastructure and services is unequal: the percentage of houses having water and electrical services is below the national average, and localities with a higher indigenous population have limited access to water, with 42% of houses lacking piped water supply.

One of the reasons for the deficient supply of water to indigenous peoples' regions, predominantly in rural settlements, is the nearly absent public investment in water supply and sanitization. This situation was made evident in a study of five indigenous regions in Mexico (Ávila, 2007) showing deficiencies in access to piped water supply: 78% of houses lack the service in the Tarahumara area; 75% in the Mazahua area; 41% in the Purépecha area; 32% in the Mixteca area; and 39% in the Nahua area. To this must be added: the problems of the frequency of water supply (two or three times per week, for a few hours at a time); the inaccessibility of supply sources (springs up to 10 km away); and, the low quality of the water being consumed (pollution of superficial and groundwater supplies).

The amount of public investment aimed at solving problems of access to water in indigenous regions is reduced to such a degree that the Mexican government will have difficulties in reaching the Millennium Development Goals. For example, during 2004, the per capita federal aid for drinking water supply and water sanitation was US $7.70 in the Tarahumara area, while these values were US $5.00, US $1.70, US $0.90, and US $0.20 in the Mazahua, Nahua, Purépecha and Mixteca areas, respectively. These budgets make clear that the indigenous regions are not a priority for the Mexican government, and that there will continue to be an increase in the occurrence of problems of access to an adequate quantity and quality of water (Ávila, 2007).

Similarly, social inequity in indigenous regions of Mexico and the subordination of rural areas to urban areas in terms of projects involving the extraction of strategic natural resources from their territories (water, forest products, minerals), have been an important cause in the appearance of social conflicts. The case of the 'Mazahua Women's Movement for the Defense of Water' is a clear example of the rising tensions between the state and indigenous peoples.

The social and environmental costs of the Cutzamala System were very high for the Mazahua people: the transfer to the valley of Mexico of an important volume of water narrowed their possibilities for development without even satisfying their basic needs (access to water and food production). The reduction in water volume affected lacustrine and riparian ecosystems: a number of marshland areas and rivers became dry. In addition, the polluted discharge from the Los Berros water purification plant, part of the Cutzamala System, was poured untreated into a stream used by several Mazahua settlements. Fish and plants died due to the high concentration of toxic substances, and the stream never again became a source of life and food for the population.

As a result of the limited access to drinking water (75% of the population lacks a supply), and of the pollution of water, the indigenous population organized themselves for the defense of this resource. Between 2004 and 2006, the collective actions of the Mazahua women included social mobilization (marches, demonstrations, sits, hunger strikes) and symbolic takeovers of hydraulic installations and buildings of the Cutzamala System. Their proposal went beyond access and management of water

by its interconnection to encompass the management of forests and of the territory. For this reason, integrated measures were proposed spanning both productive projects, such as forestry, crop diversification for self-consumption and commercialization, development of organic agriculture, establishment of domestic and collective greenhouses, tank building for aquaculture, and husbandry of small livestock, to communitarian projects such as improving water supply and quality, building of distribution tanks, sewage, dry latrines and paving, among others.

In response to the indigenous people's mobilizations and political pressure, the National Commission of Water and the government of the state of Mexico acted towards satisfying part of the demands. A convention was signed between the government ministry and the Mazahua movement to aid the realization of several social projects, but these can be characterized more as short-term 'band-aid measures', such as the building of piped water distribution and sewage networks and of dry latrines. The problem is that several Mazahua communities were either excluded or only partially covered because of political divergence between groups due to the strategy of the state to weaken and fragment the social movement.

However, despite their exclusion from economic aid from the state, the perspective of the Mazahua Women's Movement since 2006 has not centered on the actions of the state, but instead has given impulse to self-managed regional development based on principles such as integrated management of the territory and its natural resources, the strengthening and diversification of agriculture for food production and for improving the diet and nutritional level of the population, and the conservation and protection of the sources of water and of their forests in order to guarantee the quality and quantity of water for present and future Mazahua peoples.

## *Conclusions*



Water has played a primordial role in the pattern of human settlement, productive strategies, and development of indigenous peoples in Latin America. The socio-cultural value of water is expressed through the various cosmo-visions, myths, perceptions and archetypes connecting the indigenous peoples with a sacred and divine origin. For Mesoamerican and Andean cultures, water was a gift from the gods that must be cared for and earned through rituals and practices of use and appropriation that were supported by a balance of respect and integration with nature.

Water rights arose in a socio-cultural and ecological context that was founded on the concept of belonging to a territory: the notion of water as a collective good and the respect for social agreements for its management were the normative bases of the uses and customs of indigenous peoples. At the same time, it was an adaptation mechanism used by indigenous peoples in ecological settings with difficult climatic conditions and water scarcity (such as in the Andes and in the arid zones in Mexico). Until today, there are indigenous regions in Latin America in which cosmo-vision and socio-cultural strategies persist, and in which, for centuries, a culture of sustainable management of water has been generated and adapted, having as its principle the collective rights and the communitarian management of the territory with its associated natural resources.

However, in recent years, due to state reforms and changes in the economic model that privilege private property and free markets, the socio-cultural valuation of water has been replaced or even annulated by an economic valuation. In other words, during the recent neo-liberal period, water has tended to lose its integrated meaning to become a merchandise having an economic value and a price, a trend which finds support in legal and institutional reforms made by the state regarding access, appropriation and management of the resource.

Resistance and disputes for the defense of water as a common good with regulated access and free and collective beneficial ownership have occurred in Latin America. Unfortunately, the channels for negotiation and management of the conflict have closed as a result of the new legislation and water policies that have directly affected the rights of indigenous people, with the clearest expression of these being the privatization of water rights and land in their territories.

In order to find mechanisms to avoid and resolve many of the socio-environmental conflicts associated with water that exist today in the indigenous communities of Latin America, the following are required, among other things: i) going beyond the economic vision of water resources and revaluing its social and cultural importance for the indigenous peoples; ii) rethinking novel schemes of water management in the indigenous territories, such as co-management and decentralized management; iii) recognizing the water rights of the indigenous peoples as a form of legal pluralism or co-existence of state laws with the consuetudinary right; and iv) linking the legislation and national policies of international commitments about human rights with indigenous rights.

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# *Conclusions*

# *Response from the InterAction Council on the World Water Crisis*

**The Rt. Hon. Jean Chrétien**
Co-Chair of the InterAction Council
Former Prime Minister of Canada

It is perhaps appropriate that a discussion about the world's water should begin with a story, for each of us, no matter where we live in the world, has a story about water. Sir James Fitz-Allen Mitchell, former Prime Minister of Saint Vincent and the Grenadines, tells an engaging and apocryphal story about his discovery of the relative importance of water in our time.

Sir Mitchell begins his story by explaining that as obvious as the effects of climate change are, there are people who stubbornly deny it. Similarly, he notes, there are people who still maintain that water resources are not exhaustible. But Sir Mitchell knows differently.

In the wake of the 1973 oil crisis, Sir Mitchell travelled to Saudi Arabia to determine if it might be possible to negotiate price relief for his struggling Caribbean nation. As it happened, these negotiations necessitated a journey from Riyadh to Jeddah by car. On their return, excited Saudi officials made a detour to visit a pool of water in the desert. They were excited because they hoped that the appearance of the pool was evidence that geological formations below might contain vast reservoirs of water. The Saudis, however, were deeply disappointed, Sir Mitchell explained, for while they genuinely wanted to find water, all they found was oil. This is the world we live in now – a world in which water is more precious than ever before in human history.

Sir Mitchell is a member of an international organization of former heads of state called the InterAction Council. Established in 1983, the InterAction Council is comprised of some of the world's most experienced statesmen and women whose objective it is to address long-term, global issues facing humankind. The Council's membership boasts more than 30 former heads of state who volunteer their time to develop proposals for action and submit them directly to national and international decision-makers.

In 2011, the members of the InterAction Council acknowledged that humankind is faced with the danger of a water crisis. Clean and reliable access to water, they unanimously agreed, is integral to maintaining and supporting a life of full dignity. Without adequate water, energy cannot be produced, crops cannot grow, sanitation is compromised and human health and well-being are jeopardized.

Reflecting the interdependence of the world and the importance of multilateral solutions, the InterAction Council assembled for its 29th Annual Plenary Meeting in Québec, Canada in May 2011 to focus on the global water crisis. At this meeting, the Council endorsed the Chairmen's Report and recommendations that emerged from the High-level Expert Group Meeting 'The Global Water Crisis: Addressing an Urgent Security Issue' held in Toronto in March 2011.

There was complete agreement among the members of the InterAction Council on the importance of water. Water is life. It is essential in our daily lives: to quench our thirst, to grow our food, for sanitation to keep us healthy, and to produce the energy that drives our modern age. It was noted by the Saudi Arabian Minister of Electricity and Water, Mr. Abdullah Al Hussayan, that demands for fresh water are growing rapidly. Mr. Al Hussayan explained that in order to feed the extra 3 billion people expected to populate the earth by 2025, that as much as 1 trillion cubic metres of water will be needed each year. To put this in perspective, he indicated that this is the equivalent of 20 Niles or 100 Colorado Rivers.

Even now, a growing number of rivers do not make it to the sea, and surface and groundwater contamination make valuable water supplies unfit for use. Despite this, meaningful solutions for water management are impeded by jurisdictional fragmentation and institutional territoriality. Political jurisdictions have created artificial boundaries for shared resources around the world: water and rivers flow without worrying about political boundaries drawn on a map. As the former Prime Minister of New Zealand, Mr. James Bolger, pointed out, we will either fight over water or use it collaboratively.

One billion people never get a glass of clean water and more than 2 billion people lack basic sanitation. The impact of water scarcity is indeed devastating. Lack of clean water is interlinked with disease, poverty and inequality, with women often being disproportionately affected. An astounding 10 million years' worth of time and effort are expended by women and children carrying water from distant sources each year. Pervasive poverty, food insecurity, potential conflict and morbidity, however, are just the beginning of the story. What is utterly chilling is the fact that a lack of water and sanitation kills about 4,500 children every day. To put this number in perspective, this is the equivalent of 10 jumbo jets falling out of the sky every day with no one surviving.

As former U.S. President Mr. Bill Clinton pointed out, we should be chipping away at the problem of the world's poor and to do so, we should start with water. In addressing water issues, we address economic and public health woes while also advancing capacity to adapt to climate change and thus reducing the pressures of climate-related migration.

The UN Millennium Development Goals strive to halve the proportion of the population without sustainable access to safe drinking water and basic sanitation by 2015. While advancements have been made on the water target, progress on the sanitation target is lagging far behind. Solidarity needs to be shown with those needing assistance in attaining basic sanitation systems. Mr. Clinton offered that it would not take a lot of money in relative terms for the world to show solidarity in addressing the world's water supply and sanitation shortfall.

Dr. Gro Brundtland, former Prime Minister of Norway and principal author of the *Report of the World Commission on Environment and Development: Our Common Future*, widely known as the Brundtland Report on global sustainability, observed that on the matter of universal water supply, governments have not properly responded to what to some appears as a contradiction between the fundamental human right to water and appropriate pricing of water supply and sanitation services. We have to be clear, she said, that governments at different levels are responsible for promoting the fundamental right to water, while at the same time introducing appropriate pricing for water services. It cannot be one or the other: sustainable water management demands both.

It was noted that governments often fall into the vicious circle of demanding that water be priced so low or even given away because of the perception that it is a basic human need. Governments then fall short of meeting that fundamental need because they can't afford investment in maintenance and replacement of water supply and sanitation infrastructure. There are cities around the world, especially, but not exclusively, in underdeveloped and developing countries that on average lose more than 40% of domestic water supply due to leaky networks.

InterAction Council members expressed amazement at the fact that some countries – and often the most needy countries – are prepared to spend a great deal of resources to expand domestic supplies while at the same time tolerating leakage rates that are often 50% or higher when, for a fraction of the cost, better infrastructure maintenance would go a long way towards alleviating water shortages. Because of this problem, the poorest people in the world, for example in sub-Saharan Africa or southern Asia, may actually end up paying more for water on a per-litre basis than those who live in the world's most prosperous countries. In this regard, today's water crisis is not as much a crisis of affordability as it is a crisis of governance.

Problems associated with the appropriate valuation of water services are not confined to the developing world. Even among affluent nations, efficiency of water use varies dramatically between countries and even within households in the same country. Household water efficiency ranges, for example, from more than 1,000 litres per person per day in parts of Canada to less than 100 litres per person per day in Munich, Germany. From this, it was observed that wealth and availability of water supplies do not appear to be deciding factors in determining individual daily water supply requirements. Such inefficiency, however, is no longer acceptable.

Furthermore, as global energy demands rise, the energy sector is being placed into greater competition with other water users and sectors. This will impact regional energy reliability and energy security. Until our thinking about water and energy can be integrated, sustainability will continue to elude us.

As pointed out by the former Prime Minister of Singapore, Mr. Goh Chok Tong, everything we are counting upon to overcome food supply shortfalls, to ensure energy security, and to adapt to climate change effects involves more water. Citing the success Singapore has had in addressing its own water supply issues, Mr. Goh Chok Tong urged members of the InterAction Council to recognize the responsibility of each national government in responding to how important water will be to our global future.

Nowhere is the water crisis as imminent as in the Middle East, where several states contend over the use of the Euphrates and Jordan river basins. Joint efforts will be vital in making water-sharing part of a peaceful Middle East. However, the effects of the water crisis reach far beyond the Middle East and the developing world. Former U.S. President Mr. Bill Clinton observed that a sustainable world will not be possible unless water contamination becomes better regulated and the effects of agricultural run-off are globally controlled and diminished.

The Council membership acknowledged that a watershed-based approach should be pursued as a means of addressing the growing global water crisis. International examples suggest that watershed-scale management of water resources can generate increased economic benefits en route to solving environmental problems. The European Union Water Framework Directive, for example, provides a positive example of a successful agreement on water management standards and the linkages between agricultural and water policies.

In recognizing that there is only a finite amount of water in the world, we realize that the water we drink today is the same water we will drink tomorrow and our grandchildren will drink generations from now. This necessitates the promotion of an ethic of water usage and a realization that water is simply too valuable not to manage appropriately.

Speaking for many others, the former President of Argentina, Mr. Fernando de la Rua, identified the need for a new global water ethic. Mr. Bolger of New Zealand noted that just as the 1960s and 1970s promoted the Green Revolution, we now need a Blue Revolution. Solutions to the water crisis need to be sought from the perspective of development, energy, technology, international law, gender equality, migration, economic progress, public health conservation, and the environment. It was noted, however, that presently international water leadership is virtually non-existent. The world is clearly lacking in effective hydro-diplomacy. Political will, financial resources, good governance and public education are lacking. In response to this, the InterAction Council agreed to establish a panel to address global water issues, and will begin this work by building on the positive examples of the Singapore International Water Week, the Stockholm Water Conference, the World Water Council, and other similar initiatives.

Progress is possible on the global water crisis, but it won't be easy and it will take time. Alleviating the world's water woes is one of our generation's great challenges, and we should be working now toward fulfillment of the InterAction Council recommendations with all the intelligence and energy we can summon.

# *The InterAction Council Québec Declaration*

**InterAction Council**
**29th Annual Plenary Meeting, 29-31 May 2011, Québec, Canada**

Effective governments prefer proposition to opposition. The Québec Declaration on the World Water Crisis outlines steps towards a new water ethic for the world that aims to strengthen the global economies and assure environmental sustainability, while at the same time enhancing adaptive capacity at the national level in the face of growing climate effects on humankind and our future.

As elements of the Québec Declaration on the World Water Crisis, the InterAction Council (see List of Participants in this volume) recommends:

1. Placing water at the forefront of the global political agenda and linking climate change research and adaptation programmes to water issues.

2. Encouraging increased investment in urgently needed sanitation coverage and improved access to safe water supply globally.

3. Urging national governments to price water supply and sanitation services to appropriately reflect their economic value, while making provisions for those in poverty.

4. Welcoming the role of NGOs in the further development of water governance solutions and particularly emphasizing the role of women, given their special responsibility for water.

5. Supporting and advancing United Nations international water protocols.

6. Supporting ratification of the UN Watercourses Convention and the development of the draft articles on transboundary aquifers.

7. Encouraging a discussion on water security at the United Nations Security Council.

8. Urging national governments to reduce the loss of water in public networks through adequate monitoring and infrastructure development, as well as the per capita consumption in municipal use.

9. Renewing local, national, and international focus on monitoring hydrological processes and increased attention to mapping and monitoring of groundwater.

10. Urging national governments and multinational companies to improve water availability assessment, energy and water systems analysis, and decision tools.

11. Urging national governments to stimulate private and public sector innovation to address the global water crisis and capitalize on the economic opportunities that arise from finding solutions to these complex challenges.

12. Linking of agricultural and water policy with energy policy locally, nationally and globally.

13. Asserting that, where water supplies are threatened, water used to grow food should not be substituted for water to grow crops for biofuel production.

14. Supporting the conservation of the world's intact freshwater ecosystems, the establishment of ecological sustainability boundaries, and investment in ecosystem restoration.

15. Encouraging the development of materials and water treatment approaches to enable non-traditional water use in domestic, industrial, and in energy generation and refining applications, and in particular research on more cost-effective desalinization integrated with renewable energy resources.

# *List of Participants*

# List of Participants: High-Level Expert Group Meeting of the InterAction Council

***"The Global Water Crisis: Addressing an Urgent Security Issue"***
***March 21-23, 2011, Munk School of Global Affairs, Toronto, Canada***

### *InterAction Council Members*

1. Rt. Hon. Mr. Jean Chrétien, Co-Chairman (former Prime Minister of Canada)
2. H.E. Dr. Franz Vranitzky, Co-Chairman (former Chancellor of Austria)
3. H.E. Mr. Olusegun Obasanjo (former President of Nigeria)

### *Associate Members*

4. Dr. Thomas Axworthy, President and CEO, Walter and Duncan Gordon Foundation (Canada)

### *High-Level Experts*

5. Dr. Zafar Adeel, Director, United Nations University, Institute for Water, Environment and Health (Canada)
6. Dr. David Boyd, Adjunct Professor, Resource and Environmental Management, Simon Fraser University (Canada)
7. Clarissa Brocklehurst, Chief of Water, Sanitation and Hygiene, UNICEF (USA)
8. David Henderson, Managing Director, XPV Capital Corporation (Canada)
9. Mike Hightower, Distinguished Member of the Technical Staff, Sandia National Laboratories (USA)
10. Adèle Hurley, Director, Program on Water Issues, Munk School of Global Affairs (Canada)
11. Tony Maas, Director, Freshwater Program, WWF-Canada (Canada)
12. Hon. Michael Miltenberger, Minister of Environment and Natural Resources, Legislative Assembly of Northwest Territories (Canada)
13. Ganesh Pangare, Regional Water and Wetlands Programme Coordinator, IUCN Asia Regional Office (Thailand)
14. Dr. Fabrice Renaud, Head of Section, Institute for Environment and Human Security (Germany)
15. Bob Sandford, EPCOR Chair of the Canadian Partnership Initiative in support of United Nations "Water for Life" Decade (Canada)
16. Samyuktha Varma, Executive Officer to the DG, International Water Management Institute (Sri Lanka)
17. Dr. Patricia Wouters, Director, UNESCO IHP-HELP Centre for Water Law, Policy and Science, University of Dundee (United Kingdom)
18. Moneef R. Zou'bi, Director General, Islamic Academy of Science (Jordan)

# List of Participants: 29th Annual Plenary Meeting of the InterAction Council

### May 29-31, 2011, Québec, Canada

### InterAction Council Members

1. The Rt. Hon. Jean Chrétien, Co-Chairman (former Prime Minister), Canada
2. H.E. Dr. Franz Vranitzky, Co-Chairman (former Chancellor), Austria
3. H.E. Mr. Helmut Schmidt, Honorary Chairman (former Chancellor), Germany
4. H.E. Dr. Oscar Arias (former President), Costa Rica
5. H.E. Tun Abdullah Ahmad Badawi (former Prime Minister), Malaysia
6. The Rt. Hon. Mr. James Bolger (former Prime Minister), New Zealand
7. H.E. Dr. Gro Brundtland (former Prime Minister), Norway
8. H.E. Mr. William Jefferson Clinton (former President), United States of America
9. H.E. Mr. Fernando de la Rúa (former President), Argentina
10. H.E. Mr. Vicente Fox (former President), Mexico
11. H.E. Mr. Yasuo Fukuda (former Prime Minister), Japan
12. H.E. Mr. Goh Chok Tong (former Prime Minister), Republic of Singapore
13. H.E. Dr. Abdel Salam Majali (former Prime Minister), Jordan
14. The Rt. Hon. Sir James Fitz-Allen Mitchell (former Prime Minister), Saint Vincent and the Grenadines
15. H.E. Mr. Andrés Pastrana (former President), Colombia
16. The Rt. Hon. Percival Noel James Patterson (former Prime Minister), the Republic of Jamaica
17. Sheikh Abdul-Aziz Al-Quraishi (former Governor of Saudi Arabian Monetary Authority), Saudi Arabia
18. The Rt. Hon. Mr. Tung Chee Hwa (former Chief Executive), Hong Kong Administration
19. H.E. Dr. Vaira Vīķe-Freiberga (former President), Latvia
20. H.E. Dr. Ernesto Zedillo Ponce de Léon (former President), Mexico

### Associate Members

21. Dr. Thomas Axworthy, President and CEO, Walter and Duncan Gordon Foundation, Canada
22. Mr. Jean François-Poncet, Former Foreign Minister, France
23. Baroness Margaret Jay, United Kingdom
24. Mr. Seiken Sugiura, former Minister of Justice, Japan

### Special Guests

25. Dr. Abdulrahman H. Al-Saeed, Advisor, The Royal Court, President of Center for Specialized Studies, Saudi Arabia
26. Mr. Abdullah Al Hussayen, Minister of Electricity and Water, Saudi Arabia
27. H.E. Amb. Richard Butler, Chairman, Middle Power Initiative, Australia
28. Mr. Mike Hightower, Distinguished Member of the Technical Staff, Sandia National Laboratories, U.S.A.
29. Mr. Bob Sandford, EPCOR Chair of the Canadian Partnership Initiative in support of the United Nations Water for Life Decade, Canada
30. Mr. Tang Jiaxuan, Former State Councillor, People's Republic of China
31. Mr. William F. Weld, Former Governor of Massachusetts, United States of America

**In the past 20 years, it has become increasingly evident that there will not be enough fresh water on Earth to meet all human needs in the near future unless we change the way in which water is valued, allocated and managed. Countries around the world – even those with relatively abundant water resources – are facing problems of supply and quality in the face of growing populations and increased competition for use. Further, contamination is rendering a disproportionate amount of global fresh water unsuitable for use. The anticipated effects from climate change on hydrological cycles and precipitation patterns will only further exacerbate the situation.**

**We are not without hope, however. The looming water crisis and its implications for global security are being taken seriously by world leaders. Informed by science and enlightened policy direction, a new water ethic is beginning to emerge globally which views water in the context of global security and human development as an instrument for sustainable development and peace.**

**With views from water experts around the globe and insightful reactions from members of the InterAction Council, Jean Chrétien, IAC Co-chair and former Prime Minister of Canada, and Gro Harlem Brundtland, IAC member and former Prime Minister of Norway, this volume speaks to the urgent needs and challenges ahead for addressing the global water crisis and contributes informed perspectives to the emerging global dialogue on achieving water security.**

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