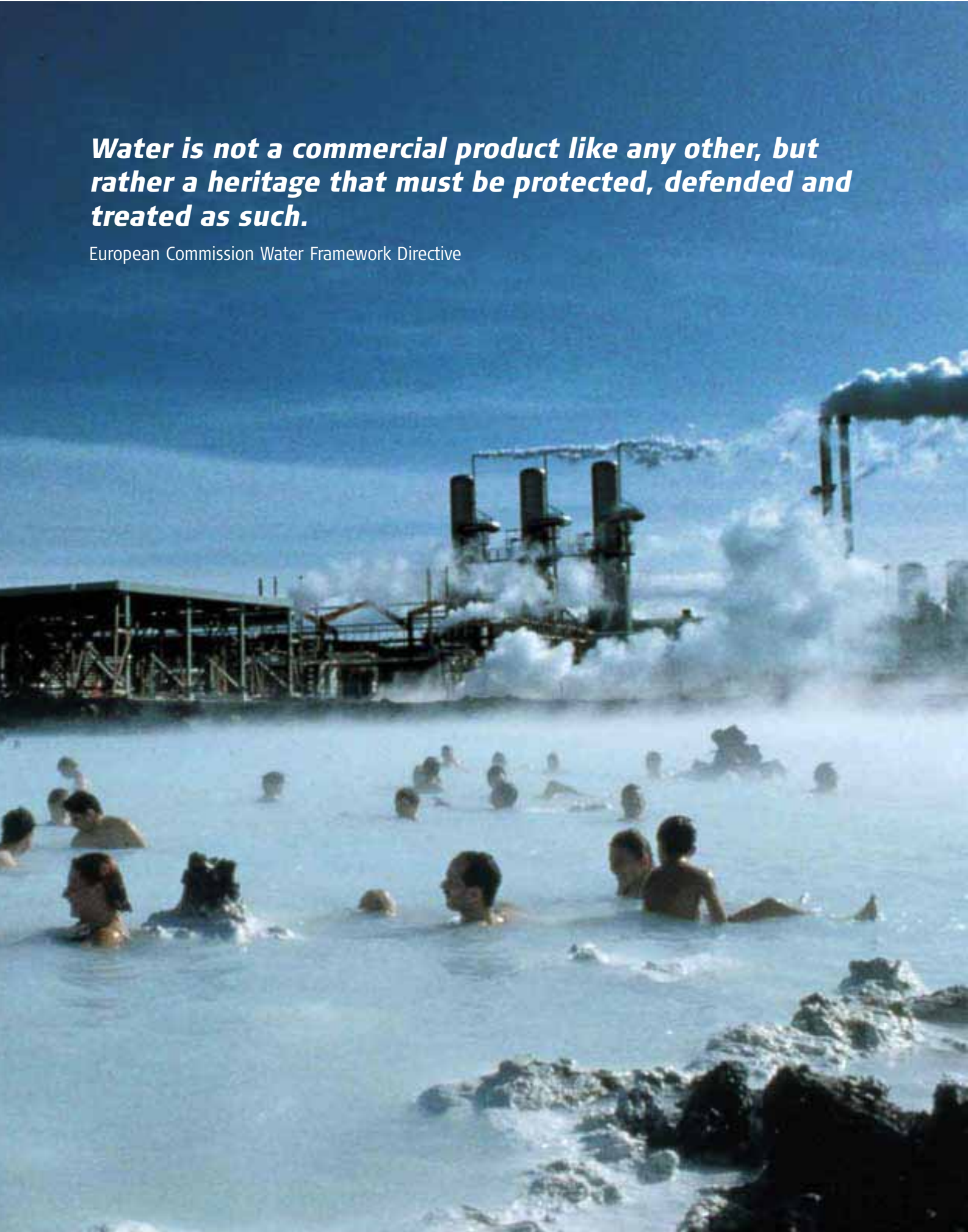
***Water is not a commercial product like any other, but rather a heritage that must be protected, defended and treated as such.***

European Commission Water Framework Directive



*Geothermal power plant with bathers enjoying geothermally-heated water, Blue Lagoon, Iceland*

CHAPTER 11

# 11 Sharing Water

*By*

**UNESCO**

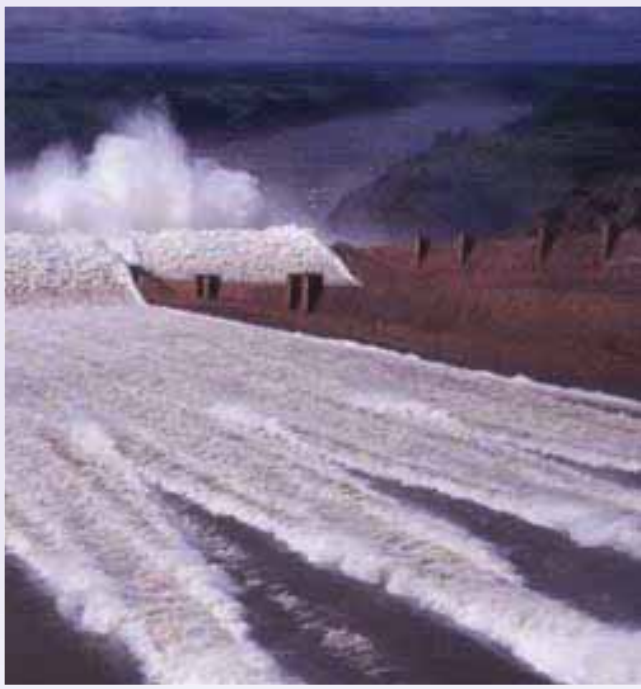
*(United Nations Educational, Scientific and Cultural Organization)*



# Key messages:

*The emerging water culture is about sharing water: integrated water resources managements (IWRM) looks for a more effective and equitable management of the resource through increased cooperation. Bringing together institutions leading with surface water and aquifer resources, calling for new legislative agreements all over the world, increasing public participation and exploring alternative dispute resolutions are all part of the process.*

- Sharing water resources constitutes a major part of integrated water resources management (IWRM).
- There is a need to further expand special indicators for measuring efficient, effective and equitable water sharing.
- Increasing complexity and interdependence regionally, nationally and internationally requires new approaches to shared water systems.
- There is a need for developing new knowledge and new capabilities in order to understand aquifers and the difficulties of underground boundaries that are difficult to define.
- There is a need to concentrate on the implementation of mechanisms for conflict avoidance and conflict management.



*Above: A man-made entrance to an underground aquifer in Quintana Roo, Mexico*

*Right: Itaipu dam and hydro-electricity power station on the river Parana, Brazil / Paraguay*

*Below: Tea plantation in Kerala, India*



# Part 1. Towards Integration and Cooperation

**The comprehensiveness of water resource planning and sharing has been the subject of much controversy and debate. It has been widely recognized that in order to maximize the benefits from any water resource project, a more systematic analysis of the broader environment is needed. In addition to a broadening of traditional management approaches, there needs to be increased sensitivity to decision-making that involves multi-purpose actions and multi-user considerations.**

A proposed framework for sharing water would mean taking the following issues into account:

- natural conditions (e.g. aridity and global changes)
- variety of uses (irrigation, hydropower, flood control, municipal uses, water quality, effluent control, etc.)
- various sources of supply (surface water, groundwater and mixed sources)
- upstream/downstream considerations
- socio-demographic conditions (population composition and growth, urbanization, industrialization, etc.).

The mismatch between political boundaries and natural river basins has become a focal point for the difficulties of joint planning, allocation of costs and benefits, advantages of scale and other integrated water management issues and is usually referred to as transboundary (the terms transnational, trans-state and international have also been used), which refers to any water system that transcends administrative or political boundaries, which often do not coincide with river basins' or watersheds' natural boundaries (see **Chapter 4**).

The time lag between the implementation and impact of management decisions – sometimes measured in decades – significantly reduces the power of contemporary water resource institutions. Efforts to implement more integrated shared water resources management are confronted with continuous changes in values, structural transformations in society and environment, as well as climatic anomalies and other exogenous shifts. These transformations have created a context of complexity, turbulence and vulnerability. The emerging water sharing paradigm attempts to bring together the above concerns with cross-cutting sustainability criteria, such as social equity, economic efficiency and environmental integrity.

Access to adequate water is becoming a highly contested issue, which is further complicated by traditional values and customs, cultural and religious considerations, historical factors and geographical variations. As for sharing the resources of an aquifer system, in which upstream-downstream relationships do not apply, current thinking is moving away from 'equitable utilization', a remarkably vague notion, given the predominance of slow responding storage overflows, towards ensuring the sound functioning and integrity of the aquifer system.[1]

## 1a. Setting the context

Sharing water is essential to meeting the goals of equity, efficiency and environmental integrity and answering the more complex questions that stem from broader challenges, such as the issue of overall security. Water sharing mechanisms (i.e. new institutional arrangements) help us adapt to these challenges through structural changes (specific organizations, joint engineering structures, etc.) and more resilient political institutions.

In 2002, UNESCO and the Organization of American States (OAS) launched the International Shared Aquifer Resource Management (ISARM) project for the Americas, which organized three workshops, in 2003, 2004 and 2005, to present the data gathered on transboundary groundwater in North, Central and South America and highlight the need to follow up on this cooperative project. The UNESCO-IHP ISARM project initiated transboundary aquifer resources inventories, covering the Americas (sixty-five aquifers; see **Map 11.1** and **Table 11.1**) and Africa (thirty-eight aquifers) as well as a recent update including the Balkan countries (forty-seven aquifers) and plans to extend coverage to Asia and the Pacific.[2] **Table 11.1** provides detailed information on shared aquifers located in Central and South America. To date, the UNESCO-ISARM project has inventoried over 150 shared aquifer systems with boundaries that do not correspond to those of surface basins. Progress in the consolidation of these newly created inventories has resulted in unprecedented development in global transboundary aquifer resources assessment.

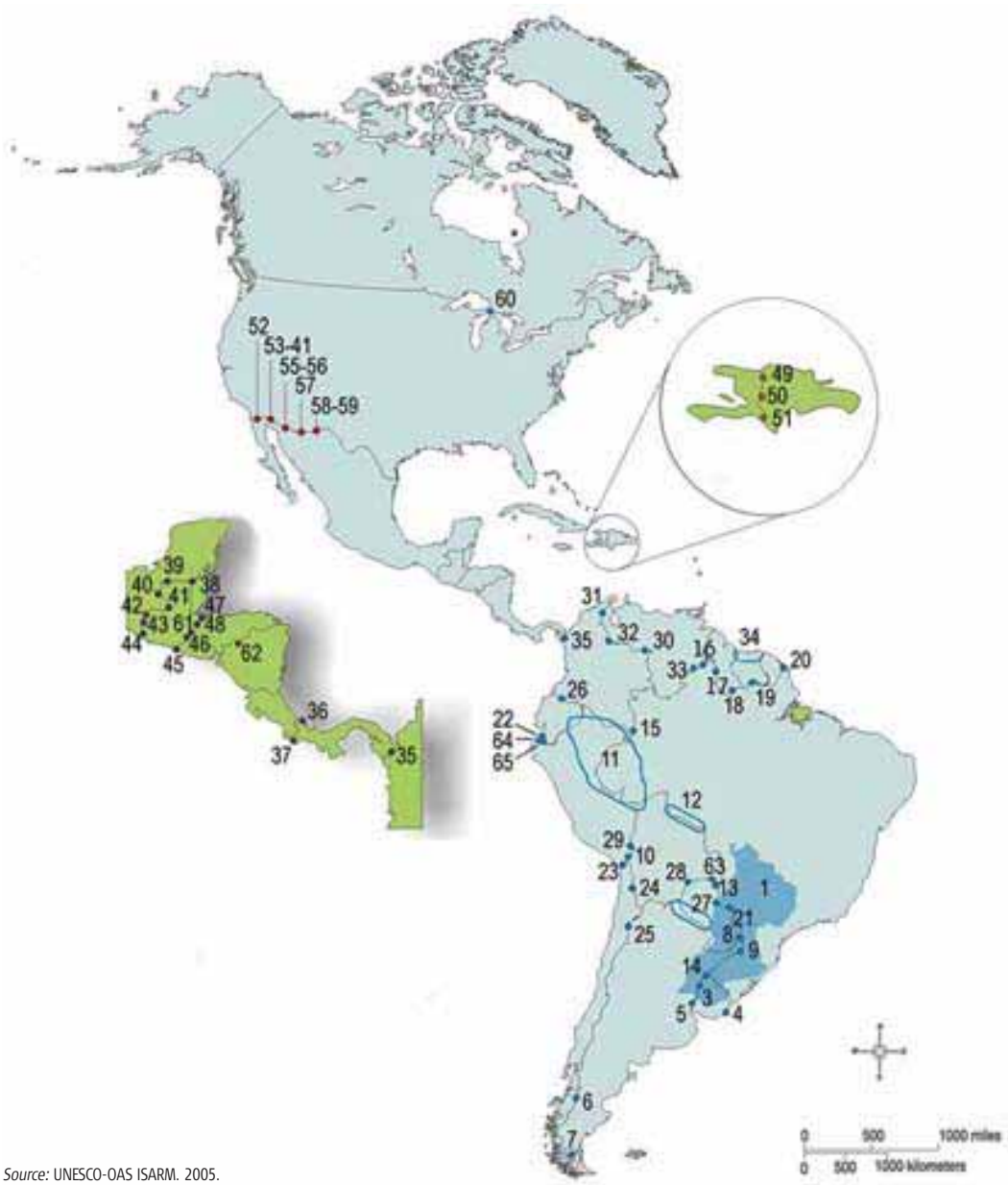
*Efforts to implement more integrated shared water resources management are confronted with continuous changes in values*

1. The integrity of an aquifer can be destroyed if, for example, saline intrusion invades to such an extent that the aquifer system ceases functioning and cannot be effectively rejuvenated.

2. A publication on the achievements of the project is under preparation. Maps for these regions can be found on the CD-ROM accompanying the book and at www.unesco.org/water/wwap

*The depletion of national water resources, recurring droughts and expanding socio-economic demands have all fuelled confrontations and forced international exchanges and cooperation*

**Map 11.1: Transboundary aquifers of the Americas (in progress)**




*Source:* UNESCO-OAS ISARM. 2005.

Underlying such broad considerations are apprehensions about the prospects for achieving the necessary cooperation for managing shared water systems, owing, for example, to persistent national sovereignty demands and further political fragmentation in many regions, despite cooperative efforts (see **Chapter 2**). Upstream states and regions lack incentives to enter into conflict resolution negotiations and other cooperative mechanisms driven by principles of comprehensive sustainable river development.

The geopolitical nature of water – a function of both geography and technology – produces different and complex cultural, historical and ecological adaptations, as well as varying power to use resources. The depletion of national water resources, recurring droughts and expanding socio-economic demands have all fuelled confrontations and forced international exchanges and cooperation. (This has generally been the case for surface waters, which are more visible, though attention is now also turning to transboundary aquifers.) There are more

**Table 11.1: Transboundary aquifers of the Americas (in progress)**

| Map Ref. | Transboundary aquifers | Countries | Country number |
|---|---|---|---|
| | **NORTH AMERICA** | | |
| 52 | Tijuana | Mexico-United States | 2 |
| 53 | Valle de Mexicali | Mexico-United States | 2 |
| 54 | Valle San Luis - Rio Colorado (Yuma) | Mexico-United States | 2 |
| 55 | Rio Santa Cruz | Mexico-United States | 2 |
| 56 | Nogales | Mexico-United States | 2 |
| 57 | Rio San Pedro | Mexico-United States | 2 |
| 58 | Conejos - Medanos | Mexico-United States | 2 |
| 59 | Bolson (Valle de Juarez) | Mexico-United States | 2 |
| 60 | Cambrian - Ordovician | Canada-United States | 2 |
| | **CENTRAL AMERICA** | | |
| 36 | Sixaola | Costa Rica-Panama | 2 |
| 37 | Coto | Costa Rica-Panama | 2 |
| 38 | Hondo San Pedro | Guatemala-Mexico | 2 |
| 39 | San Pedro | Guatemala-Mexico | 2 |
| 40 | Usamancita | Guatemala-Mexico | 2 |
| 41 | Chixoy - Xaclbal | Guatemala-Mexico | 2 |
| 42 | Selegua - Cuilco | Guatemala-Mexico | 2 |
| 43 | Coatan - Suchiate | Guatemala-Mexico | 2 |
| 44 | Bajo Suchiate | Guatemala-Mexico | 2 |
| 45 | Cuenca La Paz (Ahuachapan-Las Chinamas) | El Salvador-Guatemala | 2 |
| 46 | Alto-Paz - Ostua/Metapan | El Salvador-Guatemala | 2 |
| 47 | Motagua Norte | Guatemala-Honduras | 2 |
| 48 | Motagua Sur | Guatemala-Honduras | 2 |
| 61 | Olopa | Guatemala-Honduras | 2 |
| 62 | Rio Negro | Honduras-Nicaragua | 2 |
| | **CARIBBEAN** | | |
| 49 | Artibonito | Haiti-Republica Dominicana | 2 |
| 50 | Masacre | Haiti-Republica Dominicana | 2 |
| 51 | Pedernales | Haiti-Republica Dominicana | 2 |
| | **SOUTH AMERICA** | | |
| 1 | Guarani | Argentina-Brazil-Paraguay-Uruguay | 4 |
| 2 | Yrenda-Toba -Tarijeno | Argentina-Bolivia-Paraguay | 3 |
| 3 | Salto Chico - Salto Chico | Argentina-Uruguay | 2 |
| 4 | Litoraneo-Chuy | Brazil-Uruguay | 2 |
| 5 | Litoral - Sistema Acuífero en Areniscas Cretácicas | Argentina-Uruguay | 2 |
| 6 | Probable | Argentina-Chile | 2 |
| 7 | El Condor | Argentina-Chile | 2 |
| 8 | Caiua | Argentina-Brazil-Paraguay | 3 |
| 9 | Serra Geral; Serra Geral-Arapey | Argentina-Brazil-Paraguay-Uruguay | 4 |
| 10 | Ignimbritas Cordillera Occidental | Bolivia-Peru | 2 |
| 11 | Solimoes | Bolivia-Brazil-Colombia-Ecuador-Peru | 5 |
| 12 | Jaci Parana y Parecis | Bolivia-Brazil | 2 |
| 13 | Pantanal | Bolivia-Brazil-Paraguay | 3 |
| 14 | Permianos | Brazil-Uruguay | 2 |
| 15 | Ica | Brazil-Colombia | 2 |
| 16 | Sedimentos Paleo-Proterozoicos | Brazil-Guyana-Venezuela | 3 |
| 17 | Serra do Tucano | Brazil-Guyana | 2 |
| 18 | Boa Vista | Brazil-Guyana | 2 |
| 19 | Sem Denominacao | Brazil-Surinam | 2 |
| 20 | Costeiro | Brazil-Guyana (F) | 2 |
| 21 | Furnas e Altos Gracas | Brazil-Paraguay | 2 |
| 22 | Zarumilla - Machala | Ecuador-Peru | 2 |
| 23 | Concordia - Caplina | Chile-Peru | 2 |
| 24 | Ascotan - Silala - Ollague | Bolivia-Chile | 2 |
| 25 | Puna | Argentina-Chile | 2 |
| 26 | Tulcan | Colombia-Ecuador | 2 |
| 27 | Coronel Oviedo Basamento Cristalino | Brazil-Paraguay | 2 |
| 28 | Agua Dulce Palmar de las Islas | Bolivia-Paraguay | 2 |
| 29 | Titicaca | Bolivia-Peru | 2 |
| 30 | Arauca | Colombia-Venezuela | 2 |
| 31 | Guajira | Colombia-Venezuela | 2 |
| 32 | San Antonio Urena Santander | Colombia-Venezuela | 2 |
| 33 | Sedimentos Grupo Roraima | Brazil-Venezuela | 2 |
| 34 | Zanderji; Coesewijne; A-sand | Guyana-Surinam | 2 |
| 35 | Jurado | Colombia-Panamá | 2 |
| 63 | Rio Negro-Itapucumi | Bolivia-Paraguay | 2 |
| 64 | Tumbes - Puyango | Ecuador-Peru | 2 |
| 65 | Chira - Catamayo | Ecuador-Peru | 2 |

*Source:* UNESCO-OAS ISARM. 2005.

*On an international scale, sharing and cooperative efforts can provide benefits that far exceed those that attempt to maximize individual and national self-interests...*

than 3,800 unilateral, bilateral or multilateral declarations or conventions on water: 286 are treaties, with 61 referring to over 200 international river basins.[3] Such agreements, which serve to emphasize the importance of cooperation in many shared water settings, are expected to expand in the future. A new impetus to adopt transboundary aquifer agreements could also arise from the anticipated publication of the United Nations (UN) International Law Commission's (ILC) draft Convention on transboundary aquifers (see **Box 11.3**).

Vulnerability is increasingly discussed in the literature of environmental change, where it is associated with the shift in environmental studies from impact analysis to crisis assessment and vulnerability evaluation. Such assessment steps reflect the large number of variables involved; cumulative, interactive, synergistic and unexpected consequences, as well as multiple sources of threats. Moreover, vulnerability has been tied (especially in transboundary water systems) to security in all its forms – from food security, economic security and political security, all the way down to individual security. This dynamic evolution also coincides with the evolution from simple linear models to more complex non-linear feedback approaches. When combined with volatility and greater resilience to risks, the powerful new theme of expanding the timeframe of analysis and assessment emerges.

### 1b. The emerging water use paradigm

Traditional reactive crisis approaches were replaced by risk assessment and other proactive strategies at the beginning of the twenty-first century. These new approaches call for anticipatory action and multi-stakeholder involvement. Rapid socio-economic changes, socio-political upheavals and the transitions witnessed during the turbulent decades of the 1980s and 1990s underscored the need for a greater emphasis on environmental challenges – from the search for sustainable development and the promotion of integrated planning and governance to the attempt to combine structural and non-structural solutions to persistent water resources problems and transnational interdependencies.

In this setting of increasing complexity, interdependence and vulnerability, there is an urgent need for intergovernmental integration of the following issues:

- *hydrological interdependencies*: in terms of both uses (agricultural, urban, industrial and recreational) and water regimes (surface water and groundwater, quality and quantity)
- *political interdependencies*: both in terms of horizontal coordination in space and vertical cooperation between levels of government units
- *transboundary interdependencies*: representing both social and hydrological trans-state interdependencies
- *exogenous interdependencies*: the most notable of which are the potentially dramatic impacts and consequences of climatic change.

It is important to recognize water as a catalyst for cooperation; regions with shared international waters are often subject to water-related controversies. When coupled with reasonable and equitable utilization of the resource, cooperative efforts allow for more effective approaches to allocating and sharing water. However, cooperation is not simply an abstract term for peaceful coexistence, but also an important mechanism for managing natural resources by addressing the underlying historical, political, economic and cultural causes of water-stressed environments. It emphasizes the need for combining technological capabilities with political will and is an important part of international agreements, proclamations at water conferences and in millennial declarations, future scenarios and goal-oriented planning efforts, as well as in environmental law, conventions and regulatory provisions. On an international scale, cooperative efforts can provide benefits that far exceed those that attempt to maximize individual and national self-interests (Sadoff and Grey, 2002).

Since complexity, interdependence and rapidly changing socio-economic conditions each increase the likelihood of water conflict, we are faced with considering more complex models for understanding cooperation and contestation. Looking beyond the environmental debates and differing perspectives (optimism/pessimism, society/individualism, market/common good, etc.), we can see the broad outlines of a newly emerging paradigm for sharing water. This new paradigm emphasizes integrated



3. For more information, see Wolf et al., 2003 and www.unesco.org/water/wwap/pccp/

management, the duty to cooperate, equitable utilization, sustainable use, minimization of harm and true cost, in addition to public participation (EC, 2005).

This new water culture paradigm recognizes the inter-generational, inter-spatial and inter-species differentiations in allocating water resources. We must work towards setting up protocols for environmental protection, regulatory reform and sustainable use, such as the National Environmental Policy Act in the United States (US) and the Water Framework Directive (WFD) in the European Union (EU) (see **Chapter 14**), which can lead to more detailed practices, such as treaties and bilateral agreements, which, in turn, prescribe implementable action and monitoring performance mechanisms. Also needed is the allocation of finances to support the transaction costs of transforming contemporary institutions.

Many international conferences and other fora, including the UN's *Comprehensive Assessment of the Freshwater Resources of the World* (Kjellén and McGranahan, 1997),[4] have warned that we must fundamentally alter the way we think about and manage water. They have also made it clear that we must embrace new policies that are not only comprehensive, participatory and anticipatory, but also environmentally sound. Sound shared water management should promote intergovernmental dialogue and address long-term goals and objectives.

This shifting emphasis in water sharing has led to greater attention to cooperation rather than conflict, the latter including conflict prevention, management and resolution. Equally important is the emphasis on intra-state approaches, which address competing and conflicting uses of water through the concept of subsidiarity, or relegating responsibility to the lowest appropriate level of governance and decision-making. Other complementary approaches reinforce the need for capacity-building, the creation of an enabling environment and the mobilization of finances, as well as citizen participation. However, despite these positive trends, there remain many challenges to sharing water.

### 1c. The challenges to sharing water

Water resources are unequally distributed, and water scarcity and abundance are further affected by political changes, mismanagement and climatic anomalies. These create massive upheavals, demographic transformations and uneven development efforts, all of which, in turn, contribute to significant socio-economic differentiations. Ecological degradation and political instability can produce conflict or be catalysts for cooperation. At the same time, competition for water is also manifested in the demands between different uses – urban versus rural, present uses versus future demands, competing regions, water quantity versus water quality and water concerns versus other social priorities. Past research has stressed the following types of conflicts:

- *direct* (competing and conflicting demands)
- *indirect* (migration, environmental refugees or seasonal high peak demands from tourism)
- *structural sources* that emphasize a broader socio-economic context, such as limited institutional and social capacity, fragmented authority, transboundary interdependencies, insufficient public participation, etc.

The above list supports the observation that more emphasis has been placed on conflict, with less importance given to efforts towards the peaceful sharing of water and long-term cooperation.

Geography suggests that – by virtue of physical unity and regardless of political divisions – a river basin should be developed and managed as an indivisible whole. Moving water ties land together, and interference with its movement has repercussions elsewhere in the basin. While geographic ties prescribe the unitary development of river basins and aquifer systems, politics, culture and history distort this process. The nation state covets its sovereignty and attempts to maximize benefits for itself. However, this state-central behaviour can generate international friction and even lead to conflict. We are, therefore, faced with a situation in which states confronted with limited choices tend to adopt a non-cooperative stance. But an increasing amount of literature argues that conflict is not the inevitable result of scarcity (Carius et al., 2004). A number of variables, such as cultural traditions, the degree of social cleavages, the nature of institutions and ideologies about or perceptions of the environment, can lessen the possibility of conflict due to water scarcity.

*...we must embrace new policies that are not only comprehensive, participatory and anticipatory, but also environmentally sound*

4. See also Guerquin et al., 2003; Cosgrove and Rijsberman, 2000; 3rd World Water Forum, 2003.

### BOX 11.1: SHARED AQUIFERS BETWEEN ARGENTINA, BOLIVIA AND PARAGUAY

The Yrenda-Toba-Tarijeño aquifer system occupies about 300,000 square kilometres ($km^2$), located mostly in the Gran Chaco Americano region. Its recharge zone, located in Argentina and Bolivia, determines groundwater flow towards the east and crosses national boundaries, emerging in low-lying lands and draining into a series of streams that discharge into the Paraguayan-Argentine Chaco and eventually into the Parana River in Paraguay.

The livelihood of the 1 million indigenous people in the region is closely linked to the aquifer's surface area. Increasing pressure on scarce water resources, poor land quality and soil degradation is causing alarm. The natural water quality transition (fresh in Bolivia, to brackish and saline in Paraguay and Argentina) may be changing.

There are many pressures on the land in the region, which have arisen from the expansion of poorly planned mechanized agriculture, which has in turn led to land degradation, the decline of wetlands and the deterioration of water quality. Increased rain intensity from anticipated climate change could trigger erosion, and re-sedimentation in recharge zones could inhibit aquifer infiltration from stream beds. Due to poor awareness and divergent regulations, current aquifer management by institutions in the sharing countries is inadequate. Therefore, coordination for the long-term management and protection of the recharge zones, as well as the discharge zones, is lacking.

A case study by the UNESCO International Shared Aquifer Resource Management Programme (UNESCO-ISARM) is part of a Plata Basin project financed by Global Environment Facility (GEF). The case study's activities focus on raising awareness of the aquifer system, as well as ensuring the sustainability of its resources, the lifeline of the local population and the aquifer-dependent environment. The project will help further develop engaged and strengthened institutions that practise sound aquifer management and offer educational and technical support to the community.

*Source*: www.isarm.net.

*High altitude landscape at the border between Argentina and Bolivia*

# Part 2. Water and Geopolitics

**Given the interdependencies of water resource uses, spatial variations and surface water and groundwater, as well as upstream and downstream differentiations, the need to develop mechanisms for the sustainable sharing of water is obvious. Attention to environmental security exemplifies the growing regional and global environmental concerns that could also lead to new forms of conflict.**

## 2a. Trends in geopolitical developments

History shows few outright transboundary water-related conflicts. Although strong competition does occasionally occur between users, such as in the Tigris-Euphrates Basin, in the Jordan Basin and the Paraná-La Plata Basin (see **Box 11.2** for an example in southern India), there is an increasing trend towards inter-state collaboration (as in the case of the Nile), as well as cooperation through increased public participation, non-governmental organizations (NGOs), the common search for alternative water sources and the collaborative spirit of international water conferences, arbitration mechanisms and mediating agents (see **Box 11.3**). Efforts like the Division of Early Warning and Assessment (DEWA), UNESCO's From Potential Conflict to Cooperation Potential (PCCP) and ISARM have been developing case studies on the management of transboundary water resources, illustrating the impressive range of examples of water as a catalyst for peace and cooperative capacity-building. Many programmes – financed through the International Waters focus area of the Global Environment Facility (GEF) in Eastern Europe – are working together to develop cooperative frameworks and encourage the development and implementation of policies that support the equitable use of water and the sound functioning of other water-related natural resources.

### BOX 11.2: CAUVERY RIVER DISPUTE IN SOUTHERN INDIA

In India, the federal government plays a mediating role in river water disputes. The Inter-State Water Disputes Act of 1956 requires the government to encourage states to settle disputes through dialogue. If that does not work, a tribunal is to be constituted. After a hearing, the tribunal makes a binding judgement.

The Cauvery Basin in southern India has 75,000 square kilometres ($km^2$) of area spread over four riparian states: Karnataka, Kerala, Tamil Nadu and Pondichery. The basin is mainly drained by the 780 km-long, rain-fed, perennial Cauvery River, which flows from west to east into the Bay of Bengal. In addition to being a major source of irrigation and hydroelectric power, the Cauvery River is an important water supply source for Bangalore, a centre for information technology and the software industry.

When a dam project was developed by the upstream state of Mysore (now in Kerala), two agreements were made (in 1892 and in 1924) detailing how the river waters were to be shared. The agreement was open for review once it expired, but no agreement has been reached between the two main riparians, Kerala and Tamil Nadu, since the 1970s. A tribunal was constituted in 1990, and an interim judgement was passed in 1991. The tribunal is expected to make its final decision soon.

The dispute is based on the fact that the demand for irrigation far exceeds the irrigation potential of the river. In drought years, this leads to a flash-point. The monsoon pattern is peculiar: the southwest monsoon brings rains to the upstream areas in June and July. The downstream and delta regions depend mainly on the weaker northeast monsoon (September-October). In the Cauvery Delta in Tamil Nadu, three crops are grown annually, but the summer crop depends on the timely release of waters from upstream areas. However, upstream farmers argue that it is unfair to be forced to share their water in summer when demand for water is at its highest. The downstream farmers argue that historically they have grown three crops and hence, their livelihoods crucially depend on maintaining the sharing scenario as accepted in the 1924 agreement.

There have been attempts to promote citizen efforts towards conciliation through people-to-people dialogues, and most recently, to form a 'Cauvery family'. Such efforts should help in encouraging informed dialogue and building trust. Collective action theory suggests that it is possible for riparian states to voluntarily reach self-enforcing agreements, provided the costs and benefits are considered in a transparent manner and sustainable development priorities are given primacy.

**Table 11.2: Timeline of geopolitical developments: Inter-state water-related conflicts and cooperation since 2002**

| | |
|---|---|
| **2002** | ● In early 2002, Friends of the Earth Middle East launched the Good Water Neighbors project to raise awareness about regional water and environmental issues. A variety of cooperative programmes have been set up in Jordan, Palestine and Israel to promote exchange of information and ideas between different communities in the region. These programmes have also furthered the campaign to protect the Jordan River, which brings stakeholders from the entire region together to work on sustaining the flow of this important river. |
| **2003** | ● During the Joint River Commission (JRC) talks between India and Bangladesh – held in September 2003 – India agreed to involve Bangladesh in future discussions on the controversial US$ 200 billion (EUR 172 billion) river-linking project which will bring water for irrigation from the Ganges, Brahmaputra and Meghna river basins to Haryana and Gujarat. In February 2004, Bangladesh called on the Indian government to assess the impact on both the environment and biodiversity before it begins implementing the project. |
| | ● In October 2003, the United States and Mexico came to an agreement over water used for irrigation. Mexico – in water debt to the United States due to prior agreements – agreed to release water from its reservoirs to relieve Texan farmers of the local drought. |
| | ● In November 2003, the Limpopo Basin Permanent Technical Committee created the Limpopo Watercourse Commission (LIMCOM). The objective of the commission is to facilitate capacity-building to better manage the shared water resources in the basin states of South Africa, Botswana, Mozambique and Zimbabwe. |
| | ● Iran signed a contract with Kuwait on 13 December, 2003 to provide the country with drinking water for almost 30 years. Three hundred million cubic metres per year will be pumped to Kuwait through a 540 kilometres pipeline, to be built at an estimated cost of US$ 2 billion. |
| **2004** | ● In 2004, Kazakhstan warned of a potential environmental disaster in reaction to China's plans to divert water from the Irtysh and Ili Rivers. Similar concerns were expressed in reaction to Russian scientists' suggestion to revive an old Soviet plan to divert Siberia's Ob and Irtysh Rivers in order to replenish the Amudarya and Syrdarya Rivers. Kazakhstan and China have signed a transboundary water management agreement, but a joint commission has failed to address their concerns. |
| | ● The Dniester-Odra Project – launched in 2004 – is an Eco-TIRAS project in partnership with Polish and Ukrainian NGOs, which promotes cooperation between local NGOs as well as state and local governments in large European river basins. The focus of the project is to share knowledge of integrated transboundary water management between the Dniester and Odra Rivers. |
| | ● In 2004, countries sharing the Amazon River Basin – Brazil, Bolivia, Colombia, Ecuador, Guyana, Surinam, Peru and Venezuela – renewed their commitment to contain environmental damage and protect the planet's biggest reserve of freshwater. Representatives of these countries agreed to create three working groups to address the impact of pollution on the Amazon at a meeting of the Amazonian Cooperation Treaty Organization (OTCA) in Rio de Janeiro, Brazil. |
| | ● Despite sporadic challenges, the riparians of the Nile Basin continue work on the Nile Basin Initiative (NBI). The initiative – formally launched in 1999 – is an important project geared towards cooperative development and institutional capacity-building for the entire East Africa region as well as all riparian states: Burundi, Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda. In late May 2004, the Nile Basin Transboundary Environmental Action Programme was implemented; the first of eight on-the-ground projects to be initiated by the Shared Vision Programme of NBI. |
| | ● On 13 July 2004, seven of the eight riparian nations of the Zambezi River signed the Zambezi Watercourse Convention (ZAMCOM). The signatory states have initiated the ratification process and the convention will enter into force when two-thirds of the signatories have ratified it, to occur most probably by the end of 2005. |
| | ● Improving Water Governance in the Volta Basin – a project initiated by the World Conservation Union (IUCN)/the Swedish International Development Cooperation Agency (SIDA) in September 2004 – aims to aid Burkina Faso and Ghana to define shared principles and construct a framework for international cooperation in the management of the Volta Basin. |
| **2005** | ● In early 2005, the European Union launched the Water and Environmental Resources in Regional Development (WERRD) project which has the objective of examining policies in improving livelihoods in international river basins. The project is currently being carried out in the Okavango River with the participation of Botswana, England, Namibia, South Africa and Sweden. |
| | ● In 2005, Bolivia and Chile came to an agreement in sharing the groundwater of the Silala Aquifer – a potent source of conflict for years. The status of the Silala River – a disputed body of water flowing from Bolivia to Chile – however, is yet to be decided. Talks between the two countries have stopped due to the interim government in Bolivia, formed after the resignation of President Carlos Mesa. |
| | ● In 2005, the governments of Honduras and Nicaragua approached the Organization for American States (OAS) for financial and technical assistance to improve their border relations after the Rio Negro was diverted as a result of Hurricane Mitch. |
| | ● In April 2005, Friends of the Earth Canada and Friends of the Earth US called on the Canadian government to take the United States to the International Court of Justice in The Hague to stop the completion of the Devils Lake Emergency Outlet in North Dakota. According to the groups, the completion of the outlet threatens to move polluted waters and invasive species from the United States into a Canadian river that flows into Hudson's Bay. |
| | ● After several years of attempting to stop India from constructing the Baglihar Dam on the Chenab River, claiming that it is in violation of the Indus Waters Treaty of 1960, Pakistan invoked the dispute resolution mechanism outlined in the Treaty, marking the first time the mechanism was invoked by either party. The Treaty states that the original broker of the Treaty, the World Bank, should appoint a neutral arbitrator to resolve the issue. |
| | ● In May 2005, Green Cross International launched the La Plata Dialogues 'Water for Life' through its Water for Peace program, in cooperation with Itaipu Bi-National and the Intergovernmental Coordination Committee of the Plata Basin Countries (CIC). These high-level talks included stakeholders from all sectors of society to identify projects for improving the management of the La Plata River Basin. |
| | ● In June 2005, Guinea rejoined the *Organisation pour la mise en valeur du fleuve Sénégal* (OMVS, the Senegal River Basin Organization) and thereby brought together all four countries of the river basin – Guinea, Mali, Mauritania and Senegal – for the first time in more than 30 years. |
| | ● A Memorandum of Understanding between Israel, Jordan, and the Palestinian Authority, signed in July 2005, agreed to a two-year study to investigate the social and environmental impact of transporting large quantities of water through 200 kilometres of piping from a small canal on the Red Sea to the Dead Sea. The World Bank facilitated the $15 million agreement. |
| | ● In 2002, UNESCO and the Organization of American States (OAS) launched the International Shared Aquifer Resource Management (ISARM) project for the Americas. The project – International Transboundary Aquifers of the Americas – organized three workshops in 2003, 2004 and 2005 presenting the data gathered on transboundary groundwater in North, Central and South America and highlighting the need to follow-up on this cooperative project. |
| | ● In October 2004 UNESCO and the Aristotle University of Tessaloniki, Greece, presented in a joint workshop the draft inventory of internationally shared aquifers in southeast Europe. These were the first results of the ISARM-MED project. The results are published in this chapter. |
| | ● In 2005, UNESCO and FAO published a review of all existing treaties and other legal instruments related to the use of groundwater resources, in a publication entitled: *Groundwater in International Law: Compilation of Treaties and Other Legal Instruments.* |
| | ● In 2005, the UN International Law Commission continues work on the draft legal instrument on transboundary groundwater resources begun in 2002. |

### 2b. The case of aquifer systems

The equally important challenge of demarcating aquifer systems, as well as the need to manage them through appropriate inter-state compacts or multilateral agreements, has begun in earnest. Unlike inter-state surface water compacts (legal agreements specially made for allocating and managing shared water systems among various water users and uses), the focus of the aquifer compact is the design of a joint resource allocation and management system that would ensure the sound functioning of the systems through appropriate policies adopted by all the overlying countries. Although pilot studies to develop such mechanisms and approaches have been initiated, it is still too early to deliver firm guidelines (UNESCO-IHP/ISARM, 2001).

New inter-state aquifer agreements have to be carefully crafted to fit retroactively into existing inter-state river agreements in which the groundwater component may have been given insufficient prominence. Reviews and reassessments, coupled with new agreements, offer the possibility of managing groundwater resources in a holistic way, as opposed to disparate groundwater administrations based on artificial state boundaries. Administrative bodies could be created to address present and future disputes over claims of excessive groundwater withdrawal between neighbouring states or basins, provided that the institutional transaction costs can be covered.

Parallel conceptual and methodological advances have raised the questions of indicators, both in terms of flash points and red flags for conflict and obstacles to cooperation. In addition to the traditional sources of conflict outlined above, especially for transboundary conflicts, much literature also emphasizes rivers forming a shared boundary, human action triggering disruptions like dams, power asymmetries, unilateral basin development and extreme hydrological events like droughts and floods. On the other hand, the shifting interest in conflict management and resolution has also helped support efforts that aim to better understand obstacles to and mechanisms for cooperation. An interesting conceptual scheme by Sadoff and Grey (2002) exemplifies types of cooperation by distinguishing between increasing benefits *to the river* (the ecological river), increasing benefits *from the river* (the economic river), reducing *costs because of the river* (the political river) and increasing benefits *beyond the river* (the catalytic river). A similar conceptual scheme for aquifers could also be formulated.

All such considerations point to two conclusions: first, water conflicts are intertwined with other, larger socio-political issues, and second, the development of indicators and early warning signs for preventing and mitigating conflict must be coupled with parallel indicator systems of cooperation that complement the challenge of water sharing in both intra- and inter-state situations (see **Table 11.2**).

### 2c. Water regimes and hydrodiplomacy

The notion of water regimes also helps to better delineate water sharing challenges. Water regimes imply a specific set of rules, institutions and practices, as well as relationships of power, position and interest. Such regimes exemplify a specific hydroculture of established cultural and socio-political traditions, attitudes and practices. For example, one can think of river basins as water regimes where voluntary cooperation has emerged over time (as in the case of the Columbia basin between the US and Canada), or where external incentives, such as foreign investment and even threats by a major power in the basins, as in the Nile River Basin and the Mekong, have contributed to cooperation. It is interesting to note that such a culture is lacking for groundwater resources, except in regions where cultural norms and traditions have brought cooperative forces together (qanats or *kharez*,[5] for example) and where land management and groundwater sustainability go hand-in-hand.[6]

Supporting water sharing efforts is also a general principle of conduct in international law, treaties, binding acts and judgments of international courts that shape the rules and procedures of shared transboundary waters. The five major legal principles that shape hydrodiplomacy, including intra-state practices, are as follows:

- the principle of international water and the concept of an international watercourse
- the principle of reasonable and equitable utilization, which has generated perpetual debates and interpretations of the terms 'reasonableness' and 'equity'
- the obligation not to cause significant harm and the exercise of due diligence in the utilization of an international watercourse
- the principle of notification and negotiations on planned measures
- the duty to cooperate, including regular data exchange

*Reviews and reassessments, coupled with new agreements, offer the possibility of managing groundwater resources in a holistic way...*

5. A qanat is a traditional Middle Eastern subsurface network of tunnels and wells used to transport water from an elevated mountainous area downwards to the ground surface. *Kharez* is the term used in Baluchistan, which is a region on the border areas of Pakistan, Iran and Afghanistan.

6. See the activities of the recently created UNESCO Centre on Qanats and other hydraulic structures in Yazd, Iran.

*Harvest in Two Buttes, Colorado, United States*

The draft articles prepared by UN-ILC on the use of transboundary aquifers are developing similar though alternate principles for groundwater resources that encourage aquifer system states to focus on the integrity of the functions of the aquifer systems.

The legally binding and far-reaching WFD of the European Commission (EC, 2000) established a detailed process for community action in water policy that accentuates many normative aspects (social preferences, goals and established practices) of valuing and sharing water. It also placed a renewed emphasis on public participation. Existing legal approaches to water resources law (from the 1966 non-binding Helsinki Rules on the Uses of Waters and International Rivers to the International Law Association Berlin Conference of 2004) have now been further elaborated.[7] At the same time, declarations, international law organizations' drafts, the creation of the World Water Council and international water conferences (such as the Fourth World Water Forum in Mexico City in 2006) all aim to expand the spatial envelope (from narrowly local to national and transnational, if not global, geographical units) and accentuate integrated approaches to sharing water.

Progress in the twenty-first century will require an institutional order of cooperation, comprehensive management principles and sharing of experiences gained through the practice of ecosystemic principles in water resource projects. Paths towards further effectiveness for some authors (Rogers and Kordab, 2004) entail boosting governmental *concern*; enhancing the *contractual* and bargaining environment and, finally, building national *capacity*.

There is widespread interest in a paradigm shift to a new model that questions the traditional methods of governing water resources, as well as an ongoing debate as to what this new paradigm entails. This involves the search for new judicial norms, flexible institutions, demand-driven water policies, new concepts of water types (blue and green water, see **Chapter 4**, or virtual water, see **Chapter 12**), as well as sustainability, transparency and public participation. Conflict prevention and similar concepts of interdependence in other efforts to share water resources in a sustainable manner are also pivotal.

Noble as these goals may be, there have been repeated warnings about the difficulties of generating international agreements given the obstacles to cooperation, which include the increasing split between the North and the South, the persistence of national sovereignty and the lack of sufficient incentives to bring nations to the table for sustained negotiations.

### 2d. Water sharing and the public good

The use of the terms 'reasonable', 'equitable' and 'sustainable' in the last three decades illustrates the increasing emphasis on water sharing as a public good. It also stresses the importance of accommodating competing demands and expresses the underlying wish to manage water by hydrological boundaries rather than by administrative or political borders. The complexity of the physical river system, the interdependence of surface water with groundwater, is not a new phenomenon. But the spate of activities and declarations in international water meetings have served to redefine efforts of purposeful water sharing and laid the ground for new upstream-downstream institutional arrangements. The Global Water Partnership's (GWP) effort to clarify and utilize toolboxes (specific methodological guidelines for defining ethical variables and relevant measurable indicators) is now joined by other institutional mobilization efforts, methodological advances and mechanisms for measuring performance and output.

The desire to maintain communal control and support public participation in upstream-downstream relations further expands the recognition of water as a public good and also points out the danger of commodifying water by distinguishing between the value, price and cost of supplying water[8] (see **Chapter 12**).

In articulating general principles of integrated shared water resources, one must also raise questions about the criteria for evaluating institutional performance. Here, in addition to the standard literature, the early UN Water Conference in Mar del Plata (1977) promulgated a set of performance criteria by blending practical experiences from the social sciences. Criteria include a cluster of institutional characteristics: clarity of water ownership, legal authority capable of enforcing decisions, transparent national policies and mechanisms for coordination. They also include other institutional performance criteria, such as consideration of alternatives, incorporation of externalities, responsiveness to national and local priorities and expeditious movement from planning to implementation.



7. This is especially evident in articles 10–16 dealing with internationally shared water.

8. The now famous essay, 'Tragedy of the Commons' (Hardin, 1968), is the metaphor for the problem of sharing this public good, and the shift from exploitation for growth to the preservation of ecosystem health.

A good example of capacity-building comes from the WFD (2000), which refers to five cross-cutting principles for implementation:

- opportunities for integrated approaches between different sectors (the environment and agriculture, for example)
- scale of intervention through a distinction between large and smaller river basins
- timing in terms of early implementation
- participation and encouragement of building on traditions of public or stakeholder involvement
- capacity, or the historical existence of strong technical and scientific traditions or expertise.

The right to water is already recognized in several legal or political instruments (see **Table 11.3**). It guarantees access to water, without discrimination, in a permanent and sustainable manner – and at a socially and economically acceptable cost. It also addresses the issues of subsidiarity, solidarity, and cooperation. Finally, it takes into account the interests of disadvantaged populations and the importance of decision-making at local levels.

## 2e. Institutions, procedures and regulatory principles

Institutions are defined as established and organized procedures; water institutions represent established values, norms and practices that provide a policy, legal and administrative framework for sharing water.

A variety of actors – local institutions, NGOs, research institutions, private sector participants, donors, riparian government institutions and transnational river basins – face problems of vertical and horizontal integration, not only in water resources projects, but also within and between other resource management entities and organizations.

Cutting across this complex setting are the theoretical problems of legal doctrines, as well as the power of all encompassing international agreements. The UN Convention on the Law of the Non-navigational Uses of International Watercourses, as well as the non-binding Helsinki Rules, have adopted the principles of limited territorial sovereignty with equitable and reasonable

**Table 11.3 The right to water timeline**

Several acts, declarations, conventions and constitutions make explicit or implicit provisions for the right to water:

| | |
|---|---|
| **1949-1977** | ■ The international humanitarian law applicable to armed conflicts and human rights law:<br>– *Convention (I) for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field.* Geneva, 12 August 1949.<br>– *Convention (II) for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea. Geneva, 12 August 1949.*<br>– *Convention (III) relative to the Treatment of Prisoners of War.* Geneva, 12 August 1949.<br>– *Convention (IV) relative to the Protection of Civilian Persons in Time of War.* Geneva, 12 August 1949.<br>– *Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I),* 8 June 1977.<br>– *Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts (Protocol II),* 8 June 1977. |
| **1979** | ■ The 1979 *Declaration on the Elimination of All Forms of Discrimination Against Women*, adopted by the UN General Assembly on 18 December 1979 (resolution 34/180), entered into force on 3 September 1981. |
| **1989** | ■ The 1989 *Declaration on the Rights of the Child*, adopted by the General Assembly and opened for signature, ratification and accession by on 20 November 1989 (resolution 44/25), entered into force on 2 September 1990. |
| **1997** | ■ The 1997 *Convention on the Law of the Non-navigational Uses of International Watercourses*, adopted by the UN General Assembly on 21 May 1997 (Resolution 51/229). |
| **2000** | ■ Resolution A/RES/54175 of the UN General Assembly of 2000: *The Right to Development.* |
| **2001-02** | ■ General Comment No.15 of the Committee on Economic Social and Cultural Rights of November 2002: *The Right to Water* (arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights). |
| | ■ The Council of Europe and the European Parliament declared themselves in favour of this right, successively in 2001 and 2002. |
| **2003** | ■ The Johannesburg Declaration and the documents produced at the Third World Water Forum (Kyoto 2003) include the right to basic sanitation as part of the right to water. |

**BOX 11.3: TRANSBOUNDARY AQUIFERS ON THE AGENDA OF THE INTERNATIONAL LAW COMMISSION**

In 2002, the International Law Commission (ILC) of the United Nations incorporated in its work programme the topic of shared natural resources, including groundwater, oil and gas. In his *First Report on Outlines* submitted in 2003, the Special Rapporteur presented the background of the topic at the ILC, and indicated his intention to start with groundwaters. He also presented an addendum technical in nature and containing general information on groundwater (importance, characteristics, uses, causes of degradation, non-renewable).

In his *Second Report on Shared Natural Resources: Transboundary Groundwaters*, of 2004, the Special Rapporteur expressed his decision to consider all groundwaters, and introduced the concept of aquifers. He presented an outline of a future framework instrument for transboundary aquifers and seven draft articles dealing with aquifers' scope and definition, the obligation not to cause harm, the general obligation to cooperate, the regular exchange of data and information and the relationship between different kinds of uses. The addendum contained case studies and models of several types of transboundary aquifers.

In his third report of 2005, the Special Rapporteur proposes a complete set of draft articles for an instrument on the law of transboundary aquifers. In addition to the previous draft articles, the Special Rapporteur introduces the distinction between recharging and non-recharging aquifers; articles on bilateral and regional arrangements in relation to other conventions; the need for equitable and reasonable utilization; monitoring; protection; preservation and resource management (with provisions on ecosystems, recharge and discharge zones); and activities affecting other states. The report was discussed at the fifty-seventh session of the ILC (May-July 2005), and was generally well received. A working group was set up to review all the draft articles and will be reconvened at the ILC's next session in 2006 to complete its work. The third report was discussed at the last session of the sixth Committee of the UN General Assembly in October and November 2005. Member State delegates presented their comments and expressed their appreciation of the work being achieved by the Special Rapporteur.

An ad hoc groundwater multidisciplinary experts group was established, and meetings were organized in Paris and Tokyo. Experts convened by UNESCO-IHP participated in briefings on aquifers and the science of hydrogeology for the members of the ILC in Geneva and the members of the sixth Committee in New York.

*Source*: UN, 2005; 2004; 2003.

utilization. They currently make up the accepted doctrine in international water law (at least for surface water). In the draft articles submitted by the Special Rapporteur on transboundary aquifers, the principle of equitable and reasonable utilization was also introduced and is currently being debated at the International Law Commission (see **Box 11.3**). The doctrines of absolute territorial sovereignty and absolute territorial integrity are increasingly becoming outdated.

River basin planning and management have been a long honoured tradition – from the development of the Tennessee Valley Authority in the US in the 1930s to the Senegal development plans of more recent years. The common thread underlying these efforts has been the development of water resources for a variety of uses. The existing literature raises the important question of whether such integrative regional water plans can fit within the geographic limits of a river basin or watershed, and if so, how water can be shared in an equitable manner. Can such joint management take place in the vast expanses of the Aral, Nile, Amazon, Mekong and the Parana-LaPlata basins? Or should it be restricted to regional, specific socio-political conflicts and well-defined geographic, cultural, environmental and economic boundaries?

What implications does this have for the long-term process of sharing water? First, we need to recognize the difficulties associated with legalistic approaches that tend to emphasize conduct rather than formal governance, especially in cases where there is no agreed-upon river regime. Second, existing legal approaches can be supplemented by flexible mechanisms, such as second track diplomacy (environmental diplomacy or hydrodiplomacy); alternative dispute resolution (ADR)[9] through international bodies or in the spirit of Agenda 21, a technical professional or an independent panel of experts (water ombudsmen or a water cooperation facility); and public participation and mobilization.

The operational terms for the above are complementarity and implementation. However, there are three troublesome problems in multilateral agencies: the historical and cultural inertia of past differences and practices, the calculation of all costs involved in the development of shared waters and incorporating social and environmental concerns related to effective water sharing. Cooperation and conflict are also

9. Alternative dispute resolution (sometimes referred to as appropriate dispute resolution) is a general term, used to define a set of approaches and techniques aimed at resolving disputes in a non-confrontational way. It covers a broad spectrum of approaches, from party-to-party engagement in negotiations as the most direct way to reach a mutually accepted resolution, to arbitration and adjudication at the other end, where an external party imposes a solution. Somewhere along the axis of ADR approaches between these two extremes lies mediation, a process by which a third party aids the disputants to reach a mutually agreed solution (Shamir, 2003).

expressions of the need to accommodate geographic realities and hydrogeology into the social context of shared water. Donors who provide incentives for the creation of voluntary agreements are necessary for a true community of riparians, in addition to their willingness to come together in joint institutional mechanisms.

# Part 3. Preventing, Managing and Resolving Shared Water Conflicts

**There is a long history of water-related disputes, from conflicts over access to adequate water supplies to deliberate attacks on water systems. As growing populations, urbanization and economic development will all require more water for agricultural, municipal and industrial uses, there is a risk that such contestations will increase. At the same time, water availability may be coming up to what Falkenmark (1999) has described as the 'water barrier', a level of supply below which serious constraints to development arise. These limits may be further stretched by potential climatic anomalies, which in turn, could intensify regional conflicts between upstream and downstream users.**

There are three distinct phases in water conflicts: conflict creation, management and resolution. In the first phase, the emphasis is on diagnosis, anticipation and prevention, problem architecture and joint fact-finding. The second phase represents a trust-building stage through mechanisms such as mediation, arbitration and neutral expert fact-finding. Finally, conflict resolution involves consensus-building and the depolarization of conflicting interests through public fact-finding processes or adjudication.[10]

The search for a typology for conflicts and appropriate responses has led to several conceptual schemes. One conclusion is that we should pay particular attention to international river basins and aquifer systems, where confrontations and conflicts can be far-reaching. Sources of potential water conflicts include the following:

- scarcity (permanent and temporary)
- differences in goals and objectives
- complex social and historical factors (including pre-existing antagonisms)
- misunderstandings or ignorance of circumstances and data
- asymmetric power between localities, regions or nations
- significant data gaps or questions of validity and reliability
- specific hydro-political issues at stake (dam construction or diversion of water)
- non-cooperative settings and value conflicts, especially in terms of water mythology, culture and water symbolism.

Alternative dispute resolution mechanisms have become important means for resolving conflicts. The search for alternatives to legal institutions for arbitration was prompted not only by the saturation of legal mandates, but also by increasing litigation and confrontation. Mediation – a compromised discussion between disputants aided by a neutral third party – has become a viable alternative to adversarial processes. The gamut of adjudication, arbitration, mediation, conciliation and even principled negotiation illustrates several more alternative processes of dispute resolution. Public participation and negotiation can be tools in maximizing agreement not only about the nature of a problem but also about the desirability of specific outcomes.

The outcome of conflicts for all water regimes will also depend on other variables: the number of actors involved, external factors, preventive rather than corrective emphasis in potential cooperation, information available to all parties concerned, bureaucratic rigidity, lack of relevant institutions, historical animosities, etc. It is difficult to determine which variables are most important and how they interact with larger processes, such as demographic and socio-political pressures or with resource scarcity and environmental degradation.

10. Training courses on conflict management and cooperation-building have been instrumental: see UNESCO's PC-CP project (webworld.unesco.org/water/wwap/pccp/cd/educ_tools.html) and the World Bank's 'Shared Water, Shared Future' course workbook and the International Water Academy's Building a Curriculum for Training in Water Conflict Resolution, Prevention, and Mediation (www.thewateracademy.org/OppActivities/index_main.html), among others.

*Relevant indicators – as well as the combination of data and sound judgment – are needed in order to establish a baseline of the status of shared water resources...*

### 3a. The search for relevant indicators in water sharing

Recent literature has highlighted the need to move from descriptive studies towards the creation of measurable indicators that measure the performance of shared water systems, monitor the process of equitable sharing and provide the mechanisms for monitoring both the current state and changes in interdependent water systems, in addition to gaining more realistic insights through field studies (Carius et al., 2004; Gleick, 2005; Millennium Ecosystems Assessment, 2003).

Theoretical approaches must be counterbalanced by practical examples of water sharing at every level. Although there is great difficulty in measuring the performance, process and product of water sharing through quantitative and qualitative indicators, they can help us to develop the critical thresholds; articulate the interesting differences, as well as significant trends and developments; and put forward the data necessary for balanced decision-making.

Relevant indicators – as well as the combination of data and sound judgment – are needed in order to establish a baseline of the status of shared water resources in order to discern the nature and rate of changes, provide a solid base for understanding the process of equitable allocation and offer early warnings of emerging problems.

It is important to indicate the broad complementary goals of indicators: policy relevance as well as technical credibility and relevance. Specific criteria for indicator selection include analytical soundness (expressed in scientific and technical terms); measurability (readily available, adequately documented, valid and reliable data and information); and utility to users (simple to interpret, showing trends over time, responsive to change, comparable and providing threshold or reference value against which one can assess ultimate significance).

The critical question is how to combine metric data with more qualitative approaches that offer ordinal data, at best. The question between quantitative and qualitative measurement reflects the difficulties of the availability, validity and reliability of existing data and information, not to mention the challenges of statistical manipulation. The first *World Water Development Report* (2003) noted that beyond the general commentary of other studies' indicators, there is no empirical derivation of testing. This chapter has preliminary empirical results of indicators measuring potential conflict or cooperation in international basins. By identifying sets of parameters that appear to be interrelated and using these sets for advanced statistical analyses, two findings stand out. First, most cases show cooperation rather than conflict; and second, rapid changes – in institutional capacity or in the physical system – have historically been at the root of most water conflicts. These changes were measured by three indicators: internationalized basins (i.e. in newly independent states); basins that include unilateral developments (and the absence of cooperative regimes); and cases where basin states show hostility over non-water issues (Wolf et al., 2003).

Important methodological and policy questions for cumulative, interactive, synergistic effects and consequences remain. In addition, many of the water sharing indicators intersect with other dimensions of water discussed in this volume.

The list of potential indicators can be summarized across the following dimensions:[11]

- **Operational/administrative interdependencies for sharing water**
  - number of international basins and transboundary aquifers
  - dependency on inflow from other river basins
  - serious impact on upstream water diversions and impoundments
  - impact on groundwater ecosystems
  - upstream and downstream integrative mechanisms
  - systematic considerations of water users and uses interdependencies
  - high water stress/scarcity/poverty conditions
  - basin-wide operational water planning and management
  - surface/groundwater conjunctive use
  - number of treaties/cooperative events.
- **Cooperation/conflict**
  - existing conflict accommodation and resolution mechanisms
  - significant number of water treaties or conventions
  - economic, scientific or industrial agreements
  - cooperative events involving transboundary rivers
  - unilateral projects, highly centralized water megaprojects

11. The approach followed was to provide a set of indices, or potential indicators, which were then examined against the recent literature. These indicators were the basis for discussion at the 'Indicators of water conflict and cooperation' workshop convened in Paris in November 2004 by UNESCO-PCCP.

- existence of laws and regulations for fair water allocation
- stakeholders' involvement and participation mechanisms
- publication of joint inventories of transboundary resources
- effectiveness of community-based management
- newly internationalized river basins.

■ **Vulnerability/fragility**
- high degree of rivalries, disputes and contestation within and between countries or areas
- ratio of water demand to supply
- environmental and social fragility, non-robust social system
- diminishing water quality and degraded groundwater dependent ecosystems
- poverty, lack of good sanitary conditions
- extreme hydrological events and periodic water disasters (flood and droughts)
- demand changes (sectoral) and distribution
- dependence on hydroelectricity.

■ **Sustainability/development**
- expressed and implementable water conservation measures
- competence for dealing with and managing water-related conflicts
- desire for and implementation of balanced environmental policies
- capacity to recover the true costs of water projects
- importance of virtual water in food trade
- unaccounted-for water
- integrated resources water management (IWRM).

The underlying concern, as far as interdependencies are concerned, has to do with types of conflict and cooperation, over water or over efforts to adapt to scarcity. Ohlsson (1999) makes distinctions between stages like supply management challenges, end-use efficiency and allocative efficiency, while using first-order and second-order disputes. Here concerns with upstream-downstream relations also appear, as well as the varieties of water shortage, such as scarcity, stress and poverty. Also included in this category are a large number of groundwater indicators, such as total resource, recharge rates, total abstraction, depletion rates and risks and composite measurements of conjunctive water use.

The cooperation/conflict dimension raises questions about institutional mechanisms and conflict resolution efforts. The conflict management techniques outlined earlier support a cooperative context in conflict prevention, management and resolution. Some even suggest friendship/hostility indicators and supportive water cultures for cooperative efforts. **Box 11.*4*** shows how traditional societies have put water at the core of their values. Others emphasize conflict-processing capabilities, including risks of victimization or critical thresholds in forecasting political crises, social and geographical spread of conflict, and increasing competition over water and land distribution.

The vulnerability/fragility dimension emphasizes volatility and turbulence in terms of the surrounding environment and society. The larger issues of poverty, sanitation, environmental degradation and a lack of social resilience, community mobilization, preparedness and disaster absorption institutions are all indications of the tenuous fabric of environmental and social structures. Questions of environmental security, risks and the inability to adapt to threats and disasters – referred to as the index of human insecurity in the combination of environment, economy, society and institutions – also belong in this category.

The sustainability/development dimension emphasizes not only cleavages in expectations and achievements, but the current preoccupation with balances between environment, economy and society. It also addresses questions of growth and carrying capacity as well as the underlying debates of survival and fulfilment. A vast array of socio-economic indicators on income distribution, environmental damages, effects on cultural heritage, freedom of action, resilience, adaptability, recuperability, environmental integrity and IWRM are likewise considered.

It is important to emphasize the dynamics of the coordination/cooperation/collaboration continuum, which stresses attempts to minimize a catastrophic water crisis preoccupation, and forces us to explicate pragmatic cases of environmental conflict management, stakeholders' engagement and trade-off considerations more clearly. Articulating and testing a few central indicators in various settings is also important. These indicators form the water interdependency indicator, exemplified by the amount of water inflow from other river basins; the cooperation indicator, measured by the number of significant joint projects, treaties or other formal agreements; the vulnerability indicator, resulting from the

*The underlying concern has to do with types of conflict and cooperation – over water or over efforts to adapt to scarcity*

**BOX 11.4: TRADITIONAL APPROACHES TO WISE WATER SHARING**

Modern statutory law often overrides and marginalizes traditional methods of managing natural resources, usually to the detriment of the rural poor. A technocratic approach to water as an exploitable resource has become the standard outlook in modern states. Traditional societies, by contrast, consider water and other natural resources as embedded in a holistic world view, deeply rooted in the traditional lives of their communities. Water is, therefore, not only of economic and social importance but also of cultural and spiritual importance. It is the focus of community building and has a broad range of non-economic values that go far beyond the modern utilitarian perception. It is this broader understanding of water that is the basis for traditional mechanisms of cooperative water management and governance, which often differ considerably from modern state-centred approaches. Yet these mechanisms offer sophisticated methods for water-related conflict resolution.

Traditional laws and rights should be included in efforts to share and govern water wisely. A participatory approach that takes the inclusion and empowerment of local stakeholders seriously should combine traditional methods of water governance and conflict resolution with modern mechanisms. Questions that we need to examine more thoroughly include the following: How can traditional and modern approaches be harmonized? How and to what extent can traditional mechanisms be transferred from the local to the national and international levels? Can traditional ways contribute to non-state-centred modes of natural resource governance? Wise water governance can only occur if local indigenous water management knowledge is tapped.

*Winnowing rice in Madurai, Tamil Nadu, India*



ratio of water demand and supply; the fragility indicator, measured in terms of environmental deterioration and social unrest (especially poverty and rivalries), within and between countries; and the development indicator, summarized by competence/commitment for managing water-related conflicts.

### 3b. Capacity-building and institutional mobilization

As world attention turns to questions of sustainable development, the restoration of degraded environments and the creation of cooperative arrangements for shared water resources, it is clear that institution-building, comprehensive management and alternative dispute resolution efforts will be central endeavours for many years to come (see **Box 11.5**). One of the main challenges is bringing together surface water and groundwater management institutions – the former dominated by irrigation interests and the latter dominated by mineral resource interests. Degraded water resources and their potential impacts on international security also provide opportunities for cooperative institutions and transnational cooperation.

The arid environments of the Middle East, the fragmented entities of the Balkans and other volatile regions will force us to consider, once again, the pivotal role of water as an agent of peace. To what extent will states, multinational corporations, NGOs and existing international bodies respond to sharing power and implementing action that promotes ecological interdependence and addresses other environmental challenges? Traditional areas of contestation – historical areas of concern like the Middle East, the Nile River and the Himalayan Basins – remain priorities. The transformation of the former Soviet Union and its newly independent states has opened up new areas of concern, such as the emergence of new states in Eastern Europe and the Balkans and enclosed seas such as the Aral and Caspian seas. The Tumen River in Asia and the Lauca and Parana/La Plata rivers in Latin America are also water systems of growing concern.

Future sources of conflict are likely to be diverse and reflect a combination of internal and external considerations, as well as the larger conditions of environmental change, such as climate and land-use questions. Resource degradation and depletion, in addition to political confrontations and climate-based environmental changes, become the backdrop for potential sources of discord, which are difficult to manage with the tools that are currently available.

### 3c. Mechanisms for cooperation and crisis avoidance

Increasing sensitivity about the need to integrate competitive demands and stakeholders' interests, in addition to the evolving need for political accommodation and the proactive stance in avoiding conflict, have all contributed to a shift from confrontation to cooperation, from monologue to dialogue and from dissent to consensus.

**BOX 11.5: MAJOR INITIATIVES IN BUILDING INSTITUTIONAL CAPACITY TIMELINE**

Launched in 2002, the Consultative Group on International Agricultural Research (CGIAR) Challenge Programme includes a project on Transboundary Water Policies and Institutions. The five major themes make reference to nine benchmark basins, most of which are international.

In April 2003, the Woodrow Wilson International Center for Scholars launched a Working Group for a three-year project, Navigating Peace: Forging New Water Partnerships. Meetings have been held regularly and a report of the project is forthcoming.

The United Nations Economic Commission for Europe (UNECE) finalized the agreement on the Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters, which was formally adopted and signed by twenty-two countries at the Ministerial Conference Environment for Europe in Kiev, Ukraine, in May 2003. The Protocol will give individuals affected by the transboundary impact of industrial accidents on international watercourses – fishermen and operators of downstream waterworks – a legal claim for adequate and prompt compensation.

In November 2003, the parties of the UNECE Convention opened up the possibility of acceding the Convention and its articles on Protection and Use of Transboundary Watercourses and International Lakes to countries outside the UNECE region. This will allow others to use the Convention's legal framework and benefit from the experience in transboundary water cooperation that has been gained, since it was signed in Helsinki in 1992.

In August 2004, the International Law Association (ILA) developed the Berlin Rules, an update of the 1966 Helsinki Rules, which aim to codify customary international water law.

In December 2004, UNESCO launched the Water Cooperation Facility, which promotes cooperation, peace and prosperity in developing and managing transboundary waters, in cooperation with the World Water Council, the Universities Partnership for Transboundary Waters and many others involved in the management of shared water resources.

In 2005, the International Network of Basin Organizations (INBO) launched the TwinBasin project, which enables the mobility of staff between twinned Basin Organizations and capitalizes on the knowledge thus acquired.

In May 2005, the Euphrates-Tigris Initiative for Cooperation (ETIC) was established in Kent, Ohio, US in order to facilitate cooperation within the Euphrates-Tigris System and in the riparian countries of Syria, Turkey and Iraq in the domains of technical, social and economically sustainable development.

Although there are many conflict resolution methods available, there is no standard legal structure for proceeding. A series of non-legally binding voluntary methods – such as arbitration, adjudication, negotiation, mediation, enquiry and conciliation – are used to settle disputes. Positive evidence from these efforts and other voluntary mechanisms of ADR allow us to be realistically optimistic about our ability to resolve future potential conflicts. In 2004, an international conference was organized by UNESCO in Zaragoza, Spain on the use of these techniques in finding solutions to difficult shared water resources.

Collaboration in addressing environmental disputes involves three phases: *problem setting* (problem definition or problem architecture); *direction setting* (predominantly negotiations over substantive problems); and *implementation* (systematic management of inter-organizational relations and monitoring of agreements). All proposed alternative processes (direct negotiations, good offices mediation, conciliation, etc.) could allow the parties to reach a more timely and appropriate resolution of disputes.

Furthermore, in many countries citizen involvement has been formally incorporated into decision-making processes and is an important means of social regulation, as well as a key component of integrated natural resources management. The current emphasis on public participation is not only an attempt to fight the problem of elitism in planning, but also part of the commitment to address public demands, involve all stakeholders and increase awareness about the nature of water resources development, as well as the potential for conflicts within and between countries. Instructive here is the CABRI-Volga project, an international coordination action aimed at facilitating cooperation in large river basins in the EU, Russia and Central Asia.

Public involvement can range from simply supplying public information releases to undertaking joint planning and decision-making. A proactive public can lead to conflict management and increased consensus, and in international cases, a reinforcement of the spirit of transnational commons. Public *awareness* involves one-way information by alerting the community to issues.

**Table 11.4 Recent international conferences of interest**

- Second Israeli-Palestinian International Conference on 'Water for Life', Turkey, October 2004, sponsored by the Israel-Palestine Center for Research and Information.
- 'Water Conflicts and Spiritual Transformation: A Dialogue', Vatican City, 13-15 October 2004, co-sponsored by Oregon State University, Pacific Institute, International Water Academy, and the Pontifical Academy of Sciences
- Second International Conference, Zaragoza, Spain, October 2004, organized by UNESCO's PCCP project. The conference brought together water managers, decision makers, students, trainers and a broad range of other stakeholders involved in the management of shared water resources. A series of interactive role-plays enhanced participants' conflict management skills and improved their knowledge of selected basins.
- 'Water as a Source of Conflict and Cooperation: Exploring the Potential', Tufts University, Boston, Massachusetts, United States, February 2005. This working group brought together some the brightest minds in the field of international waters, to discuss whether or not cooperation over water resources acts as a catalyst for cooperation in other areas (www.tufts.edu/water/WorkshopLogin.html for more information.)
- The Third Biennial International Waters Conference, Brazil, June 2005, organized by the Global Environment Facility (GEF). The primary objective of the meeting was to 'foster knowledge sharing and collaboration between participating governments, GEF International Waters projects, GEF Implementing and Executing Agencies, donor partners, and the private and non-profit sectors.' This idea was proposed by, and supported by the Dushanbe International Fresh Water Forum held 29 August - 1 September 2003. Following the UN General Assembly initiative,
- The Government of Tajikistan organized an International Conference on Regional Cooperation on Transboundary River Basins in Dushanbe, on 30 May – 1 June 2005. This event was organized as a follow-up of the United Nations General Assembly's Resolution A/RES/58/217, dated 23 December 2003, declaring the period from 2005 to 2015 the International Decade of Action 'Water for Life', upon the recommendations of the President of the Republic of Tajikistan, and the President of the International Fund for Saving the Aral Sea.

*Source:* Prepared by Aaron T. Wolf, Department of Geosciences, Oregon State University and Joshua T. Newton, The Fletcher School of Law and Diplomacy, Tufts University

*A proactive public can lead to conflict management and increased consensus*

Public *involvement* implies two-way communication and is a means of engaging community members in information exchange and dialogue. Finally, public *participation*, the most intense form of interaction between authorities, experts and citizens, implies shared leadership, truly joint planning and a democratic delegation of power.

In the last two decades, the simultaneous growth of participatory democracy and expertise in decision-making have been advocated, although it is difficult to maximize both value preferences. There is a distinction between the idealized conceptions of citizen participation and the harsh demands of public policy-making, especially in transboundary considerations. Again, participation is a double-edged sword: planners and decision-makers must be open to collaborating with citizens, while citizens must be active and competent in planning and negotiation. It remains true that the broader the base of citizen participation, the more potential influence on managing conflict there is.

### 3d. Contentious water sharing and environmental security

Water sharing also raises other challenges: the quest for environmental security and cooperative water agreements that deal with the more strategic issues of conflict prevention. What was previously a concern mainly with overt military conflicts has now expanded to incorporate environmental disasters, such as chemical spills in the Danube and the destruction of the Aral Sea. These cases broaden our definition of security to incorporate contested water bodies that, according to the UN, are issues of human security and involve human life and dignity. A growing body of literature addresses water conflicts and hydrodiplomacy, not only as strategic socio-political issues, but also as environmental interventions that affect claims on water bodies and groundwater-dependent ecosystems.

In the end, reducing the risk of conflicts and promoting equitable water sharing require regional and international approaches. However, there are limited international mechanisms for environmental security issues concerned with access to water and the restoration of polluted habitats (e.g. the restoration of rivers in Eastern Europe polluted by military bases during the Cold War).

Concern about volatile and stressed regions, as well as water-scarce environments and discussions of complex shared waters, have raised questions about potential future contestation areas, critical thresholds and red flags.[12] Perhaps even more to the point, terrorist attacks have also increased the concern about security of local water supplies.

12. Brauch et al. (2003) offer a rich conceptual discussion of the emerging difference between traditional and environmental security.

Insightful works are linking water resources to vulnerability, a function of many factors that include economic and political conditions, water availability, population growth, climate variability and the extent to which a source of water supply is shared. 'Regions at risk' are suggested as a result of basic qualitative calculations. The scarcity of water is replacing that of oil as a flashpoint for conflict between high-risk countries (Brauch et al., 2003; Gleditsch, 1997). On the other hand, shortages can also stimulate cooperative solutions or international intervention for profit management. Extreme hydrological events – droughts or floods, institutional problems and expanding populations – are exacerbating problems in these regions.

Regions can therefore be characterized by three particular vulnerabilities:

- ecological vulnerability: arid regions and regions of limited resources
- economic vulnerability: concerned with past practices of traditional exploitation and state economics
- social vulnerability: over-utilizing resources, as well as complex social economic and ecological forces affecting an area's natural equilibrium.

Hence the terms 'fragility', 'volatility' and 'carrying capacity'[13] have become indicators of conflict or cooperation in shared water systems.

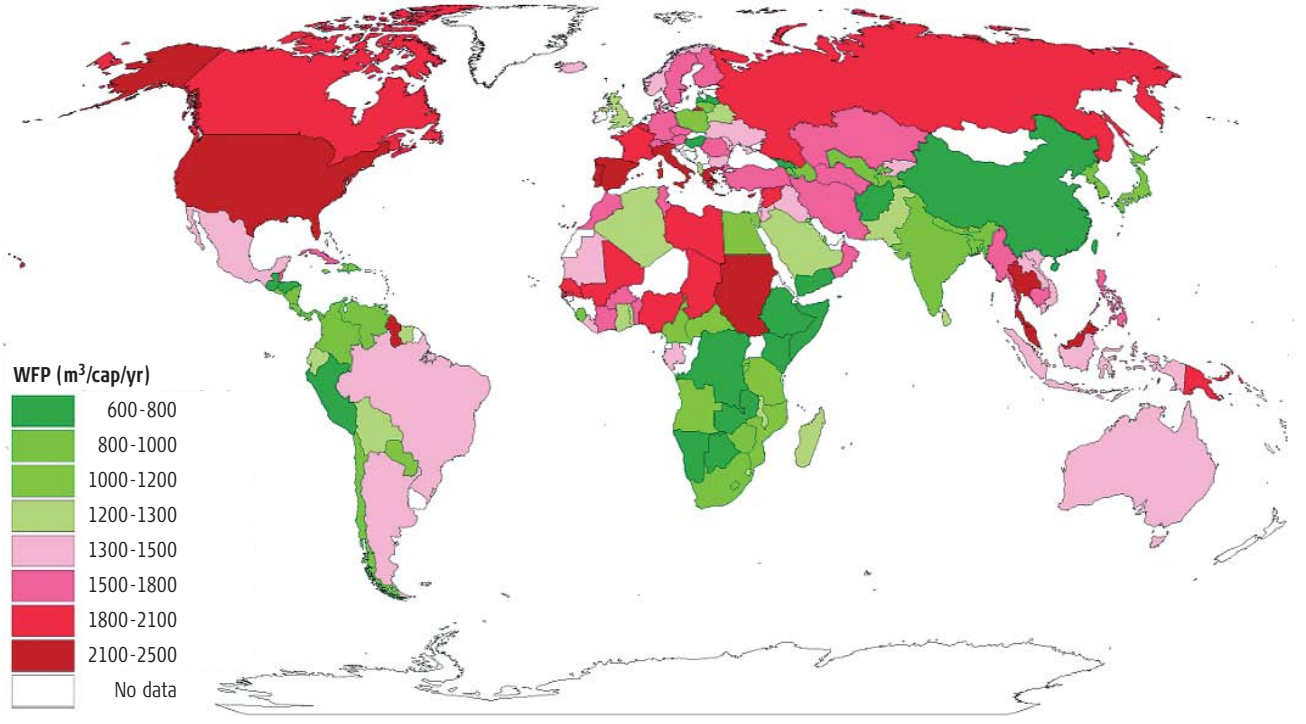
Concern about water privatization and civil unrest, which can also lead to conflict, has increased with the acquisition of national water companies by multinational corporations. The commodification of water has raised questions about poverty alleviation, water markets' effect on local economies and the search for a water democracy (see **Chapter 12**). Human rights issues, visionary declarations and the centrality of water equity all raise questions of fairness, distributive justice and the responsibilities of international communities vis-à-vis water sharing.[14]

Finally, the role of virtual water needs further attention as well. A broad indicator – a water footprint – links virtual water and world trade: via the sum of domestic water use and virtual water, we can then consider how

13. Carrying capacity is the measure of an environment's ability to sustain itself and its ecosystem.

14. *Ethics and Water*, a series of short volumes compiled by UNESCO, raises fundamental questions about our ethical and moral duties in sharing non-renewable groundwater resources and creating cooperative mechanisms. Available online at webworld.unesco.org/ihp_db/publications/GenericList_themes.asp. See also Cosgrove, 2000.

**Map 11.2: National water footprints around the world, 2004**




Note: Average national water footprint per capita ($m^3$/capita/yr). Green means that the nation's water footprint is equal to or smaller than global average. Countries with red have a water footprint beyond the global average.

*Source*: Chapagain and Hoekstra, 2004.

water used for the production of export commodities on the global market can contribute significantly to the changes in local and regional water systems (**Box 11.6**). It has been noted, for example, that since Japan consumes large quantities of American cereals and soybeans, it might be suggested that this in turn leads to the mining of aquifers (Ogallala, for example) and further water use of rivers in North America. **Map 11.2** shows national water footprints around the world. The concept of virtual water was first defined by Allan (2003) as the 'water embedded in commodities'. In terms of global trade, not only does it raise awareness about water interdependencies, but it can also serve as a means for improving water efficiency (see **Map 11.3** on water savings around the globe and **Map 11.4** on net virtual water imports). In addition, it can be an indicator of sharing water, as well as a sign of contributing to water security in water-poor regions.

*Below: Iguazu Falls, Brazil*

## BOX 11.6: VIRTUAL WATER AND THE WATER FOOTPRINT

### International virtual water flows

The International trade of commodities implies flows of virtual water over large distances, where virtual water should be understood as the volume of water required to produce a commodity. Virtual water flows between nations can be estimated from statistics on international product trade and estimates of the virtual water content of products. The global volume of virtual water flows related to the international trade in commodities is 1.6 trillion $m^3$/yr. About 80 percent of these virtual water flows relate to the trade in agricultural products, while the remainder is related to industrial product trade. An estimated 16 percent of global water use is not for producing domestically consumed products, but rather products for export. With the increasing globalization of trade, global water inter-dependencies and overseas externalities are likely to increase. At the same time, the liberalization of trade creates opportunities to increase global water use efficiency (see **Chapter 12**).

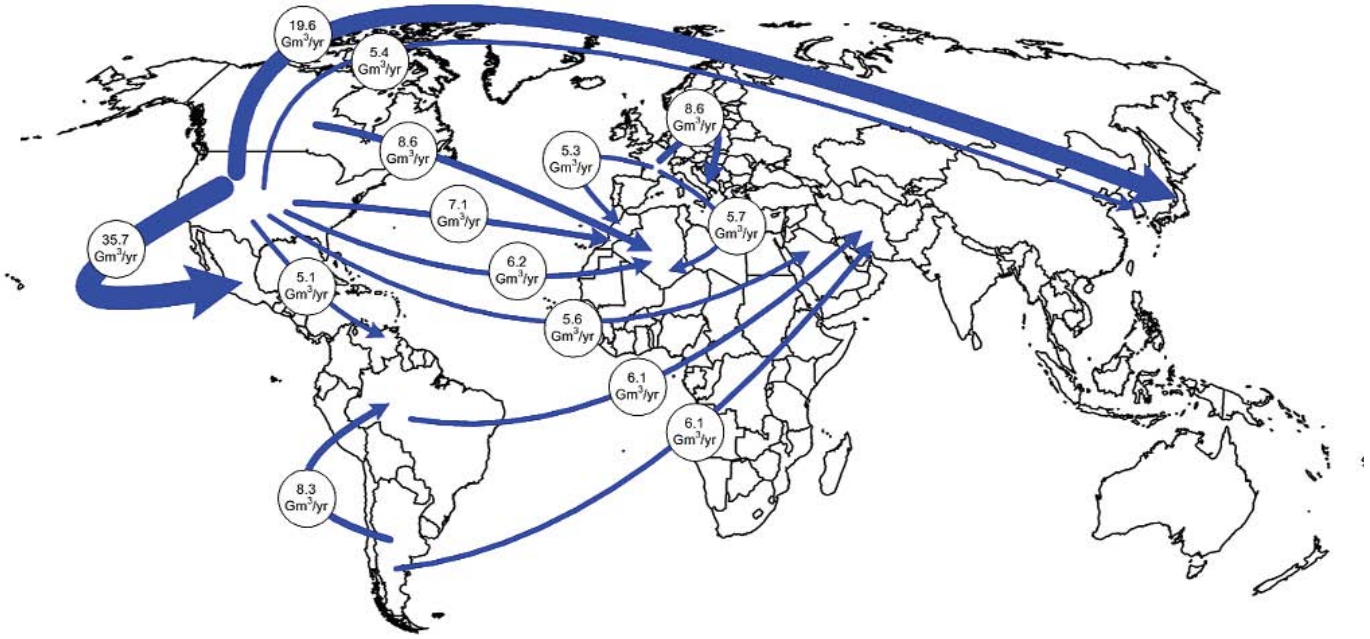
Globally, water is saved if agricultural products are traded from regions with high water productivity to those with low water productivity. At present, if importing countries produced all imported agricultural products domestically, they would require 1.6 trillion $m^3$ of water per year; however, the products are being produced with only 1.2 trillion $m^3$/yr in the exporting countries, saving global water resources by 352 billion $m^3$/yr.

### The water footprint

The water footprint shows the extent and locations of water use in relation to consumption. The water footprint of a country is defined as the volume of water needed for the production of the goods and services consumed by the inhabitants of the country. The internal water footprint is the volume of water used from domestic water resources, whereas the external water footprint is the water used in other countries. Water footprints of individuals or nations can be estimated by multiplying the volumes of goods consumed by their respective water requirement. The US appears to have an average water footprint of 2,480 cubic metres per capita per year ($m^3$/cap/yr), while China has an average footprint of 700 $m^3$/cap/yr. The global average water footprint is 1,240 $m^3$/cap/yr. The four major factors that determine the water footprint of a country are volume of consumption (related to the gross national income); consumption patterns (e.g. high versus low meat consumption); climate (growth conditions); and agricultural practice (water use efficiency).

*Sources*: Chapagain and Hoekstra, 2004; Chapagain, et al., 2005.

## Map 11.3: Water savings around the world

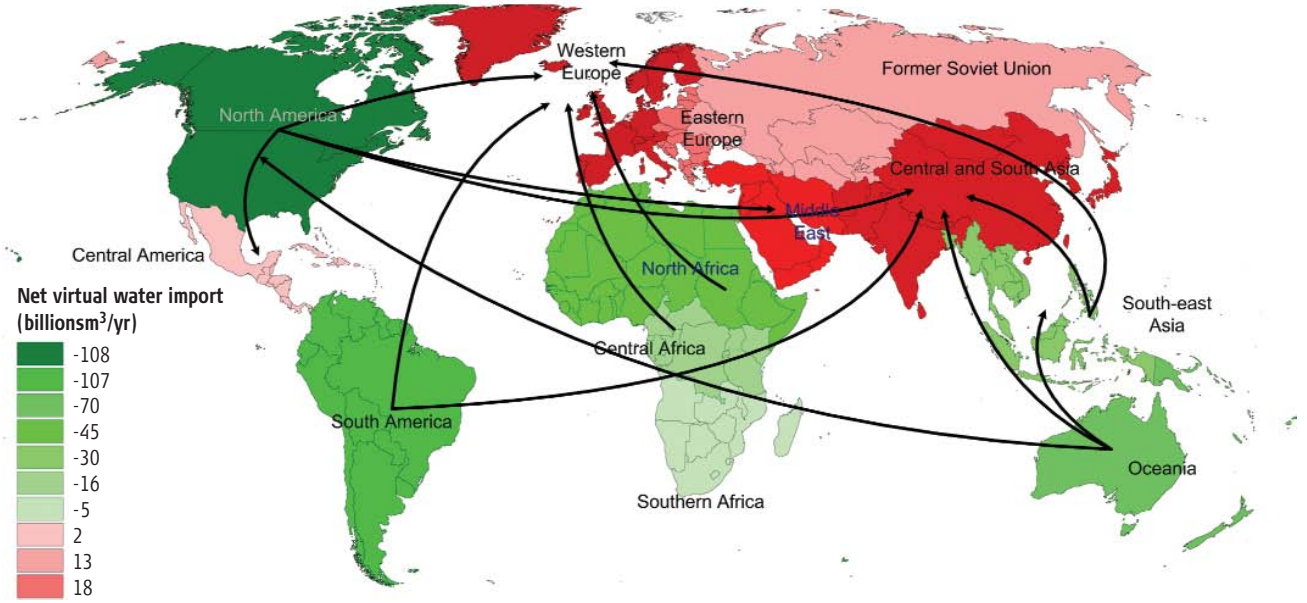



**Global water saving = 352 x $10^9$ $m^3$/yr**

Note: Global water savings (>5.0 $Gm^3$/yr) associated with international trade of agricultural products. Period 1997-2001. The arrows represent the trade flows. The numbers show the global water savings, calculated as the trade volume (ton/yr) multiplied by the difference between water requirement ($m^3$/ton) in the importing country and water requirement ($m^3$/ton) in the exporting country. Global water savings occur if an exporting country requires less water per ton of product than an importing country.

*Source*: Chapagain, et al., 2005.

## Map 11.4: Net virtual water imports around the world




Note: Regional virtual water balances and net interregional water flows related to the trade in agricultural products. Period 1997-2001. Only the biggest net flows (>10$Gm^3$/yr) are shown.

*Source*: Chapagain and Hoekstra, 2004.

*...water transcends national boundaries and must be managed cooperatively and equitably, using the best science available*

# Part 4. Conclusions and Recommendations: The Dynamics of Cooperation

**Benefits to sharing can be identified at any level of cooperation; from initial description or analysis, through series of negotiations and, finally, to concrete, implementable steps. Benefits and costs can be calculated under alternative management, development scenarios and institutional analysis. Capacity-building can delineate the best form of cooperative agreements. At the same time, no supranational agency has the mandate to handle transboundary water disputes, even though third-party mediation boards have helped to bring contending parties together.**[15]

A useful way of articulating the dynamics of cooperation is to summarize them under a continuum:

- *Coordination* relates to sharing of information, communication, as well as some preliminary regional assessments.
- *Cooperation* elevates the level of contact through joint projects, exchange of scholars and researchers, active planning, adaptation of national plans to capture regional costs and benefits, contingency alternatives or joint water flow forecasts.
- *Collaboration* implies formalized agreements, continuous interaction, integrated river basin management, joint institutions, river basin commissions, permanent secretariat and staff and other forms of joint management.

One can see the basis for indicators and indices that could measure efficiency, effectiveness and equity in evaluating and monitoring performance, processes and results of comprehensive water sharing efforts. At the same time, we also need to recognize levels of water sharing ranging from *macro-level* or transboundary river basin management (overall water allocation), to *meso-level* or country river basin (emphasizing water use allocation) and *micro-level*, which refers to multi-objective, multi-purpose and multi-stakeholder water activities, such as irrigation districts and water users' associations.

Macro-scale cooperation aims to identify water issues that act as barriers to implementing national water efforts, such as Millennium Development Goals (MDGs) that fall within the capabilities of particular nations. At the national or meso-scale, the appropriate emphasis centres around the achievement of water use priorities expressed in National Water Policies, such as access to urban water, sanitation and agricultural development. Local and focused activities on a smaller scale as well as specific projects and programmes are found at the micro-level.

For transboundary waters, there are two key interrelated water sharing issues:

- how to induce affected parties to discuss cooperation on joint water management where no prior agreement exists (in terms of identifying common interests, initiatives, future collaboration, and implementable action)
- for those countries that have agreements, treaties and established coordination mechanisms, deciding how to hold the parties accountable for implementation, which enforcement mechanisms and sanctions exist and how existing agreements can be strengthened and modified.

Again for transboundary cases, we can summarize coordination, cooperation and collaboration dynamics as part of a three-step process. The first step is to outline incentives and accepted cooperative mechanisms for water sharing at the international level. The second step is to reinforce the mechanisms by referring to different paradigms of equity and fairness that run through the variety of declarations, treaties, conventions and frameworks. The third step is to develop success indicators that reflect the results of implementation.

This chapter has continued to expand the discussion on the increasing complexity, volatility and vulnerability of water resources in a fast-changing socio-economic and environmental context. A general framework for sharing water resources tends to outline sources of tension, competing demands and the mismatch between political

15. Between 2003-06 a number of institutes and centres were established, all contributing to facilitating the management of shared water resources: the International Centre for Water Hazard and Risk Management (ICHARM) in Tsukuba, Japan; the International IHP-HELP Centre for Water Law, Policy and Science in Dundee, United Kingdom; the Regional Water Centre for Arid and Semi-arid Zones of Latin America and the Caribbean (CAZALAC) in La serena, Chile; the European Regional Centre for Echohydrology in Lodz, Poland (all at www.unesco.org/water/ihp/partners.shtml); UNESCO-IHE Institute for Water Education (www.unesco-ihe.org); Regional Centre on Urban Water Management (RCUWM) in Teheran, Iran (www.rcuwm.org.ir/).

boundaries, natural river basins and aquifer systems. At the same time, it is also important to note the positive role of cooperative efforts brought about by recent legislative and institutional developments, as well as recognition of the need for capacity-building, governance, and equitable and sustainable sharing of water. Also notable are the widespread international agreements towards peaceful settlement of differences and the concern about the consequences of present water use trends and developments.

Reflecting on recent developments since 2003, one can see noteworthy progress in water sharing. To start with, the case studies series, published by UNESCO's PCCP programme, new programmes and centres, and a series of volumes on water security have raised awareness about potential conflicts as well as the crucial role of cooperation. Similarly, there has been a steady stream of major meetings on IWRM, integrated river basin management, the application of WFD and other global water initiatives on comprehensive approaches, public participation and the sustainable management of water. Research centres have increased their efforts in extensive data collection, modelling, indicator development and practical applications of findings. UNESCO's Water Cooperation Facility (WCF) initiative, the World Water Council and other partners, for example, will turn attention to cooperation in managing transboundary waters. Visionary declarations in various international conferences, coupled with detailed guidelines for participatory assessment methods and multi-stakeholder manuals and additional water sharing agreements, illustrate the spirit and practice of the past several years. Varady and Iles-Shih (2005) point out that such initiatives have proliferated largely because of the belief that water transcends national boundaries and must be managed cooperatively and equitably, using the best science available.

An increasing number of examples of successful cooperation illustrate yet again that interdependence and changing socio-political conditions do not only produce conflicts, but also lead to collaboration. A body of formal guidelines and lessons learned from expanding sharing efforts – both nationally and internationally – are now available.

It is important to reiterate the distinction in incentives between coordination, cooperation, and collaboration. Indeed, the challenge for cooperation and the risk for conflict raise two overarching issues: namely, how to induce the affected parties to discuss cooperation on joint water management when no prior agreements exist and how, when such treaties do exist, to hold the parties accountable for implementation, promote enforcement mechanisms and continuously monitor both performance and acceptable outcomes.

The great difficulty in measuring water systems performance, levels of significance, critical thresholds and comparability of data and measurement over time is repeated in all recent literature. There are emerging agreements about specific indicators, but they tend to be evasive and difficult to pin down when there is an attempt to describe socio-political and institutional dimensions. Improving techniques in ADR and public participation complement more reasonable and acceptable solutions to water challenges. Political will and commitment are important preconditions for successful water sharing. This also implies the coordination of water resources with other natural resources, especially land-use controls and comprehensive planning and management.

*Political will and commitment are important preconditions for successful water sharing*

*Feluccas on the Nile river near Philae, Egypt*

*We can hope that shared water management becomes a realistic and thoughtful instrument for a balanced approach...*

A review of recent literature and ongoing practices reveals the following lessons learned:

- Cooperation, not conflict, is the norm in inter-state water relations in an increasing number of water courses.
- Treaties, agreements and the principles of international water law help crystallize mechanisms for conflict management and dispute resolution.
- Strengthening institutional mechanisms and legal frameworks for IWRM is needed to ensure that associated transaction costs can be covered.
- More emphasis should be placed on building capacity in terms of IWRM and conflict prevention. Involving excluded or weaker groups, especially at the local level, may prevent them from developing grievances.
- Adopting alternative dispute resolution mechanisms and confidence-increasing measures among affected parties is necessary.
- Data, information and comparative indicators can provide an arena of focused disagreement and help concentrate the debate on concrete points of contention, as is the case for Regional Water Data Banks Project and the recent efforts of UNEP's Global Environment Monitoring System.
- New paradigms of complexity and interdependence need not imply only optimal solutions and complicated models. Reasonable approximations are parts of necessary trade-offs, as are efforts to balance the relationship between ideal futures and real, or pragmatic, considerations of unfolding changes and practical solutions.

From security studies to management schemes and from administrative guidelines to conventions and bilateral agreements, a recurrent theme is the importance of the role of law and informal ties in reducing conflict and increasing cooperation. This new emphasis favours the development of contingency preparedness for continuous changes, building resilience into vulnerable systems, the ability to cope realistically with the challenges of upstream/downstream interdependencies, long-term planning and diversity and flexibility in thinking and practice. Such a combination of management would be based on regional cooperation principles, focusing on river basins and aquifer systems, with an emphasis on ecosystemic and social needs. It would focus on functionally interrelated natural resources problems, reduce potential points of friction and stress in advance and eliminate conflicting demands through risk management and vulnerability assessment. We can, then, hope that shared water management becomes a realistic and thoughtful instrument for a balanced approach and a useful tool for managing long-standing competitions, confrontations and potential outright water conflicts.



# References and Websites


Allan, J. A. 2003. Virtual Water – the Water, Food, and Trade Nexus: Useful Concept or Misleading Metaphor? *Water International*, Vol. 28, No. 1.

Appelgren, B. (ed.). 2004. *ISARM Africa: Managing Shared Aquifer Resources in Africa*. Proceedings of the International Workshop, Tripoli, Libya, 2–4 June. IHP *Groundwater Series* No. 8. Paris, UNESCO-IHP.

Bayarsaihan, T. and McKinney, D. 2002. Past Experience and Future Challenges: Cooperation in Shared Water Resources in Central Asia. Paper presented at Asian Development Bank Workshop in Almaty, Kazakhstan, 26–28 September 2002. ADB, *Water for All Series 12* online at www.adb.org/Documents/Books/Water_for_all_Series/Past_And_Future/default.asp

Brauch, H. G., Liotta, P. H. Marquina, A. Rogers, P. F. and El-Sayed Selim, M. (eds). 2003. *Security and Environment in the Mediterranean: Conceptualizing Security and Environmental Conflicts*. Berlin, Springer.

Bruch, C.E. 2003. New Tools for Governing International Watercourses. *Global Environmental Change*, Vol. 14. pp. 15–23.

Burchi, S. and Kerstin, M., 2005. *Groundwater in International Law: Compilation of Treaties and Other Legal Instruments*. Rome, FAO/UNESCO.

Carius, A., Dabelco, G. D. and Wolf, A. T. 2004. Water, Conflict, and Cooperation. *ECSP Report, Issue 10*, pp. 60–66.

Chapagain, A. K. and Hoekstra, A. Y. 2004. *Water Footprints of Nations, Volume 1: Main Report*. Value of Water Research Report Series No. 16., Delft, UNESCO-IHE.

Chapagain, A. K., Hoekstra, A. Y. and Savenije. 2005. *"Saving water through global trade"*, Value of Water Research Report Series No. 17, UNESCO-IHE, Delft, The Netherlands

Clarke, R. and J. King. 2004. *The Atlas of Water*. London, Earthscan Publications Ltd.

Cosgrove William J. (ed.). 2003. UNESCO Technical Document in Hydrology, PCCP series, Vol. 29.

Cosgrove William J. and Rijsberman Frank R. 2000. *World Water Vision: Making Water Everybody's Business*. London, Earthscan.

Creighton, J. L. 2004. Designing Effective Public Participation Programs: A U.S. Perspective: A Water Forum Contribution. *Water International*, Vol. 29, No. 3, pp. 384–91.

EC (European Commission). 2005. European Decalartion for a New Water Culture, Madrid 18 February 2005. www.unizar.es/fnca/euwater/index2.php?x=3&idioma=en

——. 2000. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. *Official Journal of the European Communities*, Brussels, EC.

Falkenmark, M. 1999. Forward to the future: A conceptual framework for water dependence. *Ambio* Vol. 28, No. 4, pp. 356–61.

Gleditsch N. P. (ed.). 1997. *Conflict and the Environment*. Dordrecht, Kluwer Academic.

Gleick, P., Cain, N., Haasz, D., Henges-Jeck, C., Hunt, C., Kiparsky, M., Moench, M., Palaniappan, M., Srinivasan, V., Wolff, G. 2005. *The World's Water 2004–2005: The Biennial Report on Freshwater Resources*. Washington DC, Island Press.

Guerquin, F., Ahmed, T., Hua, M., Ozbilen, V. and Schuttelar. 2003. *World Water Actions : Making Water Flow for All*. World Water Council, Japan Water Resources Association, UNESCO.

Hardin, G. 1968. The tragedy of the commons, *Science*, Vol. 162, No. 3859, pp. 1243–48.

ILA (International Law Association). 2004. Water Resources Law. Paper presented at the Berlin Conference, 4–21 August 2004.

International Water Academy. 2002 Building a Curriculum for Training in Water Conflict Resolution, Prevention, and Mediation. www.thewateracademy.org/OppActivities/index_main.html

Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being*. Washington DC, Island Press and World Resources Institute.

Ohlsson, L. 1999. *Environment, Scarcity, and Conflict – A Study of Malthusian Concerns*. Department of Peace and Development Research, Gothenburg University.

Rogers, P. and Kordab, I. 2004. 'Conflict Resolution in Water Resources Management: Ronald Coase meets Vilfredo Pareto.' Presented at Symposium on Challenges Facing Water Resources Management in Arid and Semi-Arid Regions, American University of Beirut, 7–9 October, 2004.

Sadoff, C.W. and D. Grey. 2002. 'Beyond the River: the benefits of cooperation on international rivers' *Water Policy* 4 (2002) pp. 389–403.

Shamir Yona 2003 UNESCO Technical Document in Hydrology, PCCP series, 2003, Vol. 7.

World Water Council. 2003. *The 3rd World Water Forum Final Report*. Marseille, World Water Council.

UN (United Nations). 2005. *Third Report on Shared Natural Resources*. UN Doc A/CN.4/551 New York, UN.

——. 2004. *Second Report on Shared Natural Resources: Transboundary Groundwaters*. UN Doc. A/CN.4/539, New York, UN.

——. 2003. *First Report on Outlines*. UN Doc. A/CN.4/533, New York, UN.

——. 1977. Convention on the Law of the Non-navigational Uses of International Watercourses. UN Doc. A/51/869, New York, UN.

UNECE (United Nations Economic Commission for Europe). 2000. Guidelines on Monitoring and Assessment of Transboundary Groundwaters. Lelystad, UNECE Task Force on Monitoring and Assessment, under the Convention of the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki 1992).

UNESCO/ISARM (United Nations Educational, Scientific and Cultural Organization/International Shared Aquifer Resource Management). 2001. *International Shared Aquifer Resource Management: A Framework Document*. IHP Groundwater Series No. 1. Paris, UNESCO.

Varady, Robert G. and Matthew Iles-Shih (forthcoming) 'Global Water Initiatives: What do the Experts Think? in A.K.Biswas (ed) Impacts of Mega-Conferences on Global Water Development and Management. Springer Verlag.

Wolf, A., Yoffe, S. and Giordano, M. 2003. International waters: Identifying basins at risk. *UNESCO Technical Document in Hydrology, PCCP Series*, Vol. 20.


**European Union water policy:** www.europa.eu.int/comm/environment/water/
**Global Water Partnership (GWP):** www.gwpforum.org/servlet/PSP
**Integrated River Basin Management (IRBM):** www.panda.org/about_wwf/what_we_do/freshwater/our_solutions/rivers/irbm/index.cfm
**International Network of Basin Organizations (INBO):** www.riob.org/
**International Rivers Network (IRN):** www.irn.org
**International Water Management Institute (IWMI):** www.iwmi.cgiar.org
**River Basin Initiative (RBI):** www.riverbasin.org/ev_en.php
**Stockholm International Water Institute (SIWI):** www.siwi.org
**United Nations Environmental Programme (UNEP):** www.unep.org/themes/freshwater
**United Nations Educational, Scientific and Cultural Organization (UNESCO) water portal:** www.unesco.org/water
**World Bank:** www.worldbank.org/water.htm
**World Water Council (WWC):** www.worldwatercouncil.org
**Organization of American States (OAS)/UNESCO:** www.oas.org/usde/isarm/ISARM_index.htm
**INWEB:** www.inweb.gr/workshops/documents/groundwater_final_report.html
**European Declaration for a New Water Culture:** www.unizar.es/fnca/euwater/index2.php?x=3&idioma=en