



Shared Waters: Conflict and Cooperation

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transboundary water resources, water conflict, water quality management, water resources development

Abstract

This review examines the state of conflict and cooperation over transboundary water resources from an environmental, political, and human development perspective. Although the potential for outright war between countries over water is low, cooperation is also often missing in disputes over transboundary resources. This background chapter will

- Provide a brief overview of the nature of conflict and experiences of cooperation over transboundary resources.
- Provide a conceptual basis for understanding cooperation and the costs of noncooperation over water.
- Indicate the possible triggers for conflict over water sharing and the implications on the livelihoods of ordinary communities.
- Offer evidence on the potential costs of noncooperation or even conflict over water resources.
- Analyze power asymmetries between riparian states and how they affect the outcomes of negotiations.
- Analyze different examples of cases that countries have used to manage the competition for water resources.
- Propose general principles and conclusions on conflict and cooperation.

“Fierce competition for fresh water may well become a source of conflict and wars in the future.”

Kofi Annan, March 2001

“But the water problems of our world need not be only a cause of tension; they can also be a catalyst for cooperation . . . If we work together, a secure and sustainable water future can be ours.”

Kofi Annan, February 2002

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BRIEF OVERVIEW OF THE NATURE OF CONFLICT AND EXPERIENCES OF COOPERATION OVER TRANSBOUNDARY RESOURCES

As human populations and economies grow, the amount of freshwater in the world remains roughly the same as it has been throughout history. The total quantity of water in the world is immense, but most is either saltwater (97.5%) or locked in ice caps (1.75%). The amount economically available for human use is only 0.007% of the total, or about 13,500 km³, which is about 2300 m³ per a person—a 37% drop since 1970 (1). This increasing scarcity is made more complex because almost half the globe’s land surface lies within international watersheds—the

land that contributes to the world’s 263 transboundary waterways.

Both water quantity and water quality have been neglected to the point of catastrophe (2).

- More than a billion people lack access to safe water supplies.
- Almost three billion do not have access to adequate sanitation.
- Five to ten million people die each year from water-related diseases or inadequate sanitation.
- Twenty percent of the world’s irrigated lands are salt laden, affecting crop production.

The pressures on water resources development leads to intense political pressures, often referred to as *water stress*, a term coined by Falkenmark (3), or *water poverty* as suggested

by Feitelson & Chenoweth (4). Furthermore, water ignores political boundaries, evades institutional classification, and eludes legal generalizations. Water demands are increasing, groundwater levels are dropping, surface-water supplies are increasingly contaminated, and delivery and treatment infrastructure is aging (5). Collectively, these issues provide compelling arguments for considering the security implications of water resources management (6–8).

A huge and growing literature speaks to the human and ecological disasters attendant on the global water crisis—essentially an ongoing deployment of a hydrological weapon of mass destruction [see especially the works of Gleick, e.g., his biennial *World's Water Series* (9–13); Postel (5, 14); the UN Environmental Program (15–18); the UN Educational, Scientific and Cultural Organization, which has produced dozens of papers under the auspices of its PCCP Program (<http://www.unesco.org/water/wwap/pccp/>), and others].

In conjunction with this crisis, though, come the political stresses that result as the people who have built their lives and livelihoods on a reliable source of freshwater are seeing the shortage of this vital resource impinge on all aspects of the tenuous relations that have developed over the years—between nations, between economic sectors, and between individuals and their environment. This review speaks to how people have, and have not, dealt with hydrogeopolitics and their impacts.

Water Conflict and Cooperation

It is quite clear that people affect their environment, but to what extent is the opposite true? Just how deep is the causal relationship between environmental stresses and the structure of human politics? This relationship is at the heart of understanding the processes of environmental conflict prevention and resolution. If, as the large and growing “water wars” literature would have it (see, for example, 19–23), the greatest threat for water conflicts is

that water scarcity can and will lead directly to warfare between nations; this lends itself to diversion of a potentially huge amount of resources in attempts to arrest these processes at the highest levels. If the processes are actually both more subtle and more local in nature (as suggested by, among others References 8, 24–27), then so too are the potential solutions.

Throughout this review, we will note that shared water does lead to tensions, threats, and even to some localized violence—and we will offer strategies for preventing and mitigating these tensions—but not to war. Moreover, these tense “flashpoints” generally induce the parties to enter negotiations, often resulting in dialogue and, occasionally, to especially creative and resilient working arrangements. We note also that shared water provides compelling inducements to dialogue and cooperation, even while hostilities rage over other issues.

But let's look at the evolution of the “water leads to war” thesis. Although the extreme water wars literature mostly began to fade in the late 1990s, a number of articles dating back decades argue quite persuasively for some degree of causality between environmental stress—reaching up against relative resource limits—and political decision making. One cannot discuss water institutions, for example, without invoking Wittfogel (28) and his classic argument that the drive to manage water in semiarid environments led both to the dawn of institutional civilization—described by Delli Priscoli (29) as the “training ground for civilization”—and to particularly autocratic, despotic forms of government. This latter argument, and the generally enthusiastic reception he received, needs to be understood in the Cold War setting from which it sprang and was quite effectively challenged by Toynbee (30), among others. Toynbee's vehemence in his review (he calls Wittfogel's book a “menace”) is particularly interesting because many of Wittfogel's theories can be seen as extensions of a sort of Toynbee's “challenge-response” thesis (31) in which he argues that the impetus toward civilization

Environmental security: the securitization or conflict potential of environmental issues

becomes stronger with greater environmental stress. Toynbee's objections are primarily with Wittfogel's "tribalistic" lens to history, aimed, as Toynbee charges, at demonizing the Soviet Union. Wittfogel (28) in turn, distinguishing himself from Toynbee, writes of his own position, "causality yes, determinism no" (p. 504). However, the premise that there is a critical link between how society manages water and its social structure and political culture remains as an important and valid insight.

This thread of causality between the environment and politics has been taken up regularly over the years. When Sprout & Sprout (32) describe the environmental factors inherent in international politics, it becomes the direct intellectual precursor to today's blossoming "environmental security" literature, as spearheaded by Homer-Dixon (33). Homer-Dixon, like Wittfogel, was initially greeted enthusiastically by the defense establishment, this time in the setting of the post-Cold War redefinition of relevance, and, again like Wittfogel, has been taken to task for the degree of causality in his arguments. (A summary of Homer-Dixon's findings, along with a debate on the topic is presented in Reference 34.) In his defense, Homer-Dixon's arguments, along with those of much of the water wars crowd, have become more muted over the last few years: In 1994, he wrote, "The renewable resource most likely to stimulate interstate resource war is river water" (35), which he repeats in his 1996 article (36). He modifies the claim, elaborated in his 1999 book (37), "In reality, wars over river water between upstream and downstream neighbors are likely only in a narrow set of circumstances . . . [and] . . . there are, in fact very few river basins around the world where all these conditions hold now or might hold in the future."

In water systems, the dichotomy of causality is manifested as whether water stress lends itself more readily to conflict or cooperation. Both arguments are powerful and have been supported by a rich, if mostly anecdotal, history. Postel (5) describes the roots of the problem at the subnational level. Water, unlike

other scarce, consumable resources, is used to fuel all facets of society, from biologies to economies to aesthetics and religious practice. As such, there is no such thing as managing water for a single purpose—all water management is multiobjective and is therefore, by definition, based on conflicting interests. Within a nation, these interests include domestic use, agriculture, hydropower generation, recreation, and environment—any two of which are regularly at odds—and the chances of finding mutually acceptable solutions drop precipitously as more actors are involved.

As described conceptually and with case studies by Trollaldalen (38), these conflicting interests within a nation represent both a microcosm of the international setting and a direct influence upon it. Trollaldalen's work is particularly useful in that he sidesteps the common trap of treating nations as homogeneous, rational entities and explicitly links internal with external interests. Bangladesh is not just the national government of Bangladesh when it negotiates a treaty with India over Ganges flow; it is its coastal population, inundated with saltwater intrusion; its farmers are dealing with decreasing quantities of water and increasing fluctuations; and its fishermen are competing for dwindling stocks.

This link between the internal and external is critical when we look at violent international conflicts (39). Gleick (6) is widely cited as providing what appears to be a history replete with violence over water resources. But a close read of his article reveals greater subtlety and depth to the argument. Wolf (40) points out that what Gleick and others have actually provided is a history rife with tensions, exacerbated relations, and conflicting interests over water, but not State level violence, at least not between nations or over water as a scarce resource. It is worth noting Gleick's careful categorization because the violence he describes actually turns out to be water as a tool, target, or victim of warfare—not the cause. Wolf (40) contrasts the results of a systematic search for interstate violence—one true water war in history, 4500 years ago—with the

much richer record of explicit, legal cooperation with 3600 water-related treaties. In fact, a scan of the most vociferous enmities around the world reveals that almost all the sets of nations with the greatest degree of animosity between them, whether Arabs and Israelis, Indians and Pakistanis, or Azeris and Armenians, either have a water-related agreement in place or are in the process of negotiating one.

Nevertheless, water management is, by definition, conflict management. Water, unlike other scarce, consumable resources, is used to fuel all facets of society, from biology to economics to aesthetics and spiritual practice. Moreover, it fluctuates wildly in space and time; its management is usually fragmented; and it is often subject to vague, arcane, and/or contradictory legal principles. There is no such thing as managing water for a single purpose; all water management is multiobjective and based on navigating competing interests. Within a nation these interests include domestic users, agriculturalists, hydropower generators, recreation enthusiasts, and environmentalists—any two of which are regularly at odds, and the chances of finding mutually acceptable solutions drop exponentially as more stakeholders are involved. Add international boundaries, and the chances decrease exponentially yet again.

The Register of International River Basins of the world (41) defines a *river basin* as the area that contributes hydrologically (including both surface- and groundwater) to a first order stream, which, in turn, is defined by its outlet to the ocean or to a terminal (closed) lake or inland sea. Thus, river basin is synonymous with what is referred to in the United States as a *watershed* and in the United Kingdom as a *catchment*, and includes lakes and shallow, unconfined groundwater units (confined or fossil groundwater is not included). We define such a basin as *international* if any perennial tributary crosses the political boundaries of two or more nations.

Similarly, the 1997 UN Convention on Non-Navigational Uses of International Watercourses defines a *watercourse* as “a sys-

tem of surface and underground waters constituting by virtue of their physical relationship a unitary whole and flowing into a common terminus.” An *international watercourse* is a watercourse with parts situated in different States [nations].

Surface and groundwater that cross international boundaries present increased challenges to regional stability because hydrologic needs can often be overwhelmed by political considerations. Although the potential for paralyzing disputes is especially high in these basins, history shows that water can catalyze dialogue and cooperation, even between especially contentious riparians. There are 263 rivers around the world that cross the boundaries of two or more nations and an untold number of international groundwater aquifers. The basin areas that contribute to these rivers (**Figure 1**) comprise approximately 47% of the land surface of the earth, include 40% of the world’s population, and contribute almost 60% of freshwater flow (42).

Within each international basin, demands from environmental, domestic, and economic users increase annually, while the amount of freshwater in the world remains roughly the same as it has been throughout history. Given the scope of the problems and the resources available to address them, avoiding water conflict is vital. Conflict is expensive, disruptive, and interferes with efforts to relieve human suffering, reduce environmental degradation, and achieve economic growth. Developing the capacity to monitor, predict, and preempt transboundary water conflicts, particularly in developing countries, is key to promoting human and environmental security in international river basins, regardless of the scale at which they occur.

A closer look at the world’s international basins gives a greater sense of the magnitude of the issues: First, the problem is growing. There were 214 international basins listed in a 1978 United Nations study (41), the last time any official body attempted to delineate them, and there are 263 today (42). The growth is largely the result of the internationalization

International watercourse: a watercourse, parts of which are situated in different States [nations]

Watercourse: a system of surface and underground waters constituting by virtue of their physical relationship a unitary whole and flowing into a common terminus



Figure 1
International basins of the world.

of national basins through political changes, such as the break up of the Soviet Union and the Balkan states, as well as access to today's better mapping sources and technology.

Even more striking than the total number of basins is a breakdown of each nation's land surface that falls within these watersheds. A total of 145 nations include territory within international basins. Twenty-one nations lie in their entirety within international basins, and a total of 33 countries have greater than 95% of their territory within these basins. These nations are not limited to smaller countries, such as Liechtenstein and Andorra but include such sizable countries as Hungary, Bangladesh, Belarus, and Zambia (42).

A final way to visualize the dilemmas posed by international water resources is to look at the number of countries that share each international basin. Nineteen basins are shared by five or more riparian countries: one basin—the Danube—has 17 riparian nations; five basins—the Congo, Niger, Nile, Rhine, and Zambezi—are shared by between 9 and 11 countries; and the remaining 13 basins—the Amazon, Ganges-Brahmaputra-Meghna, Lake Chad, Tarim, Aral Sea, Jordan, Kura-Araks, Mekong, Tigris-Euphrates, Volga, La Plata, Neman, and Vistula (Wista)—have between 5 and 8 riparian countries (42).

Although lakes and shallow, unconfined groundwater are included in these basins, the important hydrologic link between groundwater and surface water is recognized but understood only at a reconnaissance level even in the most studied basins in the world. The effects of groundwater use may be contained within national boundaries; however, the water laws of few states or provinces address groundwater management owing to the invisible nature of the resource or the technical challenges in predicting spatial and temporal changes in the groundwater system with increased use. Part of the problem is associated with recognizing the different types of aquifers; sand and gravel transmit and store groundwater differently than groundwater stored in fractured rocks or in karst. Sev-

eral scholars underscore that current international law does not adequately define groundwater, much less the spatial flow of groundwater (43–46).

Disparities between riparian nations—whether in economic development, infrastructural capacity, or political orientation—add further complications to water resources development, institutions, and management. As a consequence, development, treaties, and institutions are regularly seen as, at best, inefficient, often ineffective, and, occasionally, as a new source of tensions themselves.

There is room for optimism, though, notably in the global community's record of resolving water-related disputes along international waterways. For example, the record of acute conflict over international water resources is overwhelmed by the record of cooperation. Despite the tensions inherent in the international setting, riparians have shown tremendous creativity in approaching regional development, often through preventive diplomacy, and the creation of "baskets of benefits," which allow for positive-sum, integrative allocations of joint gains. Moreover, the most vehement enemies around the world either have negotiated water sharing agreements, or are in the process of doing so as of this writing, and once cooperative water regimes are established through treaty, they turn out to be impressively resilient over time, even between otherwise hostile riparians and even as conflict is waged over other issues. Violence over water does not seem strategically rational, hydrographically effective, or economically viable. Shared interests along a waterway seem to consistently outweigh water's conflict-inducing characteristics.

POLITICAL TENSIONS AND COSTS OF NONCOOPERATION

So if there is little violence between nations over their shared waters, what is the problem? Is water actually a security concern at all? In fact, there are a number of issues where water causes or exacerbates tensions, and it is worth

GAP: Turkish acronym for Southeast Anatolia Project

understanding these processes to know both how complications arise and how they are eventually resolved. Noncooperation costs result primarily in inefficient water management, leading to decreasing water quantity, quality, and environmental health. But political tensions can also be impacted, leading to years or even decades of efficient, cooperative futures lost. (See also the section on Regional Instability in this review for related impacts.)

Tensions and Time Lags: Causes for Concern

The first complicating factor is the time lag between when nations first start to impinge on each other's water planning and when agreements are finally, arduously reached. A general pattern has emerged for international basins over time. Riparians of an international basin implement water development projects unilaterally—first on water within their own territory, in attempts to avoid the political intricacies of the shared resource. At some point, one of the riparians, generally the regional power, will implement a project that impacts at least one of its neighbors. This might be to continue to meet existing uses in the face of decreasing relative water availability [as, for example, Egypt's plans for a high dam on the Nile (47, 48) or Indian diversions of the Ganges to protect the port of Calcutta (49, 50)] or to meet new needs reflecting new agricultural policy, such as Turkey's GAP (Turkish acronym for Southeast Anatolia Project) project on the Euphrates (51). In the absence of relations or institutions conducive to conflict resolution, the project can become a flashpoint, heightening tensions and regional instability, and requiring years or, more commonly, decades to resolve—the Indus treaty took 10 years of negotiations, the Ganges 30, and the Jordan 40—and, all the while, water quality and quantity degrades to where the health of dependent populations and ecosystems are damaged or destroyed.

This problem gets worse as the dispute gains in intensity; one rarely hears talk about

the ecosystems of the lower Nile, the lower Jordan, or the tributaries of the Aral Sea; they have effectively been written off to the vagaries of human intractability. During such periods of low-level tensions, threats and disputes rage across boundaries with relations as diverse as those between Indians and Pakistanis and between Americans and Canadians. Water was the last and most contentious issue resolved in negotiations over a 1994 peace treaty between Israel and Jordan and was relegated to “final status” negotiations—along with other of the most difficult issues such as Jerusalem and refugees—between Israel and the Palestinians (52, 53).

The timing of water flow is also important; thus, the operation of dams is also contested. For example, upstream users might release water from reservoirs in the winter for hydropower production, whereas downstream users might need it for irrigation in the summer. In addition, water quantity and water flow patterns are crucial to maintaining freshwater ecosystems that depend on seasonal flooding. Freshwater ecosystems perform a variety of ecological and economical functions and often play an important role in sustaining livelihoods, especially in developing countries. As awareness of environmental issues and the economic value of ecosystems increases, claims for the environment's water requirements are growing. For example, in the Okavango basin, Botswana's claims for water to sustain the Okavango Delta and its lucrative ecotourism industry have contributed to a dispute with upstream Namibia, which wants to use the water passing through the Caprivi Strip on its way to the delta for irrigation (54, 55).

Water quality problems include excessive levels of salt, nutrients, or suspended solids. Salt intrusion can be caused by groundwater overuse or insufficient freshwater flows into estuaries. For example, dams in the South African part of the Incomati River basin reduced freshwater flows into the Incomati estuary in Mozambique and led to increased salt levels (56). This altered the estuary's

ecosystem and led to the disappearance of salt-intolerant flora and fauna important for people's livelihoods (the links between loss of livelihoods and the threat of conflict are described below).

Excessive amounts of nutrients or suspended solids can result from unsustainable agricultural practices, eventually leading to erosion. Nutrients and suspended solids pose a threat to freshwater ecosystems and their use by downstream riparians, as they can cause eutrophication and siltation, respectively, which, in turn, can lead to loss of fishing grounds or arable land. Suspended solids can also cause the siltation of reservoirs and harbors; for example, Rotterdam's harbor had to be dredged frequently to remove contaminated sludge deposited by the Rhine River. The cost was enormous and consequently led to conflict over compensation and responsibility among the river's users. Although negotiations led to a peaceful solution in this case, without such a framework for dispute resolution, siltation problems can lead to upstream/downstream disputes such as those in the Lempa River basin in Central America (57).

Overcoming the Costs of Noncooperation: From Rights to Needs to Interests

Most of the international negotiations surveyed are hamstrung for so long primarily

because of entrenched and contradictory opening positions. Generally, parties base their initial positions in terms of rights—the sense that a riparian is entitled to a certain allocation based on hydrography or chronology of use. Upstream riparians often invoke some variation of the Harmon Doctrine, claiming that water rights originate where the water falls. India claimed absolute sovereignty in the early phases of negotiations over the Indus Waters Treaty, as did France in the Lac Lanoux case, and Palestine over the West Bank aquifer. Downstream riparians often claim absolute river integrity, claiming rights to an undisturbed system or, if on an exotic stream, historic rights on the basis of their history of use. Spain insisted on absolute sovereignty regarding the Lac Lanoux project (58), whereas Egypt claimed historic rights against first Sudan, and later Ethiopia, on the Nile (59).

In almost all of the disputes that have been resolved, however, particularly on arid or exotic streams, the paradigms used for negotiations have not been rights based at all—neither on relative hydrography nor specifically on chronology of use, but rather needs based. Needs are defined by irrigable land, population, or the requirements of a specific project. (See **Table 1** for examples of needs-based criteria.) In agreements between Egypt and Sudan signed in 1929 and in 1959, for example, allocations were arrived at on

Table 1 Examples of needs-based criteria

Treaty	Criteria for allocations
Egypt/Sudan (1929, 1959, Nile)	Acquired rights from existing uses, plus even division of any additional water resulting from development projects
Johnston Accord (1956, Jordan)	Amount of irrigable land within the watershed in each country
India/Pakistan (1960, Indus)	Historic and planned use (for Pakistan) plus geographic allocations (western versus eastern rivers)
South Africa (southwest Africa)/Portugal (Angola) (1969, Kunene)	Allocations for human and animal needs as well as initial irrigation
Israel-Palestinian Interim Agreement (1995, shared aquifers)	Population patterns and irrigation needs

the basis of local needs, primarily those of agriculture. Egypt argued for a greater share of the Nile because of its larger population and extensive irrigation works. In 1959, Sudan and Egypt then divided future water from development equally between the two. Current allocations of 55.5 billion cubic meters (BCM)/year for Egypt and 18.5 BCM/year for Sudan reflect these relative needs (59).

Likewise along the Jordan River, the only water agreement for that basin ever negotiated (although not ratified) until very recently, the Johnston Accord, emphasized the needs rather than the inherent rights of each of the riparians. Johnston's approach, on the basis of a report performed under the direction of the Tennessee Valley Authority, was to estimate, without regard to political boundaries, the water needs for all irrigable land within the Jordan Valley basin that could be irrigated by gravity flow (60, 61). National allocations were then based on these in-basin agricultural needs, with the understanding that each country could then use the water as it wished, including to divert it out of basin. This was not only an acceptable formula to the parties at the time, but it also allowed for a breakthrough in negotiations when a land survey of Jordan concluded that its future water needs were lower than previously thought. Years later, Israel and Palestine came back to needs in the Interim Agreement of 1995, whereby Israel first recognized Palestinian water rights on the West Bank—a formula for agriculture and per capita consumption that determined future Palestinian water needs at 70–80 million cubic meters (MCM)/year, and Israel agreed to provide 28.6 MCM/year toward those needs (62).

Needs are the most prevalent criteria for allocations along arid or exotic streams outside of the Middle East as well. Allocations of the Rio Grande/Rio Bravo and the Colorado between Mexico and the United States are based on Mexican irrigation requirements; Bangladeshi requirements determined the allocations of the Ganges, and Indus negotiations deferred to Pakistani projects (although

estimates of needs are still disputed and changing, particularly in these latter two examples) (63).

From the global experience in determining needs, it is not apparent that any criterion is necessarily more effective than any other—a measure that is determined in dialog between riparians by definition generates more buy in than one imposed from outside (although neutral third parties have often provided the technology to help quantify needs). Moreover, once the needs-based allocations are determined, not only is it not generally required that water actually be applied to those needs, but specific allocations are generally not readjusted, despite the fact that needs change drastically over time. For example, the Johnston Accord determined allocations on the basis of potential gravity-fed irrigated agriculture within the Jordan basin. Once the numbers were derived, and Jordan and Israel implicitly agreed, Israel applied most of its allocation to other uses entirely, many of them outside of the basin. Jordan and Israel adhere to the Johnston allocations to this day, in spite all of the dramatic changes to all water-related parameters within the basin over the past 50 years.

One might speculate as to why negotiations move from rights-based to needs-based criteria for allocation. The first reason may have something to do with the psychology of negotiations. Rothman (64), among others, points out that negotiations ideally move along three stages: the adversarial stage, where each side defines its positions, or rights; the reflexive stage, where the needs of each side bringing them to their positions is addressed; and finally, to the integrative stage, where negotiators brainstorm together to address each side's underlying interests. The negotiations here seem to follow this pattern from rights to needs and, occasionally, to interests. Although each negotiator may initially see him- or herself as Egyptian or Israeli or Indian and the rights of one's own country are paramount, over time one must empathize to some degree and to notice that even one's

enemy (be he or she Sudanese, Palestinian, or Pakistani) requires the same amount of water for the same use with the same methods as oneself.

The second reason for the shift from rights to needs may simply be that rights are not quantifiable and needs are. We have seen the vague guidance that the 1997 Convention (65) provides for allocations—a series of occasionally conflicting parameters—that are to be considered as a whole. If two nations insist on their respective rights of upstream versus down, for example, there is no spectrum along which to bargain; no common frame of reference. One can much more readily determine a needs-based criterion—irrigable land or population, for example—and quantify each nation's needs. Even with differing interpretations, once both sides feel comfortable that their minimum quantitative needs are being met, talks eventually turn to straightforward bargaining over numbers along a common spectrum (66, 67).

From Rights and Needs to Interests: Baskets of Benefits

One productive approach to the development of transboundary waters has been to move past rights and needs entirely and to examine the benefits in the basin from a regional approach. This has regularly required the riparians to go beyond looking at water as a commodity to be divided—a zero-sum, rights-based approach—and to develop an approach that equitably allocates not the water but the benefits derived therefrom—a positive-sum, integrative approach. The boundary waters agreement between the United States and Canada, for example, allocates water according to equal benefits, usually defined by hydropower generation. This results in the seemingly odd arrangement that power may be exported out of basin for gain, but the water itself may not. In the 1964 treaty on the Columbia, an arrangement was worked out whereby the United States paid Canada for the benefits of flood control, and Canada

was granted rights to divert water between the Columbia and Kootenai rivers for hydropower. Likewise, the 1975 Mekong accord defines *equality of right* not as equal shares of water but as equal rights to use water on the basis of each riparian's economic and social needs. The relative nature of beneficial uses is exhibited in a 1950 agreement on the Niagara, flowing between the United States and Canada, which provides a greater flow over the famous falls during “show times” of summer daylight hours, when tourist dollars are worth more per cubic meter than the alternate use in hydropower generation (68).

In many water-related treaties, water issues are dealt with alone, separate from any other political or resource issues between countries—water qua water. By separating the two realms of “high” (political) and “low” (resource economical) politics or by ignoring other resources that might be included in an agreement, some have argued, the process is either likely to fail, as in the case of the 1956 Johnston Accord on the Jordan, or more often to achieve a suboptimum development arrangement, as is currently the case on the Indus agreement, signed in 1960. Increasingly, however, linkages are being made between water and politics as well as between water and other resources. These multiresource linkages may offer more opportunities for the generation of creative solutions, allowing for greater economic efficiency through a basket of benefits (69).

VULNERABILITY, RESILIENCE, AND THE IMPACTS OF TENSIONS

Understanding the indicators of conflict and cooperation is a critical prerequisite both to designing resilient institutions and to developing monitoring mechanisms to identify future tensions. Vulnerable basins are at particular risk of tensions, but programs of institutional capacity building can help mitigate the potential impacts of rapid change.

Hydropolitical resilience: the complex human-environmental system's ability to adapt to permutations and change within these systems

Hydropolitical vulnerability: the risk of political dispute over shared water systems

RBO: River Basin Organization

Indicators of Hydropolitical Resilience and Vulnerability

In general, concepts of resilience and vulnerability as related to water resources are often assessed within the framework of sustainability (e.g., 70) and relate to the ability of bio-physical systems to adapt to change (e.g., 71). As the sustainability discourse has broadened to include human systems in recent years, so too has work been increasingly geared toward identifying indicators of resilience and vulnerability within this broader context (e.g., 72–74). In parallel, dialog on security has migrated from traditional issues of war and peace to also begin incorporating the human-environment relationship in the relatively new field of environmental security (see 75, 76).

The term *hydropolitics* (coined in Reference 59) is the result of substantial attention to the potential for conflict and violence to erupt over international waters and relates to the ability of geopolitical institutions to manage shared water resources in a politically sustainable manner, i.e., without tensions or conflict between political entities. *Hydropolitical resilience* is defined as the complex human-environmental system's ability to adapt to permutations and change within these systems, and *hydropolitical vulnerability* is defined by the risk of political dispute over shared water systems. Wolf et al. (27), suggested the following relationship between change, institutions, and hydropolitical vulnerability, "The likelihood of conflict rises as the rate of change within the basin exceeds the institutional capacity to absorb that change."

This suggests that there are two sides to the dispute setting: the rate of change in the system and the institutional capacity. In general, most of the parameters regularly identified as indicators of water conflict are actually only weakly linked to the dispute. Institutional capacity within a basin, however, whether defined as water management bodies or treaties or generally positive international relations, is as important, if not more so, than the physical aspects of a system. It turns out, then,

that very rapid changes, either on the institutional side or in the physical system, that outpace the institutional capacity to absorb those changes are at the root of most water conflicts. For example, the rapid institutional change in internationalized basins, i.e., basins that include the management structures of newly independent states, has resulted in disputes in areas formerly under British administration (e.g., the Nile, Jordan, Tigris-Euphrates, Indus, and Ganges-Brahmaputra) as well as in the former Soviet Union (e.g., the Aral tributaries and the Kura-Araks). On the physical side, rapid change most outpaces institutional capacity in basins that include unilateral development projects and the absence of cooperative regimes [such as treaties, river basin organizations (RBOs), or technical working groups] or when relations are especially tenuous over other issues (27).

The general assumption, then, is that rapid change tends to indicate vulnerability, whereas institutional capacity tends to indicate resilience, and the two sides need to be assessed in conjunction with each other for a more accurate gauge of hydropolitical sustainability. Building on these relationships, the characteristics of a basin that would tend to enhance resilience to change include

- International agreements and institutions, such as RBOs
- A history of collaborative projects
- Generally positive political relations
- Higher levels of economic development¹

In contrast, facets that would tend toward vulnerability would include

- Rapid environmental change

¹Higher levels of economic development enhance resilience because these countries can afford alternatives as water becomes relatively more scarce or degraded. In contrasting developing and developed countries, for example, whereas the former may struggle for a safe, stable supply of basic water resources, the latter might utilize greenhouses, expensive drip irrigation systems, bioengineered crops, or desalination.

- Rapid population growth or asymmetric economic growth
- Major unilateral development projects
- The absence of institutional capacity
- Generally hostile relations

Intranational Impacts of International Tensions

The subset of security issues of international tensions occur at the subnational level, with direct impact on ordinary communities (77). Much literature on transboundary waters treats political entities as homogeneous monoliths—“Canada feels . . .” or “Jordan wants . . .” Analysts are only recently highlighting the pitfalls of this approach, often by showing how different subsets of actors relate very different meanings to water. Rather than being simply another environmental input, water is regularly treated as a security issue, a gift of nature, or a focal point for local society. Disputes, therefore, need to be understood as more than simply over a quantity of a resource, but also over conflicting attitudes, meanings, and contexts. Throughout the world, local water issues revolve around core values, which often date back generations. Irrigators, indigenous populations, and environmentalists, for example, can see water as tied to their very ways of life that are increasingly threatened by newer uses for cities and hydropower (78, 79). Moreover, the local setting strongly influences international dynamics and vice versa (39, 77, 80, 81).

If there is a history of water-related violence, and there is, it is a history of incidents at the subnational level, generally between tribes, water-use sectors, or states/provinces. In fact, our recent research at Oregon State University suggests that, as the scale drops, the likelihood and intensity of violence goes up (82). There are many examples of internal water conflicts ranging from interstate violence and death along the Cauvery River in India (83, 84); to the United States, where California farmers blew up a pipeline meant for Los Angeles (85); to intertribal bloodshed

between Maasai herdsman and Kikuyu farmers in Kenya (86). The inland desert state of Arizona even commissioned a navy (made up of one ferryboat) and sent its state militia to stop a dam and diversion on the Colorado River in 1934 (87). (See **Table 2** for examples of water-related disputes.)

Another contentious issue is water quality, which is also closely linked to water quantity. Decreasing water quality can make it inappropriate for some uses, thereby aggravating its scarcity. In turn, decreasing water quantity concentrates pollution, and excessive water quantity, such as flooding, can lead to contamination by sewage. Low water quality can pose serious threats to human and environmental health. Water quality degradation is often a source of dispute between those who cause degradation and the groups affected by it. As pollution increasingly impacts livelihoods and the environment, water quality issues may lead to public protests.

One of the main reasons for decreasing water quality is pollution, e.g., through industrial and domestic wastewater or agricultural pesticides. In Tajikistan, for example, where environmental stress has been linked to civil war (1992–1997), high levels of water pollution have been identified as one of the key environmental issues threatening human development and security (8). Water pollution from the tanning industry in the Palar basin of the Indian state of Tamil Nadu makes the water within the basin unfit for irrigation and consumption. The pollution contributed to an acute drinking water crisis, which led to protests by the local community and activist organizations as well as to disputes and court cases between tanners and farmers (8).

Regional Instability: Political Dynamics of Loss of Irrigation Water

As water quality degrades—or quantity diminishes—over time, its effect on the stability of a region can be unsettling. For example, for 30 years the Gaza Strip was under Israeli occupation. Water quality

Table 2 Selected examples of water-related disputes^a

Main issue	
Location	Observation
Quantity	
Cauvery River, South Asia	The dispute on India's Cauvery River sprang from the allocation of water between the downstream state of Tamil Nadu, which had been using the river's water for irrigation, and upstream Karnataka, which wanted to increase irrigated agriculture. The parties did not accept a tribunal's adjudication of the water dispute; this led to violence and death along the river.
Mekong basin, Southeast Asia	Following construction of Thailand's Pak Mun Dam, more than 25,000 people were affected by drastic reductions in upstream fisheries and other livelihood problems. Affected communities have struggled for reparations since the dam was completed in 1994.
Okavango basin, southern Africa	In the Okavango River basin, Botswana's claims for water to sustain the delta and its lucrative ecotourism industry contribute to a dispute with upstream Namibia, which wants to pipe water passing through the Caprivi Strip to supply its capital city with drinking water.
Quality	
Rhine River, Western Europe	Rotterdam's harbor had to be dredged frequently to remove contaminated sludge deposited by the Rhine River. The cost was enormous and consequently led to controversy over compensation and responsibility among Rhine River users. Although the negotiations led to a peaceful solution, in areas that lack the Rhine's dispute resolution framework, siltation problems could lead to upstream/downstream arguments.
Quantity and quality	
Incomati River, southern Africa	Dams in the South African part of the Incomati River basin reduced freshwater flows and increased salt levels in Mozambique's Incomati estuary. This altered the estuary's ecosystem and led to the disappearance of salt-intolerant plants and animals that are important for people's livelihoods.
Timing	
Syr Dar'ya, Central Asia	Relations between Kazakhstan, Kyrgyzstan, and Uzbekistan—all riparians of the Syr Dar'ya, a major tributary of the disappearing Aral Sea—exemplify the problems caused by water flow timing. Under the Soviet Union's central management, spring and summer irrigation in downstream Uzbekistan and Kazakhstan balanced upstream Kyrgyzstan's use of hydropower to generate heat in the winter. But the parties are barely adhering to recent agreements that exchange upstream flows of alternate heating sources (natural gas, coal, and fuel oil) for downstream irrigation and sporadically breach the agreements.

^aReference 63.

deteriorated steadily, saltwater intrusion degraded local wells, and water-related diseases took a rising toll on the people living there. In 1987, the intifada, or Palestinian uprising, broke out in the Gaza Strip and quickly spread throughout the West Bank. Was water qual-

ity the cause? It would be simplistic to claim direct causality. Was it an irritant exacerbating an already tenuous situation? Undoubtedly (88).

An examination of relations between India and Bangladesh demonstrate that these

internal instabilities can be both caused and exacerbated by international water disputes. In the 1960s, India built a barrage at Farakka, diverting a portion of the Ganges flow away from its course into Bangladesh in an effort to flush silt away from Calcutta's seaport, some 100 miles to the south. In Bangladesh, the reduced flow from upstream resulted in a number of adverse effects: degraded surface and groundwater, impeded navigation, increased salinity, degraded fisheries, and endangered both water supplies and public health. Migration from affected areas further compounded the problem. Ironically, many of those displaced in Bangladesh have found refuge in India (89).

Two thirds of the world's water use is for agriculture, so when access to irrigation water is threatened, one result can be movement of huge populations of out-of-work, disgruntled men from the countryside to the cities—an invariable recipe for political instability. In pioneering work, S. Postel (unpublished) identified those countries that rely heavily on irrigation and whose agricultural water supplies are threatened either by a decline in quality or quantity. The list coincides precisely with the world community's current security concerns: India, China, Pakistan, Iran, Uzbekistan, Bangladesh, Iraq, and Egypt.

Water management in many countries is also characterized by overlapping and competing responsibilities among government bodies. Disaggregated decision making often produces divergent management approaches that serve contradictory objectives and lead to competing claims from different sectors. And such claims are even more likely to contribute to disputes in countries where there is no formal system of water-use permits or where enforcement and monitoring are inadequate. Controversy also often arises when management decisions are formulated without sufficient participation by local communities and water users, thus failing to take into account local rights and practices. Protests are especially likely when the public suspects that water allocations are diverting public resources

for private gain or when water-use rights are assigned in a secretive and possibly corrupt manner, as demonstrated by the violent confrontations in 2000 following the privatization of Cochabamba, Bolivia's water utility.

Finally, there is the human security issue of water-related disease. It is estimated that between 5 and 10 million people die each year from water-related diseases or inadequate sanitation. More than half the people in the world lack adequate sanitation. Eighty percent of disease in the developing world is related to water. This is a crisis of epidemic proportions, and the threats to human security are self-evident (2).

WATER AND INSTITUTIONS

The international community has long grappled with effective institutional arrangements for managing shared water resources. From the international to the local, grappling with the institutional implications of shared waters has taken many forms, from international declarations to guiding principles to treaties and local management.

Institutional Development— Contributions from the International Community²

Acknowledging the benefits of cooperative water management, the international community has long advocated institutional development in the world's international waterways and has focused considerable attention in the twentieth century on developing and refining principles of shared management. In 1911, the Institute of International Law published the Madrid Declaration on the International Regulation regarding the Use of International Watercourses for Purposes other than Navigation. The Madrid Declaration outlined certain basic principles of shared water management, recommending that coriparian states establish permanent joint

²This section draws from Reference 90.

UNCED: UN
Conference on
Environment and
Development

commissions and discouraging unilateral basin alterations and harmful modifications of international rivers. Expanding on these guidelines, the International Law Association developed the Helsinki Rules of 1966 on the Uses of Waters of International Rivers. Since then, international freshwater law has matured through the work of these two organizations as well as the United Nations and other governmental and nongovernmental bodies (66, 67).

The past decade, however, has witnessed a perhaps unprecedented number of declarations as well as organizational and legal developments to further the international community's objective of promoting cooperative river basin management. The decade began with the International Conference on Water and the Environment in the lead-up to the 1992 UN Conference on Environment and Development (UNCED) in Rio. Subsequently, actions taken by the international community have included the pronouncement of non-binding conventions and declarations, the creation of global water institutions, and the codification of international water principles. Although clearly more work is required, these initiatives have not only raised awareness of the myriad issues related to international water resource management, but also have led to the creation of frameworks in which the issues can be addressed.

Conventions, Declarations, and Organizational Developments

The 1992 UNCED served as a forum for world policy makers to discuss problems of the environment and development. As such, management of the world's water resources was only one of several topics addressed. Water was, however, the primary focus of the International Conference on Water and the Environment (ICWE), a preparatory conference held in advance of the Rio Earth Summit. The ICWE participants, representing governmental and nongovernmental organizations, developed a set of policy

recommendations outlined in the Conference's Dublin Statement on Water and Sustainable Development, which the drafters entrusted to the world leaders gathering in Rio for translation into a plan of action. Although covering a range of water resource management issues, the Dublin Statement specifically highlights the growing importance of international transboundary water management and encourages greater attention to the creation and implementation of integrated water management institutions endorsed by all affected basin states. Moreover, the drafters outlined certain essential functions of international water institutions including "reconciling and harmonizing the interests of riparian countries, monitoring water quantity and quality, development of concerted action programmes, exchange of information, and enforcing agreements" (91).

At the Rio Conference, water resource management was specifically addressed in Chapter 18 of Agenda 21, a nonbinding action plan for improving the state of the globe's natural resources in the twenty-first century adopted by UNCED participants. The overall goal of Chapter 18 is to ensure that the supply and quality of water is sufficient to meet both human and ecological needs worldwide, and measures to implement this objective are detailed in the Chapter's ambitious seven-part action plan. Although transboundary water resource management is mentioned in Chapter 18, few specific and substantive references are made to water resource issues at the international scale. The Rio Conference did, however, generate a number of activities concerning freshwater management in general, with implications for international transboundary water management (92).

One result of the Rio Conference and Agenda 21 has been an expansion of international freshwater resource institutions and programs. The World Water Council, a self-described "think tank" for world water resource issues, for example, was created in 1996 in response to recommendations from the Rio Conference. Since its inception, the

World Water Council has hosted three World Water Forums—gatherings of government, nongovernment, and private agency representatives to discuss and collectively determine a vision for the management of water resources over the next quarter century. These forums have led to the creation of the World Water Vision, a forward-looking declaration of philosophical and institutional water management needs, as well as the creation of coordinating and implementing agencies such as the World Commission on Water for the 21st Century and the Global Water Partnership. The Second World Water Forum also served as the venue for a ministerial conference in which the leaders of participating countries signed a declaration concerning water security in the twenty-first century. The recent World Summit on Sustainable Development (WWSN) has helped to sustain the momentum of these recent global water initiatives. In the Johannesburg Declaration on Sustainable Development, delegates at the WWSN reaffirmed a commitment to the principles contained in Agenda 21 and called upon the United Nations to review, evaluate, and promote further implementation of this global action plan (92).

Through these meetings, the international community has reinforced its commitment to satisfy the water quality and quantity requirements of the global population and its surrounding environment and has identified attendant tasks and policy measures needed to fulfill its pledge. Although many of strategies in Agenda 21 and subsequent statements are directed primarily at national water resources, their relevance extends to international transboundary waters. In fact, the Ministerial Declaration at the Second World Water Forum included “sharing water” (between different users and states) as one of its seven major challenges to achieving water security in the twenty-first century. Many of the other six challenges, which include meeting basic needs, securing the food supply, protecting the ecosystem, managing risks, valuing water, and governing water wisely, are also applica-

ble to waters in an international setting. Furthermore, policy measures prescribed by the international community to build greater institutional capacity, such as integrated water resource management, expanded stakeholder participation, and improved monitoring and evaluation schemes, are likewise important components of **international watercourse** management.

The large meetings are also spawning critiques, mainly by some donors and selected international nongovernmental organizations (NGOs), as becoming too large and numerous (for example, 93, 94). At the same time many local NGOs, although also criticizing the meetings, are quick to add that it may be better to err on the side of too many than too few meetings because they have become places where local NGOs have been able to interact with the so-called “world water elite” and visa versa. Indeed, the meetings seem to echo what has been happening within countries. There is increasing awareness that “water people” alone will not deal with these problems and that more and different types of stakeholders must be involved. In addition, politicians interact more with professionals. Indeed, for many years, the world water meetings were mostly run and attended by water professionals. The large meetings have begun to change this to reflect the broader trends occurring within countries. The Fourth World Water Forum emphasized implementing local actions and spawned a movement to identify and monitor these actions. It remains to be seen whether the professional water community can accept this.

Like Agenda 21, however, none of these post-Rio statements or declarations focuses exclusively on international freshwater sources. Additionally, despite the efforts over the past decade to expand global institutional capacity over freshwater resources, no supranational agency exists to manage transboundary resources globally. Thus, although many of the principles of national water management apply to international waters, the political, social, and economic

dynamics associated with waters shared between sovereign states can require special consideration.

Legal Principles

There is a vast and growing literature on international water law (see, for example, the excellent summaries in References 66, 67, 95–97. Wouters and her team (98) at the University of Dundee have created a Legal Assessment Model to help countries develop transboundary institutions. According to Cano (99), international water law was not substantially formulated until after World War I. Since that time, organs of international law have tried to provide a framework for increasingly intensive water use, focusing on general guidelines that could be applied to the world's watersheds. These general principles of customary law, codified and progressively developed by advisory bodies and private organizations, are not intended to be legally binding in and of themselves, but they can provide evidence of customary law and may help crystallize that law. Wouters (P. Wouters, personal communication, 2003) notes that, "Customary law is not 'soft law,' even though it might be found in codification efforts of NGOs or even the ILC rules. Customary laws are rules of international law and considered as sources." It is tempting to look to these principles for clear and binding rules, but it is more accurate to think in terms of guidelines for the process of conflict resolution: "(T)he principles (of customary law) themselves derive from the process and the outcomes of the process rather than prescribe either the process or its outcome" (J. Dellapenna, personal communication, 1997).

The UN Convention on the Law of the Non-Navigational Uses of International Watercourses (UN Convention), adopted in 1997 by the UN General Assembly, is one post-Rio accomplishment that specifically focuses on international transboundary water resources (65). The UN Convention codifies many of the principles deemed essential

by the international community for the management of shared water resources, such as equitable and reasonable utilization of waters with specific attention to vital human needs, protection of the aquatic environment, and the promotion of cooperative management mechanisms. The document also incorporates provisions concerning data and information exchange and mechanisms for conflict resolution. Once ratified, the UN Convention will provide a legally binding framework, at least upon its signatories, for managing **international watercourses**. Even without ratification, its guidelines are being increasingly invoked in international forums.

The UN's approval of the Convention, however, does not entirely resolve many legal questions concerning the management of internationally shared waters. First, the Convention would technically only be binding on those nations that have ratified or consented to be bound by the agreement. To date, five years after its adoption by the UN General Assembly, only 14 countries are party to the UN Convention, well below the requisite 35 instruments of ratification, acceptance, accession, or approval needed to bring the Convention into force (100).

Second, international law only guides conduct between sovereign nations. Thus, grievances of political units or ethnic groups within nations over the domestic management of international waterways would not be addressed. Third, although the Convention offers general guidance to coriparian states, its vague, and occasionally contradictory, language can result in varied, and indeed conflictive, interpretations of the principles contained therein. As stated by Biswas (101), the "vague, broad, and general terms" incorporated in the UN Convention "can be defined, and in certain cases quantified, in a variety of different ways." Fourth, there is no practical enforcement mechanism to back up the Convention's guidance. The International Court of Justice (ICJ), for example, hears cases only with the consent of the parties involved and only on very specific legal points.

Moreover, in its 55-year history, the Court has decided only one case, apart from those related to boundary definitional disputes, pertinent to international waters—that of the Gabčíkovo-Nagymaros Project on the Danube between Hungary and Slovakia in 1997.³ Finally, the Convention only addresses those groundwater bodies that are connected to surface water systems, i.e., unconfined aquifers, yet several nations are already beginning to tap into confined groundwater systems, many of which are shared across international boundaries. Nevertheless, and despite the fact that the process of ratification is moving extremely slowly, the Convention's common acceptance, and the fact that the ICJ referred to it in its decision on the 1997 case on the Gabčíkovo Dam, gives the Convention increasing standing as an instrument of customary law (102).

Institutional Lessons for the International Community

A review of international water relations and institutional development over the past 50 years provides important insights into water conflict and the role of institutions. The historical record of water conflict and cooperation suggests that international watercourses can cause tensions between coriparian states, but acute violence is the exception rather than the rule. A much more likely scenario is that a gradual decline in water quantity or quality, or both, affects the internal stability of a nation or region, which may in turn impact the international arena. Early coordination among riparian states, however, can serve to ameliorate these sources of friction.

The centrality of institutions both in preventive hydrodiplomacy and in effective transboundary water management cannot be overemphasized. Yet, although progress is in-

deed apparent, the past 50 years of treaty writing suggests that capacity-building opportunities still remain. Many international basins are without any type of cooperative management framework, and even where institutions do exist, the post-Rio treaty record highlights a number of remaining weaknesses. Thus, in combination with its existing efforts, the international community might consider focusing more attention on the specific institutional needs of individual basin communities by assisting riparian states in the development of cooperative management networks that take into account the following key factors:

1. Adaptable management structure. Effective institutional management structures incorporate a certain level of flexibility, allowing for public input, changing basin priorities, and adding new information and monitoring technologies. The adaptability of management structures must also extend to nonsignatory riparians, by incorporating provisions addressing their needs, rights, and potential accession.
2. Clear and flexible criteria for water allocations and water quality management. Allocations, which are at the heart of most water disputes, are a function of water quantity and quality, as well as political fiat. Thus, effective institutions must identify clear allocation schedules and water quality standards that simultaneously provide for extreme hydrological events; new understanding of basin dynamics, including groundwater reserves; and changing societal values. Additionally, riparian states may consider prioritizing uses throughout the basin. Establishing catchment-wide water precedents may not only help to avert interriparian conflicts over water use, but also protect the environmental health of the basin as a whole.
3. Equitable distribution of benefits. Distributing water benefits, a concept that is subtly yet powerfully different than

³The ICJ was established in 1946 with the dissolution of its predecessor agency, the Permanent Court of International Justice. This earlier body did rule on four international water disputes during its existence from 1922–1946.

pure water allocation, is at the root of some of the world's most successful institutions. The idea concerns the distribution of benefits from water use—whether from hydropower, agriculture, economic development, aesthetics, or the preservation of healthy aquatic ecosystems—not the water itself. Distributing benefits allows for positive-sum agreements, occasionally including even nonwater-related gains in a basket of benefits, whereas dividing the water itself only allows for winners and losers.

4. Concrete mechanisms to enforce treaty provisions. Once a treaty is signed, successful implementation is dependent not only on the actual terms of the agreement but also on an ability to enforce those terms. Appointing oversight bodies with decision making and enforcement authority is one important step toward maintaining cooperative management institutions.
5. Detailed conflict resolution mechanisms. Many basins continue to experience disputes even after a treaty is negotiated and signed. Thus, incorporating clear mechanisms for resolving conflicts is a prerequisite for effective, long-term basin management.

WATER CONFLICT AND COOPERATION

In order to cut through the prevailing anecdotal approach to the history of water conflicts, researchers at Oregon State University undertook a three-year research project, which attempted to compile a dataset of every reported interaction between two or more nations, whether conflictive or cooperative, that involved water as a scarce and/or consumable resource or as a quantity to be managed, i.e., where water was the driver of the events, over the past 50 years (27). Excluded were events where water is incidental to the dispute, such as those concerning fishing rights, access to ports, transportation, or river boundaries.

Also excluded were events where water is not the driver, such as those where water is a tool, target, or victim of armed conflict. (Please see **Figure 2** for instances of conflict and cooperation.) The study documented a total of 1831 interactions, both conflictive and cooperative, between two or more nations over water during the past five decades and found the following:

First, despite the potential for dispute in international basins, the record of acute conflict over international water resources is historically overwhelmed by the record of cooperation. During those 50 years, there were only 37 acute disputes (those involving violence); of those, 30 were between Israel and one or another of its neighbors, and the violence ended in 1970. Non-Mideast cases accounted for only five acute events, and during the same period, 157 treaties were negotiated and signed. In fact, the only water war between nations on record occurred over 4500 years ago between the city-states of Lagash and Umma in the Tigris-Euphrates basin (40, 103).

The total number of water-related events between nations of any magnitude are likewise weighted toward cooperation—507 conflict-related events, versus 1228 cooperative events—implying that violence over water is neither strategically rational, hydrographically effective, nor economically viable.

Second, despite the occasional fiery rhetoric of politicians—perhaps aimed more often at their own constituencies than at the enemy—most actions taken over water are mild. Of all the events, some 43% fell between mild verbal support and mild verbal hostility. If the next level on either side—official verbal support and official verbal hostility—is added in, the share of verbal events reaches 62% of the total. Thus, almost two thirds of all events were only verbal, and more than two thirds of those had no official sanction (27).

Third, there were more issues of cooperation than of conflict. The distribution of cooperative events covered a broad spectrum, including water quantity, quality,

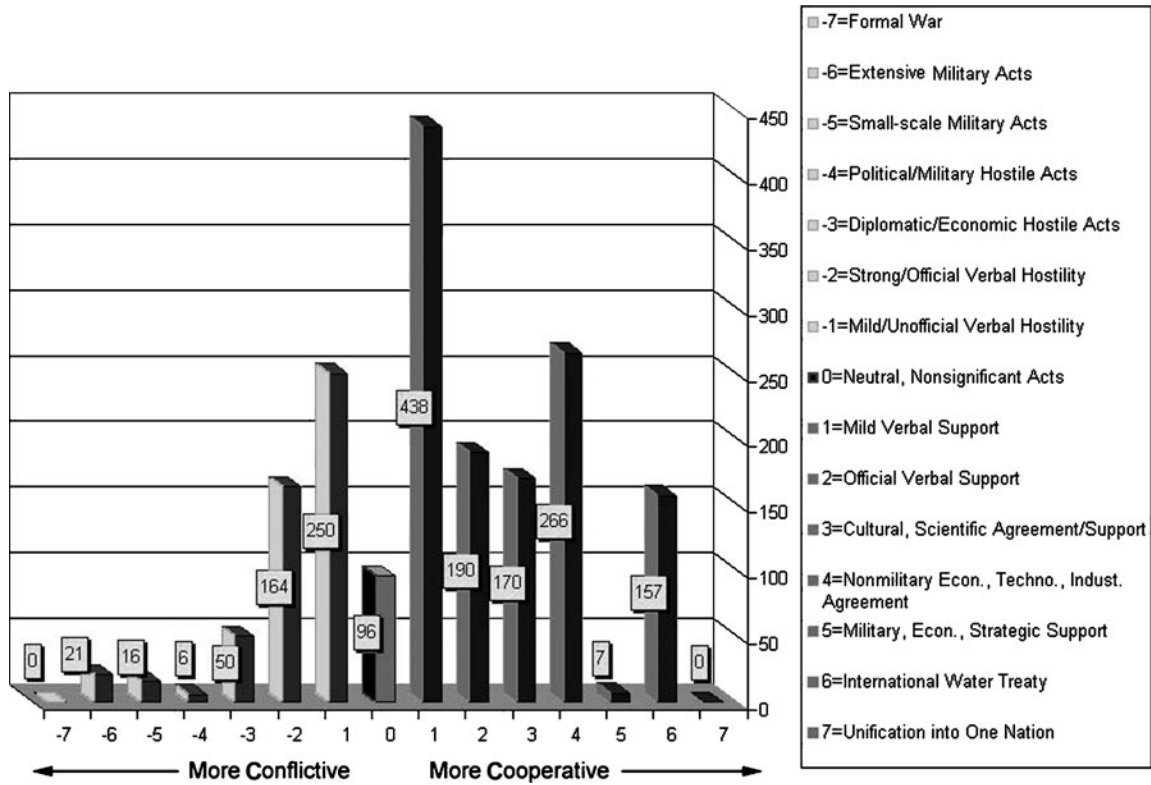


Figure 2
Number of events by BAR scale.

economic development, hydropower, and joint management. In contrast, almost 90% of the conflict-laden events related to quantity and infrastructure. Furthermore, almost all extensive military acts (the most extreme cases of conflict) fell within these two categories.

Fourth, despite the lack of violence, water acted as both an irritant and a unifier. As an irritant, water can make good relations bad and bad relations worse. Despite the complexity, however, international waters can act as a unifier in basins with relatively strong institutions.

This historical record suggests that international water disputes do get resolved, even among enemies, and even as conflicts erupt over other issues. Some of the world's most vociferous enemies have negotiated water agree-

ments or are in the process of doing so, and the institutions they have created often prove to be resilient, even when relations are strained.

The Mekong Committee, for example, established by the governments of Cambodia, Laos, Thailand, and Viet Nam as an intergovernmental agency in 1957, exchanged data and information on water resources development throughout the Viet Nam War (24, 104). Israel and Jordan have held secret "picnic table" talks on managing the Jordan River since the unsuccessful Johnston negotiations of 1953–1955, even though they were technically at war from Israel's independence in 1948 until the 1994 treaty (105). The Indus River Commission survived two major wars between India and Pakistan (106). And all 10 Nile basin riparian

countries are currently involved in senior government-level negotiations to develop the basin cooperatively (107), despite water wars rhetoric between upstream and downstream states.

GENERAL PRINCIPLES AND CONCLUSIONS

The vast experience of the international community and its shared water resources around the world offers lessons for effective, efficient, and equitable water resources management and strategies for resolving disputes or, better, in helping to avoid them altogether.

Lessons Learned

The most critical security lessons learned from the global experience in water security are as follows:

1. Water crossing international boundaries can cause tensions between nations that share the basin. Although the tension is not likely to lead to warfare, early coordination between riparians can help ameliorate the issue. Furthermore, water is a useful inducement to dialog and collaboration, even in settings of intense political tension.
2. Successful agreements move generally from thinking in terms of rights to needs and finally to interests, allowing for an equitable distribution of benefits. Whereas focusing on allocating water mires negotiators in a zero-sum game, thinking in terms of benefits allows riparians to move beyond the river, (and even beyond water) with new possibilities for the basket of benefits to be enhanced. Once international institutions are in place, they are tremendously resilient over time, even between otherwise hostile riparian nations, and even when there is conflict over other issues.
3. More likely than violent conflict occurring is a gradual decrease in water quan-

tity or quality, or both, which over time can affect the internal stability of a nation or region, and act as an irritant between ethnic groups, water sectors, or states/provinces. The resulting instability may have effects in the international arena.

4. The greatest threat of the global water crisis to human security comes from the fact that millions of people lack access to sufficient quantities of water at sufficient quality for their well-being.

Why Might the Future Look Nothing Like the Past?

Much of the work presented here is based partly on the assumption that we can tell something about the future by looking at the past. It is worth stopping at this point, then, and challenging the very foundation of that assumption: Why might the future look nothing at all like the past? What new approaches or technologies are on the horizon to change or ameliorate the risk to the basins we have identified, or even to change the whole approach to basins at risk?

By definition, a discussion of the future can not have the same empirical backing as a historical study—the data just do not yet exist. Yet there are cutting edge developments and recent trends, which, if one examined them within the context of this study, might suggest some possible changes in store for transboundary waters in the near future. What follows are four possibly fundamental changes in the way we approach transboundary waters.

New technologies for negotiation and management. Most analysis of international waters dates from the mid-1960s onward. In some ways, water management is very similar now as it was then (or, for that matter, as it was 5000 years ago). But some fundamental aspects are profoundly different. Although global water stresses are increasing, institutions are getting better and more resilient, management and understanding are

improving, and these issues are increasingly on the “radar screen” of global and local decision makers. But most importantly, the twenty-first century has access to new technology—including remote sensing and modeling capabilities and technologies as well as management practices that increase water-use efficiency, which could not be dreamed of in 1948 and adds substantially to the ability both to negotiate and to manage transboundary waters more effectively (108). Although new technologies and data cannot replace the political goodwill necessary for creative solutions, nor are they widely available outside the developed world, they can if appropriately deployed allow for more robust negotiations and greater flexibility in joint management.

Globalization: private capital, World Trade Organization, and circumvented ethics. Very little of the recent attention on globalization and the World Trade Organization (WTO) has centered on water resources, but there is a definite water component to these trends. One of the most profound is the shift of development funds from global and regional development banks such as the World Bank and the Asia Development Bank to private multinationals, such as Bechtel, Vivendi, and Ondeo (formally Lyonnaise des Eux) (for example, 109, 110). Development banks have, over the years, been susceptible to public pressures and ethics and, as such, have developed procedures for evaluating social and environmental impacts of projects and incorporating them in decision making. On international waters, each development bank has guidelines that generally prohibit development unless all riparians agree to the project, which in and of itself has promoted successful negotiations in the past. Private enterprises have no such restrictions, and nations eager to develop controversial projects have been increasingly turning to private capital to circumvent public ethics. The most controversial projects of the day—Turkey’s **GAP** project, India’s Narmada River project, and China’s Three Gorges Dam—are all

proceeding through the studied avoidance of development banks and their mores.

There is a more subtle effect of globalization, which has to do with the WTO and its emphasis on privatization and full cost recovery of investments. Local and national governments have traditionally implemented and subsidized water development systems to keep water prices down but are under increasing pressure from the forces of globalization to develop these systems through private companies. These large multinational water companies manage for profit and, if they use development capital, both push and are pushed to recover the full cost of their investment. This situation can translate not only into immediate and substantial rises in the cost of water, disproportionately affecting the poor, but also to greater eradication of local and indigenous management systems and cultures. If there is to be water-related violence in the future, it is much more liable to be like the “water riots” against a Bechtel development in Bolivia in 1999 than water wars across national boundaries.

As WTO rules are elaborated and negotiated, real questions remain as to how much of this process will be required of nations in the future, simply to retain membership in the organization. The commodification of water as a result of these forces is a case in point. Over the past 20 years, no global water policy meeting has neglected to pass a resolution, which, among other issues, defined water as an “economic good,” setting the stage at the 2000 World Water Forum for an unresolved showdown against those who would define water as a human or ecosystem right. The debate looms large over the future of water resources: If water is a commodity, and if WTO rules disallow obstacles to the trade of commodities, will nations be forced to sell their water? Although far-fetched now (even as a California company is challenging British Columbia over precisely such an issue under North American Free Trade Agreement rules), the globalization debate between market forces and social forces continues to

WTO: World Trade Organization

play out in microcosm in the world of water resources.

The geopolitics of desalination. Twice in the past 50 years—during the 1960s nuclear energy fervor and in the late 1980s, with discoveries in cold fusion—much of the world briefly thought it was on the verge of having access to close-to-free energy supplies. “Too cheap to meter” was the phrase during the Atoms for Peace Conference. Although neither the economics nor the technology finally supported these claims, it is not far-fetched to picture changes that could profoundly alter the economics of desalination.

The marginal cost of desalinated water (between US\$0.55 and US\$0.80/m³) makes it currently cost-effective only in the developed world where (a) the water will be used for drinking water; and (b) the population to whom the water will be delivered lives along a coast and at low elevations; and (c) there are no alternatives. The only places not so restricted are where energy costs are especially low, notably the Arabian Peninsula. A fundamental shift either in energy prices or in membrane technology could bring costs down substantially. If either happened to the extent that the marginal cost allowed for agricultural irrigation with sea water (around US\$.08/m³ on average), a large proportion of the world’s water supplies would shift from rivers and shallow aquifers to the sea (an unlikely, but plausible, scenario).

In addition to the fundamental economic changes that would result, geopolitical thinking of water systems would also need to shift.

Currently, there is inherent political power in being an upstream riparian, controlling the headwaters. In the scenario for cheap desalination above, that spatial position of power would shift from mountains to the valleys and from the headwaters to the sea. Many nations, such as Israel, Egypt, and Iraq currently dependent on upstream neighbors for their water supply would, by virtue of their coastlines, suddenly find roles reversed—again unlikely, but plausible.

The changing sources of water and the changing nature of conflict.

Both the worlds of water and of conflict are undergoing slow but steady changes that may obviate much of the thinking in this report. Lack of access to a safe, stable supply of water is reaching unprecedented proportions. Furthermore, as surface water supplies and easy groundwater sources are increasingly exploited throughout the world, two major changes result: Quality is steadily becoming a more serious issue to many than quantity, and water use is shifting to less traditional sources. Many of these sources—such as deep fossil aquifers, wastewater reclamation, and interbasin transfers—are not restricted by the confines of watershed boundaries, our fundamental unit of analysis in this review.

Conflict, too, is becoming less traditional, increasingly being driven by internal or local pressures, or more subtle issues of poverty and stability. The combination of changes, in water resources and in conflict, suggest that tomorrow’s water disputes may look very different from today’s.

DISCLOSURE STATEMENT

The author is not aware of any biases that might be perceived as affecting the objectivity of this review.

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