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Conflict and Cooperation Over Transboundary Waters

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Background Paper:
Conflict And Cooperation Over Transboundary Waters

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“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

Abstract

This paper surveys current thinking on the state of conflict and cooperation over transboundary water resources. Though the potential for outright war between countries over water is low, cooperation is also often missing in disputes over transboundary resources. This background paper examines the issue from environmental, political and human development perspectives. The paper will provide the conceptual basis for understanding cooperation and the costs of non-cooperation over water. It will:

- Provide a brief overview of the nature of conflict and experiences of cooperation over transboundary resources.
- Offer evidence, from different regions, on the potential costs of non-cooperation or even conflict over water resources. To the extent that establishing modes of cooperation over water takes time, it will evaluate the short and medium term implications.
- Analyze different models/examples of cases that countries have used to manage the competition for water resources. Compare and contrast cases such as, but not limited to, the Indus Treaty, Ganges-Brahmaputra basin and the Tigris-Euphrates basin.
- Indicate the possible triggers for conflict over water sharing and what implications that has on the livelihoods of ordinary communities.
- Evaluate in detail the role of institutions: how can institutional development be defined; what are the different categories of institutions and levels of operation;

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what role have they played and what successes have they had in different river and lake basins

- Analyze power asymmetries between riparian states and how they affect the outcomes of negotiations. Also, to what extent sub-national governance of local water resources impacts on neighboring countries and national level negotiations.
- Propose, to the extent possible, general principles and conclusions on conflict and cooperation, with clear policy objectives.

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 (United Nations, 1997). This increasing scarcity is made more complex because almost half the globe's land surface lies within international watersheds – that is, that land which contributes to the world's 263 transboundary waterways.

Both water quantity and water quality have been neglected to the point of catastrophe:

- 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." 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. Collectively, these issues provide compelling arguments for considering the security implications of water resources management.

Other papers in this series will speak to the human and ecological disasters attendant the global water crisis – essentially an ongoing deployment of a hydrological weapon of mass destruction. In conjunction with this crisis, though, come the political stresses which 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 which have developed over the years – between nations, between economic sectors, and between individuals and their environment. This paper speaks to how people have, and have not, dealt with hydro politics and their impacts.

Water Conflict and Cooperation

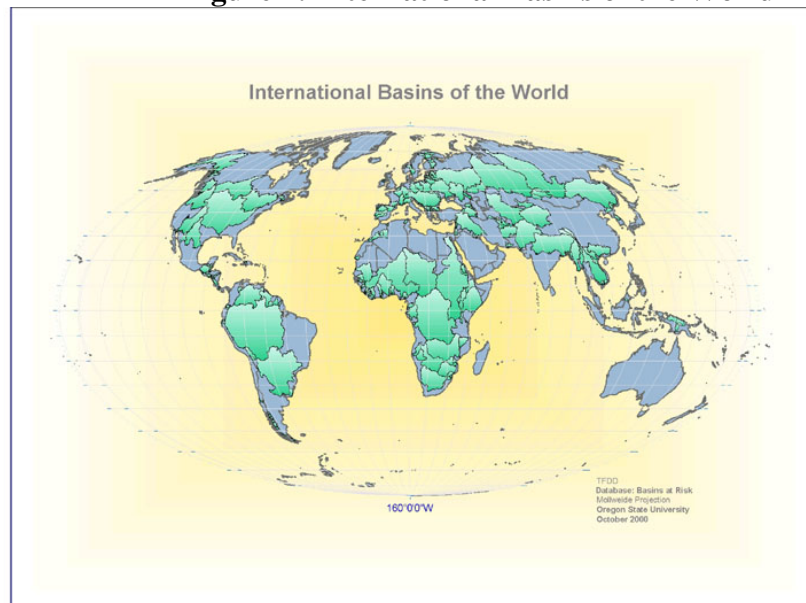
Water management is, by definition, conflict management. Water, unlike other scarce, consumable resources, is used to fuel all facets of society, from biology to economies to aesthetics and spiritual practice. Moreover, it fluctuates wildly in space and time, its management is usually fragmented, and 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 multi-objective and based on navigating competing

interests. Within a nation these interests include domestic users, agriculturalists, hydropower generators, recreators, 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.^b

Surface and groundwater that cross international boundaries present increased challenges to regional stability because hydrologic needs can often be overwhelmed by political considerations. While 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 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 (Wolf et al. 1999).

Figure 1: International Basins of the World

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,

^b The Register of International River Basins of the World (Wolf et al. 1999) defines a “river basin” as the area which 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 U.S. as a “watershed” and in the UK 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 system 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, parts of which are situated in different States [nations].

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, the last time any official body attempted to delineate them, and there are 263 today. The growth is largely the result of the "internationalization" 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 which fall within these watersheds. A total of 145 nations include territory within international basins. Twenty-one nations lie in their entirety within international basins; including these, 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.

A final way to visualize the dilemmas posed by international water resources is to look at the number of countries which 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 nine 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 five and eight riparian countries.

While 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.^c While the effects of groundwater use may be contained within national boundaries, the water laws of few states or provinces address groundwater management due 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. Both Matsumoto (2002), Puri and others (2001) and Puri (2003) underscore that current international law does not adequately define groundwater, much less the spatial flow of groundwater.

Disparities between riparian nations – whether in economic development, infrastructural capacity, or political orientation – add further complications to water resources

^c For a summary of international groundwater issues, see, "Jarvis, T., M. Giordano, S. Puri, K. Matsumoto, and A. Wolf. "International Borders, Ground Water Flow, and Hydroschizophrenia." *Ground Water*. Vol. 43 #5, Sept.-Oct. 2005., from where this paragraph is drawn.

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.

EVIDENCE, FROM DIFFERENT REGIONS, ON THE POTENTIAL COSTS OF NON-COOPERATION OR EVEN CONFLICT OVER WATER RESOURCES, WITH SHORT AND MIDTERM IMPLICATIONS

So if there is little violence between nations over their shared waters, what's 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 understanding these processes to know both how complications arise and how they are eventually resolved. Non-cooperation costs 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 foregone. (See also the section on Regional Instability in this paper 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,^d 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, or Indian diversions of the Ganges to protect the port of Calcutta, or to meet new needs reflecting new agricultural policy, such as Turkey's GAP project on the Euphrates. 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”

^d "Power" in regional hydropolitics can include riparian position, with an upstream riparian having more relative strength *vis a vis* the water resources than its downstream riparian, in addition to the more-conventional measures of military, political, and economic strength. Nevertheless, when a project is implemented which impacts one's neighbors, it is generally undertaken by the regional power, as defined by traditional terms, *regardless* of its riparian position.

negotiations—along with other of the most difficult issues such as Jerusalem and refugees—between Israel and the Palestinians.

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, while 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.

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. 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 (Lopez, 2004).

Non-cooperation effectively prohibits effective integrated watershed management, and the resulting impacts include both economic and non-economic costs:

Water quantity issues. Often, simply extrapolating water supply and demand curves will give an indication of when a conflict may occur, as the two curves approach each other and non-cooperation prohibits the search for effective solutions. The mid-1960's, a period of water conflict in the Jordan basin, saw demand approaching supply in both Israel and Jordan. Also, major shifts in supply might indicate likely conflict, due to greater upstream use or, in the longer range, to global change. The former is currently the case both on the Mekong and on the Ganges. Likewise, shifts in demand, due to new agricultural policies or movements of refugees or immigrants can indicate problems.

Water systems with a high degree of natural fluctuation can cause greater problems than relatively predictable systems.

Water quality issues. Any new source of pollution, or any new extensive agricultural developing resulting in saline return flow to the system, cannot be effectively mitigated in a state of non-cooperation. Arizona return flow into the Colorado was the issue over which Mexico sought to sue the USA in the 1960s through the International Court of Justice, and is currently a point of contention on the lower Jordan between Israel, Jordanians, and West Bank Palestinians.

Water-related disease. Non-cooperation also limits the effectiveness of responding to threats of water-related disease. It is estimated that between 5 - 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. While much of this devastation is internal to nations, non-cooperation on shared waters puts an effective barricade to addressing these issues at the border.

Management for multiple use. Water is managed for a particular use, or a combination of uses. A dam might be managed for storage of irrigation water, power generation, recreation, or a combination, for example. When the needs of riparians conflict, and there is no cooperative mechanism to dovetail interests, disputes are likely. Many upstream riparians, for instance, would manage the river within their territory primarily for hydropower where the primary needs of their downstream neighbors might be timely irrigation flows. Chinese plans for hydropower generation and/or Thai plans for irrigation diversions would have an impact on Vietnamese needs for both irrigation and better drainage in the Mekong Delta.

Political divisions. A common indicator of water conflict in a non-cooperative setting is shifting political divisions which reflect new riparian relations. Such has recently been the case throughout Central Europe as national water bodies, such as the Amu Dar'ya and the Syr Dar'ya, become international. Conflicts, including those on the Ganges, the Indus, and the Nile, took on international complications as the central authority of a hegemon, in these cases the British empire, dissipated.

Along with clues useful in anticipating whether or not water conflicts might occur, patterns based on past disputes in varying non-cooperative settings may provide lessons for determining both the type and intensity of impending conflicts. These indicators might include:

Geopolitical setting. As mentioned above, relative power relationships, including riparian position, determine how a conflict unfolds. A regional power which also has an upstream riparian position is in a greater situation to implement projects which may become flashpoints for regional conflict. Turkey and India have been in such positions on the Euphrates and the Ganges, respectively. In contrast, the development plans of an

upstream riparian may be held in check by a downstream power as, for example, have Ethiopia's plans for Nile development by Egypt.

The perception of unresolved non-water related issues with one's neighbors, both water-related and otherwise, is also an exacerbating factor in water conflicts. Israel, Syria, and Turkey, each and respectively have difficult political issues outstanding, which makes discussions on the Jordan and Euphrates more intricate.

Level of national development. Relative development can inform the nature of water disputes in a number of ways. For example, a more-developed region may have better options to alternative sources of water, or to different water management schemes, than less-developed regions, resulting in more options once negotiations begin. In the Middle East multilateral working group on water, for instance, a variety of technical and management options, such as desalination, drip irrigation, and moving water from agriculture to industry, have all been presented, which in turn supplement discussions over allocations of international water resources.

Different levels of development within a watershed, however, can exacerbate the hydropolitical setting. As a country develops, personal and industrial water demand tends to rise, as does demand for previously marginal agricultural areas. While this can be somewhat balanced by more access to water-saving technology, a developing country often will be the first to develop an international resource to meet its growing needs. Thailand has been making these needs clear with its relatively greater emphasis on Mekong development.

The hydropolitical issue at stake. In a survey of fourteen river basin conflicts, Mandel (1992) offers interesting insight relating the issue at stake with the intensity of a water conflict. He suggests that issues which include a border dispute in conjunction with a water dispute, such as the Shatt al-Arab waterway between Iran and Iraq and the Rio Grande between the US and Mexico, can induce more severe conflicts than issues of water quality, such as the Colorado, Danube, and La Plata rivers. Likewise, conflicts triggered by human-initiated technological disruptions -- dams and diversions -- such as the Euphrates, Ganges, Indus, and Nile, are more severe than those triggered by natural flooding, such as the Columbia and Senegal rivers.

One interesting lack of correlation is also found in Mandel's study -- that between the number of disputants and intensity of conflict. He suggests that this challenges the common notion that the more limited, in terms of number of parties involved, river disputes are easier to resolve.

Another surprising lack of correlation that we seem to be finding is, somewhat counter-intuitively, that climate seems not to be a major variable in water disputes. This fact may be because water has multiple uses, but these uses vary in critical importance, depending on climatic conditions. The hydropower or transportation offered by a river in a humid climate is no less important to its riparians than is the irrigation water provided by a river in an arid zone.

Institutional control of water resources. An important aspect of international water conflicts is how water is controlled *within* each of the countries involved. Whether control of the resource is vested at the national level, as in the Middle East, the state level, as in India, or at the sub-state level, as in the United States, informs the complication of international dialog. Also, *where* control is vested institutionally is important. In Israel, for example, the Water Commissioner for years was under the authority of the Ministry of Agriculture, whereas Jordanian control is at the ministerial level, with the Ministry of Water. These respective institutional settings can make internal political dynamics quite different for similar issues.

National water ethos. This term incorporates several somewhat ambiguous parameters together which determine how a nation "feels" about its water resources, which in turn can help determine how much it "cares" about a water conflict. Some factors of a water ethos might include:

- "mythology" of water in national history, eg. Has water been the "lifeblood of the nation?" Was the country built up around the heroic *fellah*? Is "making the desert bloom" a national aspiration? In most countries, in contrast, water plays little role in the national history.
- importance of water/food security in political rhetoric;
- relative importance of agriculture versus industry in the national economy.

Overcoming the Costs of Non-Cooperation: From Rights to Needs to Interests

Most 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. Up-stream 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. Down-stream riparians often claim absolute river integrity, claiming rights to an undisturbed system or, if on an exotic stream, historic rights based on their history of use. Spain insisted on absolute sovereignty regarding the Lac Lanoux project, while Egypt claimed historic rights against first Sudan, and later Ethiopia, on the Nile.

In almost all of the disputes which 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.^e [See Table 1 -- Examples of Needs-Based Allocations.] In agreements between

^e Here we distinguish between "rights" in terms of a sense of entitlement, and legal rights. Obviously, once negotiations lead to allocations, regardless of how they are determined, each riparian has legal "rights" to that water, even if the allocations were determined by "needs." The point is that it is generally easier to come to a joint definition of "needs" than it is of "rights."

Egypt and Sudan signed in 1929 and in 1959, for example, allocations were arrived at on the basis of local needs, primarily 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 BCM/yr. for Egypt and 18.5 BCM/yr. for Sudan reflect these relative needs (Waterbury 1979).^f

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 State
India/Pakistan (1960, Indus)	Historic and planned use (for Pakistan) plus geographic allocations (western vs. eastern rivers)
South Africa (Southwest Africa)/Portugal (Angola) (1969, Kunene)	Allocations for human and animal needs, and initial irrigation
Israel-Palestinian Interim Agreement (1995, shared aquifers)	Population patterns and irrigation needs

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, based on 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 which could be irrigated by gravity flow (Main 1953). 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 allowed for a break-through 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, where Israel first recognized Palestinian water rights on the West Bank -- a formula for agriculture and per capita consumption determined future Palestinian water needs at 70-80 MCM/yr. and Israel agreed to provide 28.6 MCM/yr. towards those needs.

^f It should be pointed out that not everyone's needs were considered in the Nile Agreements, which included only two of the ten riparian states -- Egypt and Sudan, both minor contributors to the river's flow. The notable exception to the treaty, and the one which might argue most adamantly for greater sovereignty, is Ethiopia, which contributes between 75-85% of the Nile's flow.

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 USA 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).

From the global experience in determining needs, it is not apparent that any criterion is necessarily more effective than any other – a measure which 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 based on 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, despite *all* of the dramatic changes to *all* water-related parameters within the basin over the last 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 (1995), 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. Where each negotiator may initially see him- or herself as Egyptian or Israeli or Indian, where the rights of one's own country are paramount, over time one must empathize to some degree 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 provide for allocations -- a series of occasionally conflicting parameters which 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.

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 rather the benefits in the basin from a regional approach. This has regularly required the riparians to get past looking at the water as a commodity to be divided – a zero-sum, rights-based approach – and rather to develop an approach which equitably allocates not the water, but the benefits derived therefrom – a positive-sum, integrative approach. The boundary waters agreement between the USA 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 where the USA paid Canada for the benefits of flood control and Canada was granted rights to divert water between the Columbia and Kootenai 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 USA 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.

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 which might be included in an agreement, some have argued, the process is either likely to fail, as in the case of the 1955 Johnston accords on the Jordan, or more often to achieve a sub-optimum development arrangement, as is currently the case on the Indus agreement, signed in 1960. Increasingly, however, linkages are being made between water and politics, between water and other resources. These multi-resource linkages may offer more opportunities for creative solutions to be generated, allowing for greater economic efficiency through a "basket" of benefits. Some resources which have been included in water negotiations include:

Financial resources. An offer of financial incentives is occasionally able to circumvent impasses in negotiations. World Bank financing helped resolve the Indus dispute, while UN-led investments help achieve the Mekong Agreement. Cooperation-inducing financing has not always come from outside of the region. Thailand helped finance a project in Laos, as did India in Pakistan, in conjunction with their respective watershed agreements. A provision of the Nile Waters Treaty has Egypt paying Sudan outright for water to which they both agreed Sudan had rights, but that it was not able to use.

Energy resources. One increasingly common linkage being made is that between water and energy resources. As noted above, in conjunction with the Mekong Agreement, Thailand helped fund a hydroelectric project in Laos in exchange for a proportion of the power to be generated. In the particularly elaborate 1986 Lesotho Highlands Treaty (LHWP), South Africa agreed to help finance a hydroelectric/water diversion facility in Lesotho -- South Africa acquired rights to drinking water for

Johannesburg, and Lesotho receives all of the power generated.^g Similar arrangements have been suggested in China on the Mekong, Nepal on the Ganges tributaries, and between Syria and Jordan on the Yarmuk.

Political linkages. Political capital, like investment capital, might likewise be linked to water negotiations, although no treaty to date includes such provisions. This linkage might be done implicitly, as for example the parallel but interrelated political and resource tracks of the Middle East peace talks, or explicitly, as talks between Turkish acquiescence on water issues have been linked in a quid pro quo with Syrian ties to Kurdish nationalists.

Data. As water management models become more sophisticated, water data is increasingly vital to management agencies. As such, data itself can be used as a form of negotiating capital. Data-sharing can lead to breakthroughs in negotiations -- an engineering study allowed circumvention of an impasse in the Johnston negotiations when it was found that Jordan's water needs were not as extensive as had been thought, allowing for more room in the bargaining mix. Conversely, the lack of agreed-to criteria for data in negotiations on the Ganges has hampered progress over the years.

Data issues, when managed effectively, can also allow a framework for developing patterns of cooperation in the absence of more contentious issues, particularly water allocations. For one, data gathering can be delegated to a trusted third party or, better, to a joint fact-finding body made up of representatives from the riparian states. Perhaps the best example of this internationally is on the Mekong, where the Mekong Committee's first five-year plan consisted almost entirely of data-gathering projects, effectively both precluding data disputes in the future, and allowing the riparians to get used to cooperation and trust.

Water-related "baskets." Some of the most complete "baskets" were negotiated between India and Nepal, in 1959 on the Bagmati and the Gandak, and in 1966 on the Kosi (all tributaries of the Ganges). These two treaties include provisions for a variety of water related projects, including irrigation/hydropower, navigation, fishing, related transportation, and even afforestation -- India plants trees in Nepal to contain downstream sedimentation. While Nepal has expressed recent bitterness to both these accords, the structures of these treaties are good examples of how broader "baskets" can allow for more creative solutions.^h

^g Months before the signing of the LHWP treaty, there was a coup in Lesotho and some scholars (eg. Homer-Dixon, 1994) interpreted the coup as a "water coup." Later assessments (Aline-Baillat 2004) suggested that the coup was not an outcome of preceding South African blockade and if there was any involvement whatsoever, it was aiming to stop the Lesotho support to ANC. The new government formed by Lekhanya after the coup was more conciliatory to South Africa than the Jonathans government and it stopped support to the ANC, although it did not hand them over to South Africa as it was requested. Signing of the LHWP treaty seems to be another result of the better relations between Lesotho and South Africa. (Thanks to Jakub Landovsky and Olga Zarubova-Pfeffermannova for the research for this note.)

^h The Kosi and the Gandak River Treaty have been subject to major controversies. They were signed respectively in 1954 and 1959 and are still today in force but many Nepalese feel cheated

by these two treaties.

These treaties were subject, indeed, to high criticism within Nepal and the domestic pressure was such that successive Nepali governments had to renegotiate the treaties. India accepted to amend them in 1964 and 1966 (and again slightly in 1971 and 1978) after months and even years of talks. Despite significant modifications in the provisions of both treaties, Nepalese opinion remained that Nepal policy makers were under undue influence by Indian to sell off the water resources of the country. Some scholars present the Kosi and Gandak projects as a positive undertaking for Nepal, especially if one considers the fact that Nepal 'was and remains unable to construct large water projects on its own' (Elhance 2000). (Thanks to Jakub Landovsky and Olga Zarubova-Pfeffermannova for the research for this note.)

ANALYSIS OF DIFFERENT MODELS/EXAMPLES OF CASES THAT COUNTRIES HAVE USED TO MANAGE THE COMPETITION FOR WATER RESOURCES

In an effort to get past the prevailing anecdotal approach to understanding water conflict and cooperation, researchers at Oregon State University attempted to compile a dataset of *every* reported interaction between two or more nations, whether conflictive or cooperative, which involved water as a scarce and/or consumable resource or as a quantity to be managed – i.e. where water is the *driver* of the eventⁱ, over the past 50 years (Wolf et al. 2003).

Our overall distribution of events over the 50-year period of assessment is shown below in Figure 2: Number of Events by BAR Scale.^j

Figure 2:

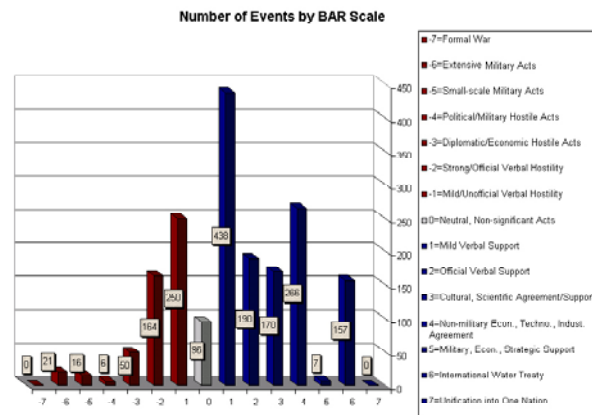
In general, we delineated a total of 1,831 events, and found the following:

No events on the extremes. In modern times, there has been no war (-7 on the BAR Scale) fought over water resources. In fact, one has to go back 4,500 years to find the single historical example of a true “water war,” to a dispute between the city-states of Lagash and Umma on the Tigris-Euphrates.

Likewise, there is no example of nations voluntarily unifying because of water resources (+7 on the BAR Scale).^k

Most interactions are cooperative. Cooperative events are more than twice as common as conflictive events – there are 1,228 cooperative events (67.1%) and 507 conflictive events (27.7%). Ninety-six events (5.2%) were delineated as neutral or non-significant.

Most interactions are mild. Seven-hundred-eighty-four events, or 42.8% of all events, fall between mild verbal support (+1) and mild verbal hostility (-1). If we add the next level on either side – official verbal support (+2) and official verbal hostility (-2) – we



ⁱ Excluded are events where water is incidental to a the dispute, such as those concerning fishing rights, access to ports, transportation, or river boundaries. Also excluded are events where water is not the driver, such as those where water is a tool, target, or victim of armed conflict.

^j The Basins at Risk (BAR) Scale delineates events along a spectrum of conflict and cooperation, as shown in Figure 2.

^k Two international basins were “lost,” however, when the two Germanies and the two Yemens unified.

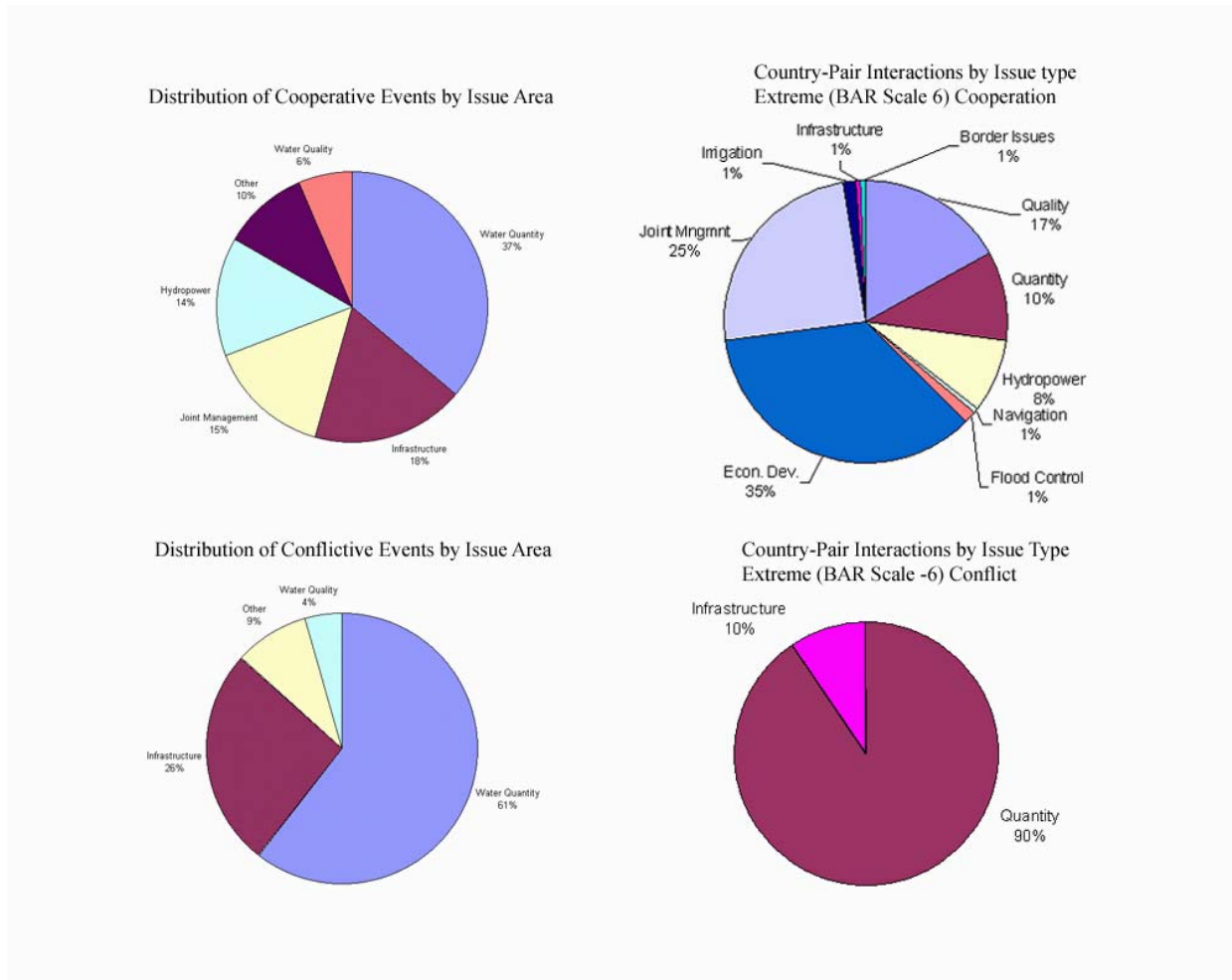
account for 1,138 events, or 62% of the total. Another way to look at this is that almost two-thirds of all events are only verbal and, of those, more than two-thirds are reported as having no official sanction at all.

Water acts as an irritant. Water resources can make good relations bad and bad relations worse. Threats and disputes have raged 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.

Water acts as unifier. Despite their complexity, the historical record shows that water disputes *do* get resolved, even among bitter enemies, and even as conflicts rage over other issues. Some of the most vociferous enemies around the world have negotiated water agreements or are in the process of doing so. The Mekong Committee has functioned since 1957, exchanging data throughout the Vietnam War. Secret "picnic table" talks have been held between Israel and Jordan since the unsuccessful Johnston negotiations of 1953-55, even as these riparians until only recently were in a legal state of war. The Indus River Commission survived through two wars between India and Pakistan. And all ten Nile riparians are currently involved in negotiations over cooperative development of the basin.

Overall, the major water-related issues are quantity and infrastructure. Figure 3 shows the number of events by issue area and the distribution of those events. Sixty-seven percent of events are primarily about water quantity and infrastructure (which are often inextricably related). Quality-related events only account for 5% of the total. (See Figure 3: Number of Events by Issue Area).

Figure 3: Number of Events by Issue Area



Nations cooperate over a wide variety of issues. Figure 3 also shows the distribution of cooperative events, and indicates a broad spectrum of issue types. If we look specifically at treaties, the most cooperative type of event, the breadth of cooperative issues is even wider, including quantity, quality, economic development, hydropower, and joint management.

Nations conflict over quantity and infrastructure. Finally, Figure 3 shows the distribution of conflictive events by issue area – 87% relate to water quality and infrastructure. Again, if we look specifically at extensive military acts, the most extreme cases of conflict, almost 100% of events fall within these two categories.

Dams and diversions *plus* a high level of animosity and/or the absence of a transboundary institution. Table 2 shows the relationship between dam density per basin and the level of dispute. Dams, by themselves, seem to be moderate indicators – Table 2 shows a 12% drop in overall conflict/cooperation level in basins with high dam density versus basins with low dam density (see Table 2: Development and Institutional Capacity). Yet when we factor in the institutional capacity, as measured by the presence or absence of treaties, the differences are enhanced. Basins without treaties and high dam density are 29% lower in their average conflict/cooperation levels than basins without

treaties and low dam density – more than twice the difference between similar densities but ignoring treaties. Conversely, the relationship between dam density and conflict level all but disappears in basins with treaties – only a 2% drop from low to high density. Even restricting ourselves to high dam density basins, there is a 26% drop in conflict/cooperation levels from basins with treaties to those without.

To further assess the role of treaties as institutional mechanisms capable of mitigating conflict, we analyzed the impact of treaties on annual levels of conflict/cooperation for each country pair.

We found that in the three year period following treaty signature, average levels of conflict/cooperation were significantly higher (3.0 on the BAR Scale) than in “normal” years (2.2). We also found, perhaps surprisingly, that in the three year period preceding treaty signature, the average level of conflict/cooperation was no different (2.3) than in “normal” years.¹ Treaty years, naturally, were the most cooperative (5.7).

Institutions matter.

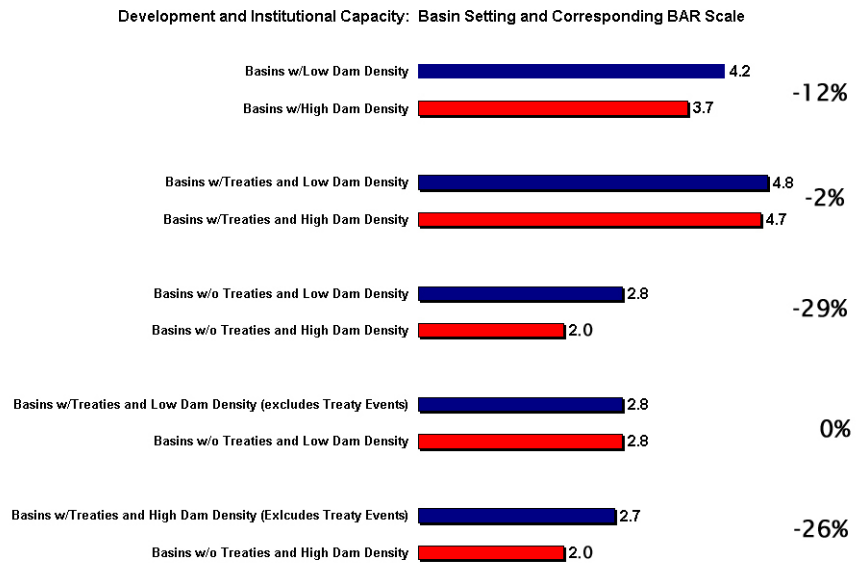


Figure 4

¹ We had hypothesized that the years immediately preceding treaties would have a higher conflict level, assuming that a conflict is necessary to drive parties to negotiate to begin with.

INDICATION OF POSSIBLE TRIGGERS FOR CONFLICT OVER WATER SHARING AND WHAT IMPLICATIONS THAT HAS ON THE LIVELIHOODS OF ORDINARY COMMUNITIES

High Politics and Low Politics

International relations theory has long grappled with the conflict between the unilateral sovereignty needs of states, and the requirement for cooperation for transboundary transactions. Because the flow of water does not respect political boundaries, it has been clear that regional management, at the watershed level at least, would be a much more efficient approach, at least from a management perspective. Nevertheless, water has regularly been “securitized,” primarily due to internal politics, but has regularly had international repercussions. The question has historically been posed repeatedly whether issues of regional water resources, considered a “low” political issue, can be addressed in advance of larger, “high,” political issues of nationalism and diplomacy. Both sides have been argued in the past.

The Functionalist theory of international politics, an alternative to the fairly self-explanatory Power Politics, claims that states will willingly transfer sovereignty over matters of public concern to a common authority.^m Cooperation over resources, then, may induce cooperation over other, more contentious and emotional issues. In the Middle East, this thinking was the rationale for the extensive Johnston negotiations over a regional water-sharing plan for the riparians of the Jordan River, from 1953-55;ⁿ plans, dubbed “water-for-peace,” for cooperative projects for immense agro-industrial complexes fueled by nuclear energy and desalination in the late 1960's; multilateral negotiations over the Yarmuk River and the Unity Dam in the 1970's and 1980's;^o and an attempt at a Global Water Summit Initiative including Middle Eastern participation in 1991.

It has also been argued that not only need one not wait for the cessation of hostilities before developing regional water-sharing plans and projects, but that cooperation over these projects may advance the pace of resolution of larger issues:

A regional water plan need not await the achievement of peace. To the contrary, its preparation, before a comprehensive peace settlement is attained, could help clarify objectives to be aimed for in achieving peace.^p

^m Mitrany, David. The Functional Theory of Politics. New York: St. Martin's Press, 1975.

ⁿ For more on each of these projects, see Wolf 1995, op. cit.; for details on the Johnston negotiations, see, Wishart, David. “The Breakdown of the Johnston Negotiations over the Jordan Waters.” Middle Eastern Studies. 26:4, October 1990.

^o For a description of these secret negotiations, see Bingham, Wolf, and Wohlgenant 1994, op. cit.

^p Ben-Shachar, in Fishelson, Gideon, ed. Economic Cooperation in the Middle East. Boulder: Westview Press, 1989.

Elisha Kally, an architect of many regional water projects in the Middle East, has also contended that, "the successful implementation of cooperative projects... will strengthen and stabilize peace."^q

In contrast to the Functionalist argument, Realist critics respond that states which are antagonists in the "high" politics of war and diplomacy tend not to be able to cooperate in the realm of "low" politics of economics and welfare. Until the Arab-Israeli peace negotiations began in 1991, attempts at Middle East conflict resolution had either endeavored to tackle political or resource problems, always separately. By separating the two realms of "high" and "low" politics, some have argued, each process was doomed to fail.^r In water resource issues -- the Johnston Negotiations, attempts at "water-for-peace," negotiations over the Yarmuk River and the Unity Dam, and the Global Water Summit Initiative -- all addressed water *qua* water, separate from the political differences between the parties.^s All failed to one degree or another. In the most detailed argument in support of the Realists regarding Middle East water resources, Lowi^t suggests that issues of regional water-sharing simply could not be successfully broached in the Jordan basin until the larger political issues of territory and refugees are resolved.

The Arab-Israeli Peace Talks of the early 1990's, however, were the first time that both bilateral and multilateral tracks took place simultaneously. The design was explicitly to provide venues for issues of both high politics and low politics, with the premise that each might help catalyze the pace of the other. As Secretary of State James Baker, the architect of the negotiating structure, described the relationship in his opening of the organizational meeting of the multilateral talks in Moscow:

Only the bilateral talks can address and one day resolve the basic issues of territory, security and peace which the parties have identified as the core elements of a lasting and comprehensive peace between Israel and its neighbors. But it is true that those bilateral negotiations do not take place in a vacuum, and that the condition of the region at large will affect them. In short, the multilateral talks are intended as a complement to the bilateral negotiations: each can and will buttress the other.^u

Or, as Joel Peters describes it,

^q Kally in Fishelson 1989, op. cit.

^r For particularly cogent presentations of this argument, see Lowi 1993, op. cit.; and Waterbury, John. "Transboundary Water and the Challenge of International Cooperation in the Middle East." Presented at a symposium on Water in the Arab World, Harvard University, 1-3 October 1993.

^s For more detail of these issues in the region's hydropolitical history, see, Wolf 1995, op. cit.

^t Lowi 1993, op. cit.

^u Cited in Peters 1994, op. cit.

Whereas the bilaterals would deal with the problems inherited from the past, the multilaterals would focus on the future shape of the Middle East.^v

The multilateral talks included five issues of regional importance. The only set which has survived the collapse of the peace negotiations and the renewed violence of the early 2000's, and continues to function to this day, is the Multilateral Working Group on Water Resources.

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,” (eg. Blaikie et al. 1994), and relate to the ability of bio-physical systems to adapt to change (eg., Gunderson and Pritchard, 2002). As the sustainability discourse has broadened to include human systems in recent years, so too has work been increasingly geared towards identifying indicators of resilience and vulnerability within this broader context (eg. Bolte et al. 2004; Lonergan et al. 2000; Turner 2003). 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 UNEP 2004; Vogel and O'Brien 2004).^w

The term “hydropolitics” (coined by Waterbury, 1979), came about as substantial new attention has been paid 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, ie. without tensions or conflict between political entities. “Hydropolitical resilience” then, 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. (2003), 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 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

^v Peters 1994, op. cit.

^w “Environmental security,” the securitization or conflict potential of environmental issues, should not be confused with either “food security” or “water security,” which are defined as self-sufficiency in food and water respectively.

to absorb those changes, are at the root of most water conflict. 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 (Wolf, Yoffe, and Giordano, 2003).

The general assumption, then, is that rapid change tends to indicate vulnerability while institutional capacity tends to indicate resilience, *and* that the two sides need to be assessed in conjunction with each other for a more accurate gage 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 development^x

In contrast, facets that would tend towards vulnerability would include

- rapid environmental change
- rapid population growth or asymmetric economic growth
- major unilateral development projects
- the absence of institutional capacity
- generally hostile relations

Table 2. Selected Examples of Water-related Disputes

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, leading to violence and death along the river.	
Mekong Basin,	Following construction of Thailand’s Pak Mun Dam, more than 25,000	

^x Higher levels of economic development enhance resilience because these countries can afford alternatives as water becomes relatively more scarce or degraded. Contrast developing and developed countries, for example – while the former may struggle for a safe, stable supply of basic water resources, the latter might utilize greenhouses, expensive drip-irrigation systems, bio-engineered crops, or desalination.

	Southeast Asia	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 users. While in this case negotiations led to a peaceful solution, in areas that lack the Rhine's dispute resolution framework, siltation problems could lead to upstream/downstream disputes.
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, sporadically breaching the agreements.

SOURCE: Wolf, A, A. Kramer, A. Carius, and G. Dabelko (2005).

Intranational Impacts of International Tensions

The subset of security issues of international tensions occur at the sub-national level, with direct impact on ordinary communities. 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 resources, 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, and

increasingly threatened by newer uses for cities and hydropower. Moreover, the local setting strongly influences international dynamics and vice versa.

If there is a history of water-related violence, and there is, it is a history of incidents at the sub-national level, generally between tribes, water-use sectors, or states/provinces. In fact, our recent research at OSU suggests that, as the scale drops, the likelihood and intensity of violence goes up (Giordano et al. 2002). There are many examples of internal water conflicts ranging from interstate violence and death along the Cauvery River in India, to California farmers blowing up a pipeline meant for Los Angeles, to much of the violent history in the Americas between indigenous peoples and European settlers. 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.

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, while 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 upon livelihoods and the environment, water quality issues can 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 (Carius et al. 2003). 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.

Regional instability: political dynamics of loss of irrigation water

As water quality degrades – or quantity diminishes – over time, the effect on the stability of a region can be unsettling. For example, for thirty years the Gaza Strip was under Israeli occupation. Water quality 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 quality the cause? It would be simplistic to claim direct causality. Was it an irritant exacerbating an already tenuous situation? Undoubtedly.

An examination of relations between India and Bangladesh demonstrate 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 upstream flow resulted in a number of

adverse effects: degraded surface and groundwater, impeded navigation, increased salinity, degraded fisheries, and endangered 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.

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 country-side to the cities – an invariable recipe for political instability. In pioneering work, Sandra Postel identified those countries which 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.^y

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.

^y Some authors (eg. Sandra Postel) have suggested that water will in fact be the limiting factor in the agricultural needs of our increasing global population, while others (eg. Tony Allan) think that “virtual water” – the water embedded in crops – are effectively traded from region to region, decreasing the impacts and demands of local shortages. Even non-irrigating regions have significant water needs, however – hydropower generation or transportation, for example – which can factor equally in security considerations.

EVALUATION OF THE ROLE OF INSTITUTIONS: HOW CAN INSTITUTIONAL DEVELOPMENT BE DEFINED; WHAT ARE THE DIFFERENT CATEGORIES OF INSTITUTIONS AND LEVELS OF OPERATION; WHAT ROLE HAVE THEY PLAYED AND WHAT SUCCESSES HAVE THEY HAD IN DIFFERENT RIVER AND LAKE BASINS

Just as the flow of water ignores political boundaries, so too does its management strain the capabilities of institutional boundaries. While water managers generally understand and advocate the inherent powers of the concept of a watershed as a unit of management, where surface- and groundwater, quantity and quality, are all inexorably connected, the institutions which have developed to manage the resource have historically followed these tenets only in the exception.

Frederiksen (1992), for example, describes principles and practice of water resources institutions from around the world. He argues that while, ideally, water institutions should provide for on-going evaluation, comprehensive review, and consistency among actions, in practice this integrated foresight is rare. Rather, he finds rampant lack of consideration of quality considerations in quantity decisions, a lack of specificity in rights allocations, disproportionate political power-by-power companies, and a general neglect for environmental concerns in water resources decision-making. Buck, Gleason, and Jofuku (1993) describe an “institutional imperative” in their comparison of transboundary water conflicts in the United States (U.S.) and the former Soviet Union. Feitelson and Haddad (1995) take up the particular institutional challenges of transboundary groundwater.

To address these deficiencies at the international level, some have argued that international agencies might take a greater institutional role. Lee and Dinar (1995) describe the importance of an integrated approach to river basin planning, development, and management. Young, Dooge, and Rodda (1994) provide guidelines for coordination between levels of management at the global, national, regional and local levels. Delli Priscoli (1989) describes the importance of public involvement in water conflict management. In other work (1992), he makes a strong case for the potential of Alternative Dispute Resolution (ADR) in the World Bank's handling of water resources issues. Trolldalen (1992) likewise chronicles environmental conflict resolution at the United Nations, including a chapter on international rivers.

Institutional Development—Contributions from the International Community^z

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 20th 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

^z This section draws from Giordano and Wolf 2003.

outlined certain basic principles of shared water management, recommending that co-riparian states establish permanent joint 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 non-governmental bodies.

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.^{aa} 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. While clearly more work is required, these initiatives have not only raised awareness of the myriad issues related to international water resource management, but have also 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 non-governmental 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. While 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."^{bb}

At the Rio Conference, water resource management was specifically addressed in Chapter 18 of Agenda 21, a non-binding action plan for improving the state of the globe's natural resources in the 21st century adopted by UNCED participants. The overall goal of

^{aa} The UN Conference on Environment and Development is often referred to as the Rio Earth Summit.

^{bb} Partial text of Dublin Statement available in FAO, 1998.

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.

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, non-government, and private agency representatives to discuss and collectively determine a vision for the management of water resources over the next quarter century.^{cc} 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 21st century. The recent World Summit on Sustainable Development (WWSO) has helped to sustain the momentum of these recent global water initiatives. In the Johannesburg Declaration on Sustainable Development, delegates at the WWSO 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 (United Nations, 2002a).

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. While 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 21st 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 applicable 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.

^{cc} The Fourth World Water Forum will take place in March 2006 in Mexico City.

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, while 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

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.^{dd} 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 (United Nations, 2002b).^{ee} 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, while the Convention offers general guidance to co-riparian states, its vague, and occasionally contradictory, language can result in varied, and indeed conflictive, interpretations of the principles contained therein. As stated by Biswas (1999), 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, 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

^{dd} UN General Assembly document A/RES/51/229 of 8 July 1997.

^{ee} As of January 2006, Finland, Hungary, Iraq, Jordan, Lebanon, Libya, Namibia, Netherlands, Norway, Portugal, Qatar, South Africa, Sweden, and Syria were party to the Convention.

the Danube between Hungary and Slovakia in 1997.^{ff} 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 International Court of Justice 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

Institutional Developments in Basin-Level Transboundary Water Management

In addition to the efforts of the international community, riparian states have developed a rich history of treaties concerning the management of shared watercourses. In contrast with the vague and sometimes contradictory global declarations and principles, the institutions developed by co-riparian nations have been able to focus on specific basin-level conditions and concerns. An evaluation of these institutions over the past half-century, with particular attention to treaties signed since the Rio Conference, offers insights into how appropriately the emphasis areas highlighted in Agenda 21 and subsequent declarations and conventions on freshwater resource management in general address the needs of international transboundary waters specifically.

Figure 5:

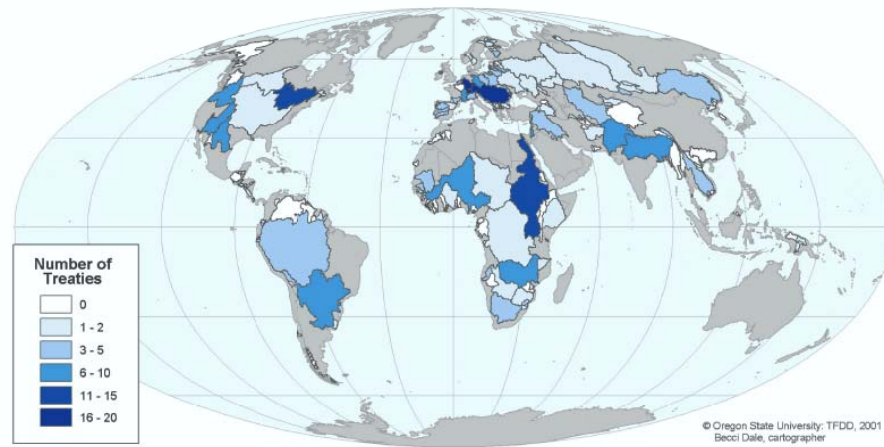
The history of international water treaties dates as far back as 2500 BC, when the two Sumerian city-states of Lagash and Umma crafted an agreement ending a water dispute along the Tigris River, bringing an end to the first and only “water war” in history. Since then a large body of water treaties has emerged. The Food and Agricultural Organization of the United Nations has identified more than 3,600 treaties dating from AD 805 to 1984 (Wolf, 1998). While the majority of these relate to some aspect of navigation, a growing number address non-navigational issues of water management, including flood control, hydropower projects, or allocations for consumptive or non-consumptive uses in international basins. Since 1820 more than 400 water treaties and other water-related agreements have been signed, more than half of which were concluded in just the past 50 years.^{gg}

^{ff} The 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.

^{gg} Statistics obtained from the Transboundary Freshwater Dispute Database (TFDD) maintained at Oregon State University. The TFDD is available on-line at:
<http://www.transboundarywaters.orst.edu/>

Number of Agreements per International River Basin

Despite their growth in numbers, however, a review of treaties from the last half-century reveals an overall lack



of robustness. Water allocations, for example, the most conflictive issue area between co-riparian states, are seldom clearly delineated in water accords. Moreover, in the treaties that do specify quantities, allocations are often in fixed amounts, thus ignoring hydrologic variation and changing values and needs.^{hh} Likewise, water quality provisions have played only a minor role in co-riparian agreements historically. Enforcement mechanisms are also absent in a large percentage of the treaties. Finally, international basins with water agreements remain in the minority. Formal management institutions have been established in only 106 of the 263 international basins (see Figure 5), and even within these few include all nations riparian to the affected basins, which precludes the integrated basin management advocated by the international community.

^{hh}

The treaty record is replete with agreements which do not allow for the vagaries of nature and the scientific unknown, misunderstandings which often lead to tense political standoffs:

The waters of the Colorado were already overallocated between the upper and lower US states when a treaty with Mexico was signed in 1944, which also neglected the entire issue of water quality. After legal posturing on both sides as water quality continued to degrade, the US subsequently built a massive desalination plant at the border so that the water delivered would at least be usable. Currently, the fact that shared groundwater is likewise not covered in the treaty is leading to its share of tensions between the two nations.

In December, 1996, a treaty between India and Bangladesh was finally signed, allocating their shared Ganges waters after more than 35 years of dispute. In April 1997, however – the very first season following signing of the treaty – the two countries were involved in their first conflict over cross-boundary flow: water passing through the Farakka dam dropped below the minimum provided in the treaty, prompting Bangladesh to insist on a full review of the state of the watershed.

In 1994, Israel and Jordan signed one of the most creative water treaties on record. It has Jordan store winter runoff in the only major surface reservoir in the region – the Sea of Galilee – even though that lake happens to be in Israel; it has Israel lease from Jordan in 50 year increments wells and agricultural land on which it has come to rely; and it created a Joint Water Committee to manage the shared resources. But it did not adequately describe what would happen to the prescribed allocations in a drought. In early 1999, this excluded issue roared into prominence with a vengeance, as the worst drought on record caused Israel to threaten to renege on its delivery schedule, which in turn caused protests in the streets of Amman, personal outrage on the part of the King of Jordan, and, according to some, threatened the very stability of peace between the two nations before a resolution was found.

More encouraging characteristics are the inclusion of information sharing, monitoring, and conflict resolution provisions in many of the past half-century's treaties. In addition, there has been a broadening in the definition and measurement of basin benefits. Traditionally, co-riparians have focused on water as a commodity to be divided – a zero-sum, rights-based approach. Precedents now exist for determining formulas that equitably allocate the benefits derived from water, not the water itself – a positive-sum, integrative approach. For example, as part of the 1961 Columbia River Treaty, the United States paid Canada for the benefits of flood control and Canada was granted rights to divert water between the Columbia and Kootenai for hydropower purposes. Similarly, a 1975 Mekong River agreement among the four lower riparian states of Laos, Vietnam, Cambodia, and Vietnam defined '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 (Wolf, 1999).ⁱⁱ

A review of treaties signed within the last ten years also reveals some encouraging developments. At least 54 new bilateral and multilateral water agreements have been concluded since the Rio Conference, representing basins in Asia, Africa, Europe, North America, and South America. Like the past fifty years as a whole, European water accords continue to dominate. However, agreements from other regions, in particular Asia, have grown disproportionately.^{jj} In addition to greater geographic representation, a number of improvements can be seen in this more recent set of treaties compared with the last half-century as a whole. First, a growing percentage of treaties address some aspect of water quality, a finding consistent with Rio's goal of both managing and protecting freshwater resources. Second, provisions concerning monitoring and evaluation, data exchange, and conflict resolution are included in many of the post-Rio treaties. Third, a number of agreements establish joint water commissions with decision-making and/or enforcement powers, a significant departure from the traditional advisory standing of basin commissions. Fourth, country participation in basin-level accords appears to be expanding. Although few of the agreements incorporate all basin states, a greater proportion of treaties are multilateral and many incorporate all major hydraulic contributors. Finally, although the exception, a 1998 agreement on the Syr Darya Basin, in which water management is exchanged for fossil fuels, provides a post-Rio example of basin states broadly capitalizing on their shared resource interests.

While a review of the past century's water agreements highlights a number of positive developments, institutional vulnerabilities remain. Notably, 158 of the world's 263 international basins lack any type of cooperative management framework. Furthermore, of the 106 basins with water institutions, approximately two-thirds have three or more riparian states, yet less than 20 percent of the accompanying agreements are multilateral. Moreover, despite the recent progress noted above, treaties with substantive references to

ⁱⁱ In the context of navigation, the 1995 Mekong River agreement, which superseded the 1975 agreement, again referenced, but in this case did not define, the concept of 'equality of right.'

^{jj} The fact that agreements representing European basins dominate the treaty record is not surprising given that Europe has the largest number of international basins (69) followed by Africa (59), Asia (57), North America (40), and South America (38) (Wolf, et al., 1999, 2002).

water quality management, monitoring and evaluation, conflict resolution, public participation, and flexible allocation methods, remain in the minority. As a result, most existing international water agreements continue to lack the tools necessary to promote long-term, holistic water management. Many treaties, for example, ignore issues of allocation, and of those that do few possess the flexibility to handle changes in the hydrologic regime or in regional values. References to water quality, related groundwater systems, monitoring and evaluation, and conflict resolution mechanisms, while growing in numbers, are often weak in actual substance. Furthermore, enforcement measures and public participation, two elements that can greatly enhance the resiliency of institutions, are largely overlooked.^{kk}

Finally, groundwater, with all its uncertainties and complexities, adds further challenges to these international regimes. A review of international water law specifically addressing groundwater reveals that many of the agreements were developed in the past 50 years, and have only recently adopted a definition of an aquifer. Matsumoto (2002) inventoried nearly 400 treaties listed in the Transboundary Freshwater Dispute Database (TFDD) of Wolf (1999), and UNEP (2002) and summarized the number of treaties recognizing groundwater by continent:

- 35 treaties developed between European countries;
- 13 treaties in Africa;
- 10 treaties in the Middle East and Asia;
- four treaties in North America; and
- no treaties developed in South America.

Protection of groundwater quality has only been addressed in the past few years (UNEP, 2003). The transboundary movement or “silent trade” of hazardous wastes into Lebanon described by Jurdi (2003) provides an example of the need to increase the need for “global harmonization” of international water and waste treaties. Of the many international water treaties, few have monitoring provisions, and almost none have enforcement mechanism (Chalecki and others, 2002).

Types of Institutional Arrangements

^{kk} A consensus is generally emerging that regional agreements, while proliferating, have *less* impact than bilateral agreements, precisely because they are unenforceable guidelines rather than detailed agreements (see Varady 2005). Likewise, bilateral agreements are, in general, *easier* to negotiate than multilateral agreements, simply because of the truism that, “the more people (or interests) in the room, the more difficult it is for them to agree (or the less the final document will say). Oftentimes, however, even multilateral basins are effectively managed through sets of bilateral agreements. The Jordan comes to mind, where agreements exist between Syria-Jordan, Jordan-Israel, and Israel-Palestine, and, while no multilateral agreement has regional oversight, the basin is managed relatively effectively.

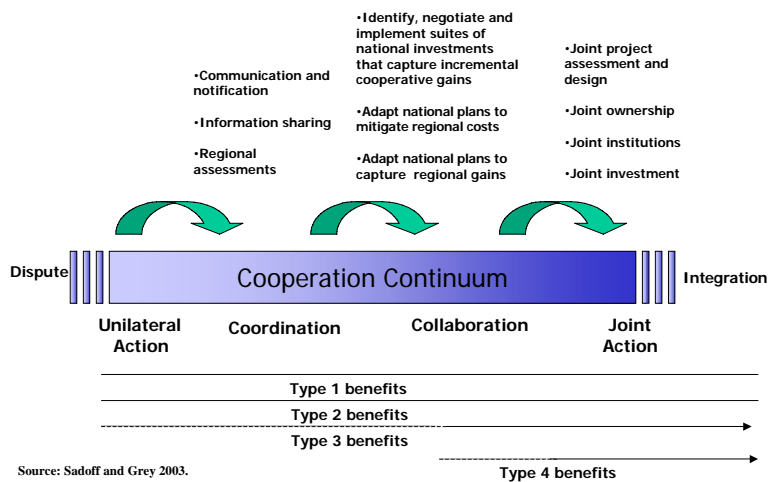
An agreement or institution may be thought of as a sociopolitical analogue to a vibrant ecosystem, and thus vulnerable to the same categories of stresses which threaten ecosystem sustainability. Will the agreement and institutions which were crafted in the exercise sustain themselves through:

- Biophysical stresses? Are there mechanisms for droughts and floods? Shifts in the climate or rivercourse? Threats to ecosystem health
- Geopolitical stresses? Will the agreement survive elections or dramatic changes in government? Political stresses, both internal and international
- Socioeconomic stresses? Is there public support for the agreement? Does it have a stable funding mechanism? Will it survive changing societal values and norms?

Figure 6:

Similar to an ecosystem, the best management is *adaptive* management, i.e., the institution has mechanisms to adapt to changes and stresses, and to mitigate their impact on its sustainability.^{ll}

Types of Cooperation – a Cooperation Continuum



Source: Sadoff and Grey 2003.

Crafting institutions requires a balance between the efficiency of integrated management with the sovereignty-protection of national interests. Along with greater integration of scope and authority may come greater efficiency, but also comes greater potential for disagreements, greater infringement on sovereignty, and greater transaction costs (see Feitelson and Haddad (1998) for more information). Some possible institutional models are offered in Figure 7, below. Nevertheless, for every set of political relations, there is some possible institutional arrangement which will be acceptable (even if it is only to collect data separately but in a unified format, in the hopes that they may one day be merged) and, if its management is iterative and adaptive, responsibility can be regularly “re-crafted” to adapt or even lead political relations.

Selected Case Studies^{mmm}

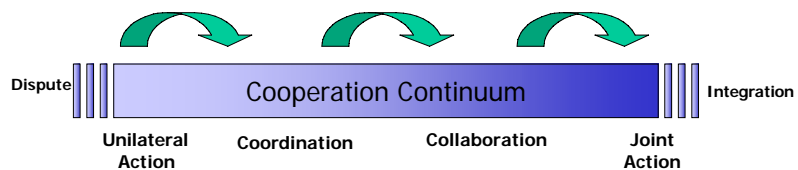
Hundreds of examples of transboundary

^{ll} See Lee (1995) for the c

^{mmm} For details on these and Landovsky.

Types of Cooperation – some examples

Indus	Mekong	Rhine	Orange	Senegal	River
communication	info sharing, assessments	convergent national agendas	joint prep and investment	joint equity ownership	type of cooperation
1-3	1-4	1,3	2,3	1-4	type of benefit
	cost sharing	cost sharing	purchase agreement, financing	joint ownership	type of benefit sharing



Source: Sadoff and Grey 2003.

conflict and cooperation exist throughout the world. While several examples have already been referenced, some particularly salient cases are discussed below in greater detail, with the aim of further exploring themes already mentioned while identifying new findings and lessons. Annex I describes these cases in more detail.

Analytic Framework

Sadoff and Grey (2002, 2005) suggest two spectrums which together define the level of cooperation between riparians on international waterways. The first, described above, and in Figure 7, delineates increasing cooperative integration, beginning with “dispute,” and increasing to total “integration.” As noted above, efficient water management generally trends towards increasing integration, while the political needs to protect national sovereignty trend in the opposite direction.

The other spectrum is the *type* of benefit that can be gained through cooperation, and includes:

- Type 1: Benefits to the River – the ecosystem protection which is best gained through cooperative management;
- Type 2: Benefits from the River – in increased food and energy production, for example;
- Type 3: Reduction in Costs because of the River – primarily the political and economic costs of a conflictive setting, which can be reduced through hydro-cooperation;
- Type 4: Benefits Beyond the River – branching out to increase the “basket of benefits” through greater cooperation and even infrastructural and economic integration.

The case studies below represent different examples of both the level and integration and the type of benefits, as shown in Figure 7:

The **Boundary Waters Agreement between Canada and the United States of America**, 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 where the USA paid Canada for the benefits of flood control and Canada was granted rights to divert water between the Columbia and Kootenai 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 USA 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 (for further details see annex).

Mekong Basin: In 1957 the creation of the Mekong Committee for Coordination of Investigations of the Lower Mekong Basin was the first example of UN involvement in a program to develop an international river basin. The new Mekong Agreement was signed in 1995 after a relatively short period of negotiation benefiting from a shared data base,

long-established relationships, and familiarity of the key players with the provisions of relevant international jurisprudence. The Mekong Agreement clearly states the mutual commitment to cooperate. It established the Mekong River Commission as the international body that implements the Agreement and seeks cooperation on all aspects of water management (for further details see annex).

Indus Basin: Despite three wars and numerous skirmishes since 1948, India and Pakistan, with World Bank support, have managed to negotiate and implement a complex treaty on sharing the waters of the Indus River system. The Indus Water Treaty was finally signed in 1960. During periods of hostility, neither side has targeted the water facilities of the other nor attempted to disrupt the negotiated arrangements for water management (for further details see annex).

Nile River Basin: The political will to achieve a basin-wide agreement and framework for long-term cooperation on the part of the ten Nile Basin riparian states is gathering pace. In 1992 representatives of all ten states agreed upon a Nile River Basin Action Plan with the task of developing a cooperative scheme for the management of the Nile. In 1995 the World Bank, together with UNDP and the Canadian International Development Agency, accepted the request from the Nile riparian states to give impetus to the project. In 1999 the Nile Basin Initiative was launched, with the membership of all Basin States. The international community has facilitated an ongoing dialogue between the riparians of the Nile Basin to a process of dialogue and joint planning (for further details see annex).

Danube River Basin: The Danube Convention is a vital legal continuation of a tradition of regional management along the Danube dating back 140 years. As a document, it provides a legal framework for integrated watershed management and environmental protection along a waterway with wide-spread potential for disputes. The Environmental Program for the Danube River is also a basin-wide international body that actively encourages public and NGO participation throughout the planning process. This proactive stakeholder participation may help preclude future disputes both within countries and as a consequence, internationally (for further details see annex).

Jordan River Basin: Even while Israel and Jordan were legally at war, Israeli and Jordanian water officials met several times a year at so called „Picnic Table Talks“. As a result, when the Jordan-Israel Peace Treaty was signed in 1994, it was possible to include a well-developed annex acknowledging that, „water issues along their entire boundary must be dealt with in their totality“ (for further details see annex).

Institutional Lessons for the International Community

A review of international water relations and institutional development over the past fifty years provides important insights into water conflict and the role of institutions. The historical record of water conflict and cooperation suggests that while international watercourses can cause tensions between co-riparian states, 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 over-emphasized. Yet, while progress is indeed apparent, the past fifty 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 new information and monitoring technologies. The adaptability of management structures must also extend to non-signatory 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 inter-riparian 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 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 non-water-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 towards 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.

ANALYSIS OF POWER ASYMMETRIES BETWEEN RIPARIAN STATES AND HOW THEY AFFECT THE OUTCOMES OF NEGOTIATIONS. ALSO, TO WHAT EXTENT SUB-NATIONAL GOVERNANCE OF LOCAL WATER RESOURCES IMPACTS ON NEIGHBORING COUNTRIES AND NATIONAL LEVEL NEGOTIATIONS

Once we begin to focus on institutions – whether defined by formal treaties, informal working groups, or generally warm relations – and their relationship to the physical environment, we need to address the issue of power. Whether political, military, or economic, power impacts the way in which a conflict will play out, as well as what both negotiations and a negotiated settlement will look like. As we began to get a clear picture of the settings most conducive to political tensions in international waterways, what we found was that the likelihood of conflict increases significantly whenever two factors come into play. The first is that some large or rapid change occurs in the basin's physical setting—typically the construction of a dam, river diversion, or irrigation scheme—or in its political setting, especially the breakup of a nation that results in new international rivers. The second factor is that existing institutions are unable to absorb and effectively manage that change. This is typically the case when there is no treaty spelling out each nation's rights and responsibilities with regard to the shared river, nor any implicit agreements or cooperative arrangements. Even the existence of technical working groups can provide some capability to manage contentious issues, as they have in the Middle East.

The overarching lesson of the OSU study on conflicts is that unilateral actions to construct a dam or river diversion *in the absence* of a treaty or institutional mechanism that safeguards the interests of other countries in the basin is highly destabilizing to a region, often spurring decades of hostility before cooperation is pursued. Both factors are driven primarily by the interests of the regional hegemon. In other words, the red flag for water-related tension between countries is not water stress per se as it is within countries, but rather the unilateral exercise of domination of an international river, usually by a regional power.

In the Jordan river basin, for example, violence broke out in the mid-1960s over an “all-Arab” plan to divert the river's headwaters (itself a pre-emptive move to thwart Israel's intention to siphon water from the Sea of Galilee). Israel and Syria sporadically exchanged fire between March 1965 and July 1966. Water-related tensions in the basin persisted for decades and only recently have begun to dissipate.

A similar sequence of events transpired in the Nile basin, which is shared by ten countries—of which Egypt is last in line. In the late 1950s, hostilities broke out between Egypt and Sudan over Egypt's planned construction of the High Dam at Aswan. The signing of a treaty between the two countries in 1959 defused tensions before the dam was built. But no water-sharing agreement exists between Egypt and Ethiopia, where some 85 percent of the Nile's flow originates, and a war of words has raged between these two nations for decades. As in the case of the Jordan, in recent years the Nile nations have begun to work cooperatively toward a solution thanks in part to unofficial

dialogues among scientists and technical specialists that have been held since the early 1990s, and more recently a ministerial-level "Nile Basin Initiative" facilitated by the United Nations and the World Bank.

The hydropolitical record is clear that "power is power," whether the hegemon is upstream or down, which begs the question: Why is there not more violence over international waterways? In other words, why do hegemonies reign themselves in and eventually contribute to the rich record of global hydrocooperation? There seem to be at least three reasons why hegemonies eventually find their way to the negotiating table:

Strategic Argument

If one were to launch a war over water, what would be the goal? Presumably, the aggressor would have to be both downstream and the regional hegemon -- an upstream riparian would have no cause to launch an attack and a weaker state would be foolhardy to do so. (Foolhardiness apparently does not preclude such "asymmetric conflicts." Paul (1994) describes eight such case studies from 1904-1982, but points out that in none did the weaker power achieve its goals.) An upstream riparian, then, would have to launch a project which decreases either quantity or quality, knowing that it will antagonize a stronger down-stream neighbor.

The down-stream power would then have to decide whether to launch an attack -- if the project were a dam, destroying it would result in a wall of water rushing back on down-stream territory; were it a quality-related project, either industrial or waste treatment, destroying it would probably result in even worse quality than before. Furthermore, the hegemon would have to weigh not only an invasion, but an occupation and depopulation of the entire watershed in order to forestall any retribution -- otherwise, it would be extremely simple to pollute the water source of the invading power. Both countries could not be democracies, since the political scientists tell us that democracies do not go to war against each other, and the international community would have to refuse to become involved (this, of course, is the least far-fetched aspect of the scenario). All of this effort would be expended for a resource which costs about a US dollar per cubic meter to create from seawater.

There are "only" 263 international watersheds -- there are only a handful on which the above scenario is even feasible (the Nile, Plata, and Mekong come to mind), and many of those either have existing treaties or ongoing negotiations towards a treaty. Finding a site for a "water war" turns out to be as difficult as accepting the rationale for launching one.

Shared Interest Argument

One is offered insight into the question of what it is about water which tends to induce cooperation, even among riparians which are hostile over other issues, by reading through the treaties which have been negotiated over international waterways. Each treaty shows sometimes exquisite sensitivity to the unique setting and needs of each basin, and many detail the shared interests a common waterway will bring. Along larger waterways, for instance, the better dam sites are usually upstream at the headwaters where valley walls are steeper and, incidentally, the environmental impact of dams is not as great. The

prime agricultural land is generally downstream, where gradient drops off and alluvial deposits enrich the soil. A dam in the headwaters, then, can not only provide hydropower and other benefits for the upstream riparian, but it can be managed to even out the flow for downstream agriculture, or even to enhance water transportation for the benefit of both riparians.

Other examples of shared interests abound: no development of a river which acts as a boundary can take place without cooperation; farmers, environmentalists, and beach-goers all share an interest in seeing a healthy stream-system; and all riparians share an interest in high water quality.

These shared interests are regularly exemplified in treaties: In conjunction with the 1957 Mekong Agreement, Thailand helped fund a hydroelectric project in Laos in exchange for a proportion of the power to be generated. In the particularly elaborate 1986 Lesotho Highlands Treaty, South Africa agreed to help finance a hydroelectric/water diversion facility in Lesotho -- South Africa acquired rights to drinking water for Johannesburg, and Lesotho receives all of the power generated. Similar arrangements have been suggested in China on the Mekong, Nepal on the Ganges, and between Syria and Jordan on the Yarmuk.

The unique interests in each basin, whether hydrological, political, or cultural, stands out in the creativity of many of the treaties. A 1969 accord on the Kunene River allows for "humanitarian" diversions solely for human and animal requirements in Southwest Africa as part of a larger project for hydropower. Water loans are made from Sudan to Egypt (1959), and from the USA to Mexico (1966). Jordan stores water in an Israeli lake while Israel leases Jordanian land and wells (1994), and India plants trees in Nepal to protect its own water supplies (1966). In a 1964 agreement, Iraq "gives" water to Kuwait, "in brotherhood," without compensation. In contrast, a 1957 agreement between Iran and the USSR has a clause which allows for cooperation in identifying corpses found in their shared rivers.

The changes of local needs over time are seen in the boundary waters between Canada and the USA. Even as the boundary waters agreements of 1910 were modified in 1941 to allow for greater hydropower generation in both Canada and the United States along the Niagara to bolster the war effort, the two states nevertheless reaffirmed that protecting the "scenic beauty of this great heritage of the two countries" is their primary obligation. A 1950 revision continued to allow hydropower generation, but allows a greater minimum flow over the famous falls during summer daylight hours, when tourism is at its peak.

Institutional Resiliency Argument

As mentioned previously, another factor adding to the stability of international watersheds is that once cooperative water regimes are established through treaty, they turn out to be tremendously resilient over time, even between otherwise hostile riparians, and even as conflict is waged over other issues. The Mekong Committee has functioned since 1957, exchanging data throughout the Vietnam War. Secret "picnic table" talks have been held since the unsuccessful Johnston negotiations of 1953-55, even as these riparians until only recently were in a legal state of war. The Indus River Commission

survived through two wars between India and Pakistan. And an agreement between China and Hong Kong survived strains between those two countries.

Economic Argument?

It is tempting to add an economic argument against "water wars." Water is neither a particularly costly commodity nor, given the financial resources to treat, store and deliver it, is it particularly scarce. Full-scale warfare, on the other hand, is tremendously expensive. A "water war" simply would not cost out.

This point was probably best made by the Israeli Defense Forces analyst responsible for long-term planning during the 1982 invasion of Lebanon. When asked whether water was a factor in decision-making, he noted, "Why go to war over water? For the price of one week's fighting, you could build five desalination plants. No loss of life, no international pressure, and a reliable supply you don't have to defend in hostile territory" (cited in Wolf 1995b).

To make such a case convincingly, though, one would have to show times when war *was* cost-effective and, if such a thing is possible, it is well-beyond the scope of this paper.

Nevertheless, hydropolitical history is rife with examples of cases where economic "baskets of benefits" were crafted in a way which induced even the hegemon to participate in collaborative agreements, as suggested in previous sections throughout this paper.

GENERAL PRINCIPLES AND CONCLUSIONS ON CONFLICT AND COOPERATION, WITH CLEAR POLICY OBJECTIVES

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. While 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. While 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 as conflict is waged over other issues.
3. More likely than violent conflict occurring is a gradual decreasing of water quantity 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.

Policy Recommendations

Given these lessons, what can the international community do?

International Institutions:

Water dispute amelioration is as important, more effective, and less costly, than conflict resolution. Watershed commissions should be developed for those basins that do not have them, and strengthened for those that do.

Three characteristics of international waters – the fact that conflict is invariably sub-acute, that tensions can be averted when institutions are established early, and that such institutions are tremendously resilient over time – inform this recommendation. Early intervention can be far less costly than conflict resolution processes. In some cases, such as the Nile, the Indus, and the Jordan, as armed conflict seemed imminent, tremendous energy was spent getting the parties to talk to each other. In contrast, discussions in the Mekong Committee, the multilateral working group in the Middle East, and the working group on the Danube, have all moved beyond the causes of immediate disputes on to actual, practical projects which may be implemented in an integrative framework.

Funding and Development Assistance Agencies:

Water-related needs to be coordinated and focused, relating quality, quantity, groundwater, surfacewater, and local socio-political settings in an integrated fashion. Funding should be commensurate with the responsibility that assistance agencies have for alleviating the global water crisis.

Ameliorating the crux of water security – human suffering – often rests with agencies that, given the size of the crisis, are extraordinarily underfunded. One can contrast the resources spent on issues such as global change and arms control, laudable for their efforts to protect against potential loss of life in the future, to the millions of people now dying because they lack access to clean fresh water. Agencies such as USAID, CIDA, and JICA have the technical expertise and experience to help, yet are hindered by political and budgetary constraints. Funding agencies often are hamstrung by local politics. A powerful argument can be made that water-related disease costs the global economy US\$125 billion per year, while ameliorating the diseases would cost US\$7-50 billion in total (Gleick 1998). Programs such as USAID's Project Forward, which integrates water management with conflict resolution training, offer models for the future.

Donor agencies are able to provide expertise and financial resources, accelerating the rate at which activities are undertaken and to foster the transfer of experience between regions and countries. To maximize effectiveness, United Nations Agencies, Regional Banks and other organizations need to cooperate and coordinate their efforts.

The effective development of a process of engagement and discussion requires considerable third-party support and process financing. Donors contribute only a small proportion of total financial flows in transboundary water management. Therefore it is important to identify further innovative funding mechanisms.

Universities and Research Agencies:

Universities and research agencies can best contribute to alleviation of the water crisis in three major ways: 1) Acquire, analyze, and coordinate the primary data necessary for good empirical work; 2) Identify indicators of future water disputes and/or insecurity in regions most at risk; and 3) Train tomorrow's water managers in an integrated fashion.

The internet's initial mandate is still one of the best: to allow communication between researchers around the world to exchange information and enhance collaboration. The surplus of primary data currently threatens an information overload in the developed world, while the most basic information is often lacking in the developing world. Data availability not only allows for greater understanding of the physical world but, by adding information and knowledge from the social, economic and political realms, indicators showing regions at risk can be identified.

Private Industry:

Private industry has historically taken the lead in large development projects. As the emphasis in world water shifts to a smaller scale, and from a focus on supply to one on demand management and improved quality, private industry has much to offer.

Private industry has three traits that can be harnessed to help ameliorate the world water crisis: their reach transcends national boundaries, their resources are generally greater than those of public institutions, and their strategic planning is generally superb. The private sector can be a source of resource mobilization, complementing its comparative advantages to manage the design, construction and operation of water and energy facilities located in transboundary basins. In addition to mobilizing investment and management efficiency, the private sector can be an important source of innovation and creativity. Public-private- partnerships can be encouraged by developing an enabling environment for involvement of the private sector in financing interventions promoted by River Basin Organizations. This includes national legal frameworks that provide credibility and security, and reduce political risks.

Historically, private companies such as Bechtel and Lyonnaise des Eaux have been involved primarily in large-scale development projects, while the smaller-scale projects have been left to development assistance agencies. Recently, a shift in thinking has taken place in some corporate board rooms. Bank of America, for example, was not involved in the California-wide process of water planning until recently, when its president noticed that practically *all* of the bank's investments relied on a safe, stable supply of water. This was true whether the investments were in micro-chip manufacturing, mortgages, or agriculture. When the bank became involved in the "Cal-Fed Plan," it brought along its lawyers, facilitators and planning expertise, and its financial resources. Subsequently, progress was made in several areas where previously there had been impasse.

Civil Society:

Inherent in our recognition that the most serious problems of water security are those at the local level, is the attendant recognition that civil society is among the best suited to address local issues.

One recurrent pattern in water resources development and management has been a series of projects or approaches in opposition to local values, customs and other cultural processes. Examples of these include large projects such as dams that have displaced hundreds of thousands of people and wiped out sites of cultural and religious heritage, projects promoting water markets among religious groups for whom the idea is sacrilege, or activities as seemingly minor as cutting down a tree sacred to a village djinn. In recent years, as a consequence, those affected by a project have been increasingly involved in the decision-making process, and such efforts must be strongly encouraged.

Mechanisms to facilitate stakeholder participation should be incorporated into the design phase of a project as well as actual implementation, so that stakeholders participate in the discussion and planning process as much as possible.

An important role for NGOs is to channel feedback from civil society in the development of transboundary waters. NGOs can act as facilitators for activities aimed at increasing public participation and involvement. They can mobilize expertise and provide independent judgment and long term commitment that is different from the support normally obtained from professional consultant companies.

*The UN System:*ⁿⁿ

Water-related expertise is spread throughout the UN system, including such bodies as UNDP, UNEP, UNESCO, UNICEF, FAO, and the UN Economic Commissions, and partners such as the World Bank and the Global Environment Facility. The fragmentation of this impressive expertise has historically prevented the UN from taking the lead in water-related conflict mitigation. To redress this problem, the UN system must integrate policy and coordinate its extensive but diffuse expertise on water, conflict, and cooperation across its bodies.

The UN might take the lead in developing an integrated, systematic program of preventive water diplomacy based on modified versions of the World Bank and Global Environment Facility frameworks. This program would 1) bolster early warning for regions with potential for water conflicts (conducted by, for example, UNEP's Division of Early Warning and Assessment); 2) develop a systematic program for enhancing institutional capacity between nations, including reconciling national legal frameworks (perhaps led by FAO's Development Law Service); and 3) craft, by unifying existing expertise, a "one-stop shop" for developing programs to enhance cooperation (such as UNESCO's recently launched Water Cooperation Facility). All these efforts should integrate traditional conflict-prevention bodies, such as UNDP's Bureau for Crisis Prevention and Recovery, in both the design and use of these products and capacities. The UN must address a number of gaps that impede the implementation of this systematic, integrated program.

First, only a small number of experienced water-dispute facilitators are viewed as truly neutral. The World Bank has a few, but they are in short supply at other UN bodies. The UN system should rebuild its ability by recruiting and training facilitators in hydrology, international law, regional history, and conflict prevention (the Universities Partnership for Transboundary Waters offers a model for developing and executing this training).

Second, UN conveners/facilitators and their bilateral funders must be willing to support long processes without requiring instant or easily measurable results. The World Bank's twenty-year commitment to the Nile Basin Initiative is an exemplary model, which the Bank is reproducing in other African basins. The UN should extend this model beyond Africa and encourage disparate UN bodies to cooperate as equal partners. Third, to achieve sustainable implementation, the UN must find ways to include all stakeholders throughout the process, in order to offset the secrecy that traditionally surrounds high-

ⁿⁿ See Dabelko, Carius, and Wolf, from where this is drawn, for more detail on the UN system and international waters.

level negotiations. Unlike the NBI, this should not wait until state-to-state agreements have been reached.

Finally, the UN should seek to strengthen the capacity of parties to negotiate contested water issues. Disparities in capacity and knowledge have often led to mistrust between riparian countries, hindering cooperative action. Strengthening the negotiating skills of less powerful riparians can therefore help prevent conflict, as can strengthening their capacity to generate and authorize relevant data. A hydrological database that is accepted by all stakeholders is essential for any joint management efforts, as it builds trust and enables water-sharing parties to make decisions based on the same understanding of the situation.

Why Might The Future Look Nothing Like The Past?^{oo}

The entire basis of this study rests on the not unassailable 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 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, then, 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-1960's onward. In some ways, water management is very similar now as it was then (or, for that matter, as it was 5,000 years ago). But some fundamental aspects are profoundly different. While 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 21st century has access to new technology – including remote sensing and modeling capabilities and technologies and management practices which increase water use efficiency – which could not be dreamed of in 1948, and which adds substantially to the ability both to negotiate and to manage transboundary waters more effectively

While 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.

^{oo} This section draws from Wolf et al. 2002.

Globalization: private capital, WTO, 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). 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, though, which has to do with the World Trade Organization (WTO) and its emphasis on privatization and full cost recovery of investments. Local and national governments, which have traditionally implemented and subsidized water development systems to keep water prices down, are under increasing pressure from the forces of globalization to develop these systems through private companies. These large multinational water companies in turn 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 last twenty 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 show-down 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? While far-fetched now (even as a California company is challenging British Columbia over precisely such an issue under NAFTA rules), the globalization debate between market forces and social forces continue to play out in microcosm in the world of water resources.

The Geopolitics of Desalination. Twice in the last fifty years – during the 1960’s nuclear energy fervor, and in the late 1980’s, 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.

While 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: 1) the water will be used for drinking water; and 2) the population to whom the water will be delivered lives along a coast and at low elevations; and 3) 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).

Besides the fundamental economic changes which would result, geopolitical thinking of water systems would also need to shift. Currently, there is inherent political power in being an upstream riparian, and thus 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 which 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 study.

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.

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