4

Water disputes

Water is likely to be the most pressing environmental concern of the next century (American Academy of Arts and Sciences, 1994). As global populations continue to grow exponentially, and as environmental change threatens the quantity and quality of natural resources, the ability for nations to resolve conflicts peacefully over internationally distributed water resources will increasingly be at the heart of stable and secure international relations. There are more than 200 international rivers in the world, covering more than one-half of the total land surface. Water has been a cause of political tensions, and occasional exchanges of fire, between Arabs and Israelis; Indians and Bangladeshis; Americans and Mexicans; and all 10 riparian states of the Nile river. Water is one of the few scarce resources for which there is no substitute, and over which there is poorly developed international law. The demand for water is also overwhelming, constant, and immediate (Bingham et al., 1994).

Comparative analysis and case studies

Resource conflicts will gain in frequency and intensity as water resources become relatively scarcer, and their use within nations can no longer be insulated from impacting on one's neighbours. A clear understanding of the details of how water conflicts have been resolved historically will

be vital to those responsible for bringing together the parties of future conflicts.

What are readily available to the scholar and policy-maker interested in international water conflicts are the *results* of a particular period of negotiations – usually a treaty or other agreement that allocates the resource. This information tells us little about the *process* by which the disputes were resolved. For example, what were each side's opening positions? What underlying interests informed those positions? What obstacles were encountered during negotiations and how were those obstacles overcome? What principles were finally agreed to for water allocations? What provisions were established for resolving future water conflicts and enforcement mechanisms? Finally, has the agreement been effective? The cases presented in Chapter 7 do provide for some patterns. Some of them are discussed below.[1]

Anticipating possible water conflict

Given that the international community has neither the resources nor the time to help establish a basin-wide institution for integrated watershed management on each of the world's international rivers and aquifers, patterns do emerge which may be useful in anticipating likely conflicts.

Generally, the chronology of a typical water conflict is as follows: 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, as water demand approaches supply, one of the riparians, generally the regional power,[2] will implement a project that impacts on at least one of its neighbours. Egypt's plans for a high dam on the Nile river, or Indian diversions of the Ganges river to protect the port of Calcutta, and Turkey's GAP project on the Euphrates river to meet the needs of a new agricultural policy are examples of how countries continue to meet existing uses of water resources in the face of decreasing water availability.

In the absence of relations or institutions conducive to conflict resolution, the project that impacts on one's neighbours can become a flashpoint, and conflict among various parties is imminent. Each of these projects is preceded by indicators of impending or likely water conflict, which might include those given below.

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. Conflicts over water in the Jordan river basin were inevitable during the mid-1960s, when demand outstripped 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 river and on the Ganges river. Likewise, shifts in demand, due to new agricultural policies or movements of refugees or immigrants can also lead to 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 point or nonpoint pollution, or any new extensive agricultural development resulting in saline return flow to the system, can indicate water conflict. Return flows from the state of Arizona into the Colorado river was the issue over which Mexico sought to sue the US in the 1960s through the International Court of Justice. It is also a point of contention on the lower Jordan river among Israel, Jordan, and Palestinians living in the West Bank.

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 of all these. When the needs of riparians conflict, disputes are likely. Many upstream riparians, for instance, would manage the river within their territory primarily for hydropower, whereas the primary needs of their downstream neighbours 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 river delta.

Political divisions

A common indicator of water conflict is shifting political divisions that reflect new riparian relations. Such is currently the case throughout Central Europe as national water bodies such as the Aral sea, the Amu Dar'ya, and the Syr Dar'ya become international. Many of the conflicts presented here, including those on the Ganges river, the Indus river, and the Nile river, took on international complications as the central authority of hegemony, in these cases the British Empire, was dissipated. The converse – territorial integration – such as the unification of the two Germanies, can also present problems.

Indicators for type and intensity of conflict

Along with clues useful in anticipating whether or not water conflicts might occur, patterns based on past disputes may provide lessons for

determining both the type and intensity of impending conflicts. These indicators might include the following.

Geopolitical setting

As mentioned above, relative power relationships, including riparian position, determine how a conflict unfolds. A regional power which is also an upstream riparian is in a more advantageous position to implement projects. These projects, in turn, are then catalysts for regional conflict. Turkey and India have been in such positions on the Euphrates river and the Ganges river, respectively. In contrast, the development plans of an upstream riparian may be held in check by a downstream power. An example would be Ethiopia's plans for Nile river development and its effect on Egypt.

Unresolved non water-related issues with one's neighbours could also have a deleterious effect in water conflicts. Israel, Syria, and Turkey, each and respectively have difficult political issues outstanding, which makes discussions on the Jordan river and Euphrates river more intricate.

Level of national development

The relative level of development of a party can affect 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. This situation results in more options once negotiations begin. In the Middle East multilateral working group on water, a variety of technical and management options, such as desalination, drip irrigation, and moving water from agriculture to industry, have all been presented. These options, in turn, supplement discussions over allocations of the international water resource.

Different levels of development within a river basin, 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 balanced somewhat by more access to water-saving technology, a developing country will often be the first to develop an international resource to meet its growing needs. Thailand has been making these needs clear with its greater emphasis on Mekong river development relative to the other riparians.

The hydropolitical issue at stake

In a survey of 14 river basin conflicts, Mandel (1991) offers interesting insights relating to the issues at stake in 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 river between the US and Mexico, can induce more severe conflicts than issues of water quality, such as the Colorado, Danube, and

Plata rivers. Likewise, conflicts triggered by human-initiated technological disruptions – dams and diversions – such as the Euphrates, Ganges, Indus, and Nile rivers, are more severe than those triggered by natural flooding, such as the Columbia and Senegal rivers.

Mandel's study also finds that there is no correlation between the number of disputants and the intensity of the conflict. He thus argues with the notion that river disputes with fewer parties are easier to resolve.

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 and complicates international dialogue. It is also important to know *where* control is vested institutionally. In Israel, for example, the Water Commissioner is under the authority of the Ministry of Agriculture, whereas in Jordan, the Ministry of Water has control over water resources. These respective institutional settings can shape internal political dynamics quite differently, despite the similarity of issues under concern.

National water ethos

This term incorporates several somewhat ambiguous parameters which together determine how a nation ''feels'' about its water resources. This ethos, 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, e.g. 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?
- importance of water/food security issues in political rhetoric;
- relative importance of agriculture versus industry in the national economy.

Obstacles to successful negotiations

In addition to helping anticipate water conflicts, the patterns that begin to emerge from past conflicts also suggest that there are common barriers to successful negotiations. Early identification of these barriers, included below, can help to overcome them more easily.

Lack of willingness to recognize other parties with the ability to block implementation

One limiting aspect of the International Court of Justice is that only states may be parties to cases. This structure excludes minority political

or ethnic groups, as well as a whole range of political, environmental, and special interest groups who may have a stake in an international agreement. When the Middle East peace talks began, Palestinians had representation only as part of a joint delegation with the Jordanians. Currently, Kurdish interests have no representation by any of the parties to the Euphrates river dispute. All of these exclusions result in the interests of at least one party being ignored as disputes are being resolved; parties who may be able block implementation of a final agreement.

Scientific uncertainty/disputes

Except for the Mekong river, all of the basins included within this study include data disputes as a major component of the overall water conflict. In many of the countries, at least some water data are secret. Used as a stalling tactic in some negotiations has been the call for more study of data before decisions can be made. The Mekong Committee, as the notable exception, used joint data gathering as the first major cooperative task, precluding these kinds of problems.

National vs international settings

It should be clear from the cases presented in this study that both similarities and distinct differences are inherent between national and international water conflicts. Stressed more often are the differences, but just how different the two settings are is open to debate. Assumptions that are common include the following.

Institutions and authority

National cases are often played out in relatively sophisticated institutional settings, particularly in the West, while international conflicts are hampered by the lack of an institutional capacity for conflict resolution.

It has been argued, though, that even sophisticated institutions have often not been amenable to relinquishing the traditional, usually legal, approaches to resolving water conflicts, effectively presenting the same challenges as at the international setting.

Law and enforcement

The US and other countries have, over the years, established intricate and elaborate legal structures to provide both guidance in cases of dispute, and a setting for clarifying conflicting interpretations of that guidance. International disputes, in contrast, rely on poorly defined water law, a court system in which the disputants themselves have to decide jurisdiction and frames of reference before the hearing of a case, and little in the way of enforcement mechanisms. One result is that international

water conflicts are rarely heard in the International Court of Justice. Likewise, of the international cases presented in this document, only the Mekong Committee has used the legal definition of ''reasonable and equitable'' use in its agreement.

Presumption of equal power

''All are equal in the eyes of the law,'' is a common phrase describing national legal frameworks. No such presumption exists in international conflicts, where power inequities define regional relations. Each of the watersheds presented here includes a hegemonic power, which brings its strength to bear in regional negotiations, and which often sees agreements tilt in its favour as a consequence.

Here, too, it has been argued that unequal resources, usually financial or political, result in real-world inequities finding their way into the national settings of conflict resolution as well.

The BATNA (Best Alternative to a Negotiated Agreement)

A difference commonly pointed out between national and international disputes is that, in national water conflicts, war is not usually a realistic alternative to failed negotiations. While it may be true that intranational ''water wars'' are not likely, the same is increasingly accepted as being true of the international setting. While shots have been fired, both nationally and internationally, and there has been troop mobilization between countries, no all-out war has ever been caused by water resources alone. As one analyst familiar with both strategic issues and water resources has 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'' (Tamir, in Wolf, 1995: 76).

While real differences do exist between the national and international settings for water conflict resolution, these distinctions may not be as great as is often thought. The fortunate corollary to this situation is that many of the successes of ADR in the national realm may be more applicable to the international setting than is commonly argued.

Summary

A clear understanding of the details of how water conflicts have been resolved historically is vital in discerning patterns that may be useful in resolving or, better, precluding, future conflict. Our investigations of 14 disputes suggest that, generally, the following pattern tends to emerge: riparians of an international basin implement water development projects

unilaterally first on water within their territory, in attempts to avoid the political intricacies of the shared resource. At some point, as water demand approaches supply, one of the riparians, generally the regional power, will implement a project that impacts on at least one of its neighbours. This project can, in the absence of relations or institutions conducive to conflict resolution between the riparians, become a flashpoint, resulting in conflict. The comparative analysis also suggests other indicators of impending or likely water conflict; obstacles to successful negotiations; and observations regarding the national versus international settings.

Water treaties[3]

With the single exception of air to breathe, the human physiology needs no resource greater than water. Humans use water for a variety of needs, ranging from absolutely critical (drinking) to luxurious (swimming pools, fountains, or golf courses in the desert). Population pressures have a stronger impact every year on the amount of water available per capita in various parts of the world. International agreements about water address a growing relative scarcity. Agriculture requires nearly salt-free water, and concerns about industrial effluent mean that water quality issues will also find their way into international agreements. But the problem of scarcity, though growing, is not new. Water has been a source of contention for at least 4,500 years, as historians have found a treaty to end a water war between the ancient Mesopotamian states of Lagash and Umma (Cooper, 1983). More recently, treaties dating from the nineteenth century have addressed all facets of consumptive and non-consumptive water uses.

Because the basic problems associated with scarce water and water quality remain unchanged, the way in which governments solved difficulties in the past may prove useful for negotiations in the present. With this aim in mind, the authors have undertaken to collect and summarize all treaties addressing freshwater needs of the signatories in a Transboundary Freshwater Dispute Database. Our main criterion for selecting a treaty depended on whether its ''major'' focus was water as a scarce, consumable resource. Therefore, we include those that touch on transportation, fishing, and boundary demarcations only as they are relevant to issues of allocation and use.

The treaty database provides some confirmation or insight into other authors' ideas, such as Gulhati's (1973) comment that outside negotiators with additional resources to bring to bear can smooth or eliminate difficulties. The treaty database also shows areas in need of improvement or examination: perhaps if the reasoning behind the language of water allocations were better known, the numbers and bargains could be reused for

equitable treaty making elsewhere or later in the same basin. As more treaties enter the database, more theories of negotiation also come up for analysis; some theories could be made new by application in a different region.

Studies of conflict do not usually centre on the treaties; if two states have a conflict, either the treaty does not satisfy one or either side (was the agreement negotiated fairly at the outset?), or a new development has changed the circumstances of the original treaty (climatic change and/or population growth). In addition, a treaty depends on good relations and good faith. In the absence of both, a treaty has little hope of maintaining peace. Yet of the 145 treaties making up the database in late 1997, the authors know of few if any that have been broken.

Treaties offer great amounts of information: they can tell about regional hegemony, how and which water needs are met, the relative importance of water in the political climate, development issues, and whether earlier treaties have successfully guided or guaranteed state behaviour.

Literature review

Treaty studies occupy only a small fraction of the dispute resolution literature. Most recently, Wescoat (1996) has produced ''Main Currents in Early Multilateral Water Treaties: A Historical-Geographic Perspective.'' Legal scholars have discussed international law and treaty making, notably Teclaff (1991) and McCaffrey (1993). McCaffrey also offers theories about trends in treaty making, specifically the move towards integrated management from cut-and-paste approaches, the move away from navigation as the primary use, and the trend towards ''equitable utilization.'' Hayton (1988, 1991) has argued that international law should include hydrologic processes in its theory. Dellapenna (1995) describes the evolution of treaty practice dating back to the mid-1800s, and Wescoat assesses historic trends of water treaties dating from 1648–1948 in a global perspective. Gulhati (1973) and Michel (1967) provide the most comprehensive analysis of a single treaty and the events and people leading up to its approval. The two authors discuss the 1960 Indus Waters Treaty and provide history that explains the wording and spirit of the treaty. Deeper analysis of major treaties, like Gulhati and Michel's work, is necessary for better interpretation of any statistical data the database may produce.

Background of modern water treaties

Treaties acknowledging and addressing water at least in terms of fishing, regularization, and navigation became common in the nineteenth century, based on the frequency of these treaties occurring in the treaty sources

(see Methodology, below, for a list of sources). Population pressures may be responsible for water's rise in importance. Population-induced water stress may also change the parameters under which a treaty was previously concluded, rendering the treaty less applicable to the situation.

Water allocations are not included in early negotiations of an economic nature, such as treaties regulating pilotage or trade. In fact, few allocative treaties were negotiated prior to water needs and water stress reaching critical levels. Regarding hydropower, these treaties have decreased in significance because of a decrease in new dam construction. One exception may be Nepal, with an estimated 2 per cent (83,000 megawatts) (Aryal, 1995) of the world hydropower potential, but at present, geologic, engineering, and financial problems have slowed construction even in this country (Ganguly, personal communication).

Methodology

Many sources contain information about water-related treaties. The FAO (1978, 1984) indices of water treaties provide the greatest number – more than 3,600 relating to water use dating between 805 AD and 1984 – from which to choose relevant treaties. In addition to the FAO indices, law texts, journal articles, foreign policy documents or collections, personal contacts, and departments of state all provided additions to the database.

The treaties are identified as relevant based on their inclusion and treatment of one or more of the following issues: water rights, allocations, pollution, or principles for equitably addressing water needs; hydropower and reservoir/flood control development; environmental issues/water ''rights'' for riverine ecological systems; and on occasion, navigation, fishing, or border demarcation, usually in combination with unique and innovative conflict resolution methods.

All treaties were read thoroughly for specific and non-specific information. Some sources only contain excerpts or annotated treaty summaries. The full texts of those documents will eventually complete the database records for those agreements. Condensed treaties (some with direct quotes from the text) reside in the database; the reader will find the entire collection in Chapter 8. The textual information exists in discrete records, and the authors have taken some data – which may be meaningful when expressed statistically – and compiled it into percentages. As answers to further questions fill gaps in the database (such as how well each treaty has prevented diplomatic friction or how smoothly the negotiations proceeded), more meaningful quantitative analysis can be conducted.

Each treaty summary contains the following information: the name of the basin, principal focus, number of signatories, non-water linkages (such as money, land, or concessions in exchange for water supply or access to

water), provisions for monitoring, enforcement, and conflict resolution, method and amount of water division, if any, and the date signed. Treaties signed before the mid-twentieth century are often incomplete or contain standard answers in most categories. Not surprisingly, population pressures affected fewer water treaties earlier in the century (that is, explicit allocations were less frequent in earlier treaties). Many of these treaties therefore address competition and conflict over water quantity less completely than do more modern treaties.

The category ''principal focus'' elicited the most possible answers (seven). Defining the principal focus of a treaty often proves difficult. Other categories are less difficult to manage. For instance, the existence of a commission (or council, technical advisory body, etc.) is easily determined. Either a treaty provides for it or it does not. Less clear are the powers of a commission; technical commissions *could* address disputes, but often the treaty deals with conflict resolution through other channels. If the agreements list no other form of dispute resolution, the authors assume that any conflict falls first to the advisory council and later to the respective signatory governments.

The database and its contents[4]

Number of signatories

Some treaties show common characteristics when expressed in statistical terms. For instance, a large majority of agreements have only two signatories (124 out of 145, or 86 per cent). Yet international rivers often have more than two riparians. The development and implementation of multilateral treaties have taken much more time than bilateral treaties. Even in situations where more than two parties have interests over a given body of fresh water (for instance, the Danube), few treaties (only 21 out of 145, or 14 per cent) include three or more parties.

It is unclear whether so many treaties are bilateral because only two states share a majority of international watersheds or because, according to negotiation theory, the difficulty of negotiations increases as the number of parties increases (Zartman, 1978). In basins with more than two riparians, this preference towards bilateral agreements can preclude the comprehensive regional management long advocated by water-resource managers. In addition, as ''Balkanization'' continues, i.e the fragmentation of countries into smaller, more homogeneous units, named for the historic and ongoing difficulties in the former Yugoslavia, the number of riparians will increase as well.

Multilateral treaties are still at a developmental stage, accounting for only 21 of the treaties in the current database. They usually address only

minor environmental and data-gathering issues, although efforts to change that situation are underway. Some have established advisory bodies. None have follow-up treaties to add specifics lacking in the original agreements.

Wescoat (1996) examined multilateral treaties because they ''reflect the influence of broad (rather than local) geopolitical situations,'' but the obvious prominence of bilateral treaties also indicates that countries prefer to negotiate one-on-one. Some nations have a predisposition to bilateral agreements: India's longstanding policy of bilateral-only negotiations presents a problem when attempting to develop a basin-level approach to managing the Ganges-Brahmaputra or Indus river systems. The Murray River Agreement, although not included in this database, has undergone substantial analysis as a ''multilateral agreement.'' Although this agreement is among three Australian territories and is not international per se, it is often used as a model for the management of river basins among neighbours with more tenuous relationships, such as India and Bangladesh. All but three of the multilateral agreements listed in our database lack definite water allotments, although a few establish advisory and governing bodies among states to address this issue.

Of the 21 multilateral treaties/agreements, developing nations account for 13. Only one multilateral treaty exists among industrialized nations for allocations to a water source, namely the treaty regarding water withdrawals from Lake Constance signed by Germany, Austria, and Switzerland in 1966. None of the preindustrial-nation multilateral agreements specified any water allocations; instead all involved hydropower or other industrial uses.

The states surrounding the Aral sea signed an agreement in 1993 that addresses several issues, but the text itself does not address the issue of water allocations nor does it provide a blueprint for future water use. Like the Aral sea, Lake Chad also suffers from intense, poorly managed water resources, and extensive water withdrawals (Rangeley et al, 1994). The Chad Basin Treaty (1964), among Cameroon, Niger, Nigeria, and Chad, covers issues such as the economic development inside the basin, the lake's tributaries, and industrial uses of the lake, but does not address allocations. The agreement does create a commission, which, among other things, arbitrates disputes concerning implementation of the treaty. The commission prepares general regulations, coordinates the research activities of the four states, examines their development schemes, makes recommendations, and maintains contact among the four states.

Principal focus

Most treaties focus on hydropower and water supplies: 57 (39 per cent) of the treaties discuss hydroelectric generation, and 53 (37 per cent) distribute water for consumption. Nine (6 per cent) mention industrial uses,

six (4 per cent) navigation, and six (4 per cent) primarily discuss pollution. Thirteen of the 145 (9 per cent) focus on flood control. The database includes one treaty that primarily discusses fishing (less than 1 per cent) (included in the database for other elements).

Monitoring

Seventy-eight treaties (54 per cent) have provisions for monitoring, while 67 (46 per cent) do not. When monitoring is mentioned, it is addressed in detail, often including provisions for data sharing, surveying, and schedules for collecting data.

Information sharing generally engenders good will and can provide confidence-building measures between co-riparians. Unfortunately, some states classify river flows as secret and others use lack of mutually acceptable data as a stalling technique in their negotiations. Most monitoring clauses contain only the most rudimentary elements, perhaps due to the time and labour costs of gathering data.

However, data collected by signatories of the treaty can provide a solid base for later discussions. India and Bangladesh previously could not agree on the accuracy of each other's hydrologic records, but eventually agreed on Ganges flow data and based a workable agreement on those data in 1977. The cooperation between engineers or among council members can result in the formation of an epistemic community, another positive outcome of data gathering/sharing. Treaties do not yet include provisions to monitor compliance, but such additions may bolster trust and increase the strength of these epistemic bonds.

Method for water division

Few treaties allocate water: clearly defined allocations account for 54 (37 per cent) of the agreements. Of that number, 15 (28 per cent) specify equal portions, and 39 (72 per cent) provide a specific means of allocation. There are four general trends in those treaties that specify allocations:

1. A shift in position often occurs during negotiations from ''rights-based'' criteria (whether hydrographic or chronological) in favour of ''needs-based'' values, based on irrigable land or population.
2. In the inherent disputes between upstream and downstream riparians over existing and future uses, the needs of the downstream riparian are more often delineated (agreements mention upstream needs only in boundary waters accords in humid regions) and existing uses, when mentioned, are *always* protected.
3. Economic benefits are not explicitly used in allocating water, although economic principles have helped guide definitions of ''beneficial'' uses and have suggested ''baskets'' of benefits, including both water and non-water resources, for positive-sum solutions.

4. The uniqueness of each basin is repeatedly suggested, both implicitly and explicitly, in the treaty texts.

This last point is exemplified in three unique treaties devised by negotiators: the 1959 Nile Waters Treaty divides the average flow based on existing uses, then evenly divides any future supplies projected from the Aswan High Dam and the Jonglei canal project; the Johnston Negotiations led to allocations between Jordan river riparians based on the irrigable land within the watershed; each party could then do what it wished with its allocation, including divert it out-of-basin; and the Boundary Waters agreement, negotiated with a hydropower focus between Canada and the United States, which provides for a greater minimum flow limit of the Niagara river over the famous falls during summer daylight hours, when tourism is at its peak.

Hydropower

Fifty-seven of the treaties (39 per cent) focus on hydropower. Power-generating facilities bring development, and hydropower provides a cheap source of electricity to spur developing economies. Some, however, suggest that the age of building dams will soon end, because of lack of funding for large dams, a general lack of suitable new dam sites, and environmental concerns.

Not surprisingly, mountainous developing nations at the headwaters of the world's rivers are signatories to the bulk of the hydropower agreements. Nepal alone, with an estimated 2 per cent of the world's hydropower potential, has four treaties with India (the Kosi river agreements of 1954, 1966, and 1978, and the Gandak power project in 1959) to exploit the huge power potential of the region.

Groundwater

Only three agreements deal with groundwater supply: the 1910 Convention between Great Britain and the Sultan of Abdali, the 1994 Jordan-Israeli and 1995 Palestinian-Israeli agreements. Treaties that focus on pollution usually mention groundwater, but do not quantitatively address the issue.

The complexities of groundwater law are described elsewhere in this work. Overpumping can impair an aquifer as a source for human consumption, through salinity from natural sources, seawater intrusion or evaporation deposition. Therefore, allocating groundwater is an especially intricate exercise.

The Bellagio Draft Treaty, developed in 1989, attempts to provide a legal framework for groundwater negotiations. The treaty requires joint management of shared aquifers and describes principles based on mutual respect, good neighbourliness, and reciprocity. While the Draft recog-

nizes that obtaining groundwater data can prove difficult and expensive, and that mutually acceptable information relies on cooperative and reciprocal negotiations, it nevertheless provides a useful framework for future groundwater diplomacy.

Non-water linkages

Negotiators may facilitate the success of treaty negotiations by enlarging the scope of water disputes to include non-water issues. If pollution causes trouble in a downstream country, an upstream neighbour may opt to pay for a treatment plant in lieu of reduced inputs or reduced withdrawals. In such a case, lesser amounts of high-quality water may improve relations more than a greater quantity of polluted or marginal-quality water. Such tactics ''enlarge the pie'' of available water and other resources in a basin. Non-water linkages include capital, 44 (30 per cent); land, 6 (4 per cent); political concessions, 2 (1 per cent). Other linkages account for 10 treaties (7 per cent) and there are no linkages for 83 treaties (57 per cent).

Examples of these linkages can be found in the 1929 Nile agreement, in which the British agreed to give technical support to both Sudan and Egypt. In lieu of payments, the Soviet Union agreed to compensate lost power generation to Finland in perpetuity (the 1972 Vuoksa agreement). Britain even established a ferry service across newly widened parts of the Hathmatee river in India, in compensation for the inaccessibility problems created by a dam project in the late 1800s.

Compensation for land flooded by dam projects is common. For example, British colonies usually agreed to pay for water delivery and reservoir upkeep, and the British government agreed to pay for damage to houses. However, capital can provide compensation for a greater array of treaty externalities and requirements, such as the construction of new water delivery facilities (the India-Nepal Kosi river project agreements, signed in 1954 and 1966 provide two examples).

Treaties that allocate water also include payments for water – 44 treaties (30 per cent) include monetary transfers or future payments. As early as 1925, Britain moved towards equitable use of the rivers in its colonies: Sudan agreed to pay a portion of the income generated by new irrigation projects to Eritrea, since the Gash river flowed through that state as well. Some treaties also recognize the need to compensate for hydropower losses and irrigation losses due to reservoir storage (the 1951 Finland/Norway treaty and the 1952 Egypt/Uganda treaty both include such clauses). Again, these agreements emphasize the monetary aspect of water: they do not describe water as a right.

Because of individual specialization in conflict management or regional studies, one person may have difficulties finding information about similar

Table 1 Selected treaty clauses regarding non-water linkages and unique water sharing

Agreement	Clause
Exchange of notes constituting an agreement between the UK/ Uganda and Egypt regarding the construction of the Owen Falls dam in Uganda	Egypt pays Uganda £980,000 (loss of hydroelectric power) and also flood compensation (upon a later flood)
Convention between the governments of Yugoslavia and Austria concerning water economy questions relating to the Drava	Yugoslavia receives at least 50m schillings in industrial products for 82,500 MWH over 4 years
Johnston Negotiations	Syria: 132 MCM (10.3%); Jordan: 720 MCM (56%); Israel: 400 MCM (31.0%); Lebanon: 35 MCM. Based on area of irrigable land within the watershed in each country
Exchange of notes constituting and agreement between the US and Mexico concerning the loan of waters of the Colorado river for irrigation of lands in the Mexicali valley	USA releases 40,535 acre-feet (50 MCM) of water from September to December 1966 and will retain the same amount over one or three years, depending on the weather conditions that follow
Agreement between Finland and the USSR concerning the production of electric power in the part of the Vuoksi river bounded by the Imatra	The loss of 19,900 MWH generating capacity will be compensated to Finland in perpetuity

treaties in other areas. A survey of the Database reveals some interesting means of solving disputes. At least a few are worthy of a brief discussion. In addition to the two clauses in the 1952 Egypt/Uganda and the 1951 Finland/Norway treaties that provide financial compensation, other treaties address compensation or allocation without money. The common denominator among these selections is the willingness to use, as stated above in Method for water division, ''baskets of benefits'' instead of water or simple monetary transfers. Table 1 lists several non-water linkage or unique methods of sharing water.

Enforcement

Treaties may handle disputes with technical commissions, basin commissions, or via government officials. Fifty-two (36 per cent) of the treaties provide for an advisory council or conflict-addressing body within the parties' governments. Fourteen (10 per cent) refer disputes to a third party or the United Nations. Thirty-two (22 per cent) make no provisions

for dispute resolution, and 47 (32 per cent) of the texts are either incomplete or uncertain as to the creation of dispute resolution mechanisms. Can a technical advisory body address disputes? Perhaps, but as noted in Methodology (above), the treaties do not *expressly* provide for such activity.

Historically, force or the threat of force can ensure that a water treaty will be followed – but power is less desirable and more expensive as a guarantor of compliance than mutual agreement. Britain, for example, could force its colonial holdings to follow water treaties because it had one of the most powerful administrative and military organizations in the world. Similarly but more subtly, allocative agreements tend to favour regional hegemons because of their respective power. In some cases, such as the 1959 Nile Waters Treaty, other riparians do not appear in the treaty at all, clearly showing the balance of power in this basin.

While the conflict resolution mechanisms in these treaties do not generally show tremendous sophistication, new enforcement possibilities exist with new monitoring technology. It is now possible to manage a watershed in real time, using a combination of remote sensing and radio-operated control systems. In fact, the next major step in treaty development may well be mutually enforceable provisions, based in part on this technology of objective and highly detailed images, better chemical testing and more accurate flow computations than previously available.

Summary

The study of treaties does not occupy a significant portion of published literature, and therefore the useful information contained in international agreements remains largely undiscovered. More information is necessary regarding the success of treaties and whether the advisory/arbitration councils provide useful services in maintaining just and peaceful relations. The study of successes in some states may yield new ideas for negotiation in other regions. Hopefully the people responsible for the successful treaties can also provide input into the discussions concerning less successful or less amicable agreements. The authors hope that as additional treaties make the database more robust, clearer trends will emerge and scholars will find tools to broaden further the range of dispute resolution.

Notes

1. Some of these arguments, and many of these case studies, are summarized from Wolf's work in Bingham et al. (1994).

2. "Power" in regional hydropolitics can include riparian position, with an upstream riparian having more relative strength *vis-à-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 on one's neighbours, it is generally undertaken by the regional power, as defined by traditional terms, *regardless* of its riparian position.
3. The authors are indebted to those agencies that have helped fund different aspects of the Database, including the US Institute of Peace, the World Bank, the US Agency for International Development, Pacific Northwest National Labs, the Alabama Water Resources Institute, the University of Alabama, and the Oregon State University Department of Geosciences.
4. Some of the following is drawn from Hamner and Wolf (1998).