Legal and Institutional Adaptation to Climate Uncertainty: A Study of International Rivers

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Abstract
This study seeks to understand why nations find it difficult to include climate-uncertainty mechanisms in treaties regulating international rivers. It also aims to examine the implications of not adopting these mechanisms, particularly during a crisis. The study focuses on the negotiation process of three water treaties, and seeks to identify the underlying reasons behind the inclusion – or exclusion – of such mechanisms. Second, it review how the treaties performed and evolved during drought. The first case study is the current drought along the lower Rio Grande and the 1944 water treaty between Mexico and the U.S; the second is the 1961-1964 drought along the Great Lakes and the 1909 water treaty between Canada and the U.S. and, finally, it examines the 1997-2000 water shortage in the Jordan Basin and the 1994 treaty between Israel and Jordan. It was found that issues of sovereignty, water stress, power asymmetry, optimistic water scenarios, and the nature of the treaties as "package deals" impede riparians from adopting some of these mechanisms. Among them is a joint institution with wide scope and geographical jurisdiction, escape clause, allocating water according to percentage of flow, balance mechanism and a binding arbitration procedure. By excluding these mechanisms the anticipated political cost of an agreement decreases. However, this exclusion process limits the ability of these treaties and their institutions to manage a crisis situation, which may in turn engender controversy between the riparians as to how to divide the water in such a situation. Yet, It was found that during crisis treaties tend to evolve as the different parties supplement them with new legal and institutional measures that provide only partial immediate remedy to the crisis at hand. This stress the need to incorporate the mechanisms that are simultaneously politically feasible and hydrologically effective.

1. **Introduction**

Political and physical boundaries often do not spatially correspond. Consequently, upstream riparians often impose externalities on their downstream neighbors. This situation raises the need to establish joint mechanisms to internalize negative externalities (LeMarquand, 1993; Molden and Douglas, 2002; Dieperink, 1995). Treaties and international institutions often provide the mechanisms for regulating the use of common natural resources (Oran and Levy, 1999; Susskind, 1994; Beach et al, 2000). In the sphere of water resources, the role of these mechanisms is to regulate the quality and quantity of water between riparians sharing international rivers (Benvenisti, 1996), often by setting the amount of water the upstream riparian delivers downstream (Wolf, 1998). The last millennium has seen more than 1,000 international treaties signed (UN FAO 1978), 300 of them in the last century, in an attempt to regulate water use among international basins (Wolf, 1991).

In the process of divvying up their shared water resources, however, riparians must also consider variations in water availability. These changes can result from meteorological drought (climate fluctuations) or socioeconomic drought (human actions) (Hoyt, 1942; Wilhite and Glantz, 1985). Since demand and supply swings may hinder the riparians' ability to supply the amount specified by the treaties, it is essential that mechanisms are built into the treaties to accommodate change in circumstances (Benvenisti, 1996, 2002; Koremanos et al, 2001; Gleick, 1993) such as seasonal fluctuations (Wolf, 1998; Tarlock, 1994; Benvenisti, 2002). The Bonn Ministerial Declaration on Freshwater (2001) provides an example for the need to institutionally accommodate climate changes. It states, "Decision-making mechanisms under uncertainty should ensure flexibility to respond to both rapid onset disasters and long-term changes to water resources"

Yet, despite the need to adopt mechanisms to address events of climate uncertainty many treaties lack such language (Tarlock, 1994; Goldeman, 1988) and flexible allocation methods remain in the minority (UNEP, 2002). This study seeks to understand why nations find it difficult to include hydrologic variability mechanisms in treaties. It also aims to examine the implications of not adopting these mechanisms, particularly during a crisis. It is hypothesized that it is not a lack of awareness, but the political cost associated with the inclusion of these mechanisms that prevents riparians from adopting climate-uncertainty mechanisms.

The first part of this study focuses on the negotiation process of three water treaties, and seeks to identify the underlying reasons behind the inclusion – or exclusion – of such mechanisms, especially drought mitigation measures. Second, it examines the ramifications of not adopting comprehensive mitigation measures by reviewing how the treaties performed and evolved during drought conditions. Finally, it draws conclusions by comparing and contrasting the three case studies. The first case, concerns the current drought along the lower Rio Grande and the 1944 treaty between Mexico and the United States; the second case is the 1961-1964 drought along the Great Lakes and the 1909 treaty between Canada and the U.S.; and the third is the case of the 1997-1999 severe water shortage in the Jordan Basin and the 1994 peace treaty between Israel and Jordan which appropriated the international waters in the Jordan Basin.

These cases were selected since they represent cases under flux where the decisions made in the past to exclude many of the climate uncertainty mechanisms have to be addressed today under crisis conditions. This provides an opportunity to identify how

these cases function and evolve during conditions of drought. Furthermore, these three cases represent conditions of power asymmetry between the different parties that, as is shown below, affected the decision to exclude many of these mechanisms. Yet, since these treaties differ in the hydrological and development setting, the impact of this variability can be better understood.

2. The Available Climate Uncertainty Mechanisms

Several relevant mechanisms can be identified. First, a treaty may specify that the upper riparian delivers to the lower riparians a minimal amount of water. An agreement with wide margins of water flow can help ensure the treaty requirements are met, even during crises. However, downstream riparians may not agree to receive a minimal amount of water, which the upper riparian may under normal conditions be able to deliver. Thus, riparians can use an escape-clause mechanism to cover only exceptional situations. This mechanism allows countries suffering from drought to deliver less water than they would under normal conditions. Thereby, allow them to respond to unpredicted shock while preserving the treaty itself (Koremenos et al, 2001). This escape clause often specifies the absolute quantity in volumetric terms the upstream riparian is to deliver in times of a drought. However, since downstream riparians often oppose the use of such a mechanism, as it implies that they will receive less water in times of drought, it is often accompanied by a deficit mechanism. This allows the upstream riparians to reduce their water flow, while compelling them to return the water a few years later, when the drought ends. Another type of escape clause enables the signatories to revoke the treaty if deemed necessary and then to renegotiate it in order to redivide the resources. Advance notice of several years is necessary before taking this measure (Elias, 1974), which implies that in a crisis situation the signatory countries still have to deliver the required water. A less implicit escape clause enables adoption a periodic review process. This allows the different sides to evaluate the treaty performance, and especially the water allocation, every few years and thus to update it in line with current hydrological and development conditions and new scientific knowledge (Susskind, 1994). Such a mechanism was adopted in 1972 by Canada and the U.S. when they signed the Great Lakes Water Quality Agreement[1].

Another way to enhance treaty flexibility is to allocate water according to percentage and time of flow. This mechanism is commonly used among Berbers in the High Atlas Mountains and the Bedouin in Israel's Negev Desert (Wolf, 1998). Yet, this type of mechanism, which spreads the risk of drought among parties, puts downstream users at particular risk if changes occur upstream. Such is the case on the Ganges River where, nowadays, Bangladesh experienced decreasing flow due to greater upstream use by India (Wolf, 1997).

The establishment of joint institutions to manage the shared water and optimize its use in times of crisis, such as drought is also an option (Feitelson and Haddad, 1999; Najjar, 2001). These institutions may be granted wide scope and jurisdiction that include management elements, such as initiating joint projects like desalinization plants or storage reservoirs aimed at increasing the available water supply. They may even include a conflict-resolution mechanism that allows them to change the water allocations between the states as a response to drought (Feitelson and Haddad, 1999).

[1] This agreement signed in 1972 and updated in 1978 and 1987 aim is to incorporate water quality standards to the Great Lakes. Yet, it was done within the excising 1909 treaty framework. For more see Becker, 1996.

These institutions are often supported by external bodies that may provide financial and technical help often at the implementation phase of the treaty. One example for going beyond negotiating around allocation of flow and seeking third party involvement for joint development is the case of the recent Nile Initiative and the role of the World Bank. In this case the World Bank to a major role in coordinating donor involvement and establishing a consultative group to raise financing for cooperative projects (World Bank, 2003).

These institutions will have greater flexibility to mitigate crisis situations if they are given control over the different parts of the hydrologic cycle, including allocation of surface water, groundwater, and water quantity (Feitelson, 2000). This conjunctive management can allow greater operational leeway by advancing spatial and temporal tradeoffs between the different components of the hydrologic cycle and between water quality and quantity especially during climate change (Marino, 2001). A balancing mechanism is thus established in which difficulties in delivery of water in one place can be offset by water deliveries at another place, where the water is abundant. Furthermore, in the event that climate change altering flow, it may be easier for the joint bodies to determine how to re-divide the resource if the treaty specifies an order of preference for uses of water shared (Goldeman, 1990).

Despite the need to adopt climate-uncertainty mechanisms so as to increase a treaty's flexibility to cope with fluctuations in the water availability, riparians find it difficult to do so; as a result, many treaties lack such language (Tarlock, 1994; Goldeman, 1988). Thus, upstream riparians may have to reduce their internal water consumption in order to deliver the water in times of shortage. If they fail to do so, and violate their international agreements, conflict is likely to ensue. In other cases, the climate-uncertainty mechanisms incorporated may be found to be insufficient in times of crisis; this is the cause of the current conflict between the U.S. and Mexico along the lower Rio Grande, which will be discussed in greater detail below.

The next sections explores why nations find it difficult to include these mechanisms and also identify the implications of it. This is though focusing on the negotiation process of three treaties and examining how these treaties functioned and evolved during drought events.

3. The Lower Rio Grande Basin

3.1 The 1944 Treaty and Its Climate-Uncertainty Mechanisms: A Review

Already at the beginning of the twentieth century the U.S. and Mexico were trying to divide their transboundary water along their two major international basins: the Rio Grande and the Colorado (Timm, 1941; Hundley, 1966) (Fig 1). In 1944 a treaty was achieved to divide these waters. The 1944 Treaty stipulated that, on the Rio Grande, Mexico must deliver to the U.S. one-third of the flow reaching the main channel of the river, subject to the U.S. right to an average of at least 350,000 acre-feet per year (Article 4, 1944 Treaty). In case of "extraordinary drought," the treaty includes an escape clause that enables Mexico to deliver less than this minimum amount in a five-year cycle, but requires it to make up the deficit over the subsequent five years (Article 4, paragraph B(d), 1944 Treaty). Furthermore, the treaty provides an order of preference for uses of water shared between the two sides that can ease the process of determining

an equitable utilization in the event of climate-related flow alteration (Goldeman, 1990). The treaty was supplemented with a minute mechanism that allows establishing new joint actions around a particular issue, conditioned on the approval of the two governments and their presidents (Herrera and Friedkin, 1967). Furthermore, the treaty agreed upon the construction of two international dams to mitigate seasonal variability in the water flow and generation of hydroelectricity along the Rio Grande (Part II, Articles 5 and 7, 1944 Treaty). To administer the treaty a permanent institution (the International Boundary and Water Commission, IBWC) was established, comprised of a Mexican and an American section. However, this body's authority was restricted to only the boundary surface water.

To understand the rationale for the mechanisms included and excluded in the 1944 Treaty, the next section identifies some of the riparians' underlying assumptions at the time it was negotiated.

Fig. 1. The transboundary basins between the US and Mexico

3.2. Underlying Reasons for Including and Excluding Mechanisms

When the treaty was negotiated, the Mexican National Irrigation Commission estimated that the six tributaries, which under the 1944 Treaty deliver a minimum of 350,000 acre-feet to the U.S., provide an average annual flow of 1,153,000 acre-feet of water, thus leaving Mexico on the Rio Grande with 803,000 acre-feet of water a year (Alba, 1945). As the major focus for development at that time was the Mexicali Valley along the lower Colorado River (Hundely, 1966,p 80), the Mexicans predicted a low development rate along the lower Rio Grande basin and especially along the Delicias River[2] (Alba, 1945). Consequently, it was estimated that the water allocated to the lower Rio Grande Basin should be enough to cover any future projects including the water delivered to the U.S. (Alba, 1945). As a result of prioritizing the Colorado Basin over the Rio Grande Basin, Mexico had an interest in having a treaty that was broad in jurisdiction and scope. This, it was thought, would later facilitate advancement of a tradeoff in which Mexico would deliver to the U.S. more water on the Rio Grande in exchange for more water on the Colorado, as in fact happened (Northcutt, 1946; Gomez, 1945).

The Mexicans were aware of temporal and spatial fluctuations in water availability that might occur during droughts. Hence, they insisted that the treaty contain a drought stipulation enabling Mexico to deliver its water to the U.S. not on an annual basis but on a five-year cycle that could be extended to ten years if necessary (Gomez, 1945). This stipulation was based on the assumption that no more than a few consecutive years of drought were expected; thus, a second five-year cycle would be sufficient to enable Mexico to pay the debt accumulated in the first five years (Gomez, 1945). Some irrigation managers along the Rio Bravo were concerned with the lack of equity in this drought stipulation as it allowed the U.S. during drought not to deliver Colorado water but did not enable the same flexibility for Mexico along the Rio Grande (Alba, 1945). Still, the Mexican federal government argued for the mechanism's efficiency, which on the Rio Grande provided Mexico with a flexible delivery schedule – in contrast to the rigid monthly schedule the U.S. was obligated to on the Colorado (Albe, 1945).

Mexico was looking for a comprehensive treaty in scale and scope, but within the U.S. there was fear that the IBWC would become a supranational organization that could advance trans-basin tradeoffs and have basin-wide authority. This fear, expressed most vociferously by the states of California, Nevada and the Bureau of Reclamation (which was afraid of the IBWC taking control of its water infrastructure), finally restricted the IBWC's authority to surface flow across the boundary line, excluding the trans-basin water-balancing mechanism (Hearing at the Committee of Foreign Affairs, 1945,p. 1683- thereafter referred to as Hearing; Glaeser, 1947), and subordinated it to the domestic laws of the individual states (Hearing, p. 124). The result was a treaty that covered only limited aspects of the international waters problems (Mumme, 1982, p. 91) and a water commission that was limited in power, which, as is shown below, hampered its ability to meet the challenge of climate uncertainty.

[2] This river accounts for about 57% of the Mexican irrigated water used along the Rio Grande (*Kelly, 2001a*).

To identify the implications of excluding corrective mechanisms, the next section examines how the treaties function and evolve during droughts.

3.3. The Treaty and Mechanisms on Trial

By 2002, the Rio Grande has experienced 10 consecutive years of drought. Basin average annual rainfall until thee year 2000 was 20% less than normal (R.J. Brandes Company, 2000) and flow of the lower Rio Grande tributaries was decreased by 66%. The drought conditions have been also accompanied by rapid agricultural and urban development in the Mexican border state of Chihuahua, which contributes most of the water delivered to the U.S. This increase in agricultural development is reflected in the land irrigated around the Delicias River, which, by 1990, had exceeded by 50% the development rate predicted at the time the 1944 Treaty was negotiated.[3] This means that some 421 million cubic meters (mcm) of water were consumed beyond predictions,[4] an amount that could have counterweighted the Mexican annual water deficit.

As a result of the unpredicted change in conditions, Mexico already in 1997, invoked the "extraordinary drought" stipulation as it was about to complete a five-year cycle of water deliveries to the U.S. and it was not able to meet its commitment. However, continued drought and ongoing development along the basin meant that by 2000 Mexico had accumulated a water deficit of 1.4 million acre-feet (IBWC, 2002).

The non-delivery of water has caused the 28 Texas irrigation districts, which are entirely dependent on this water transfer, an estimated $1 billion in losses (Taylor, 2002b) and a loss of 4,000 jobs just in the year 2002 (Texas Comptroller, 2002a). The U.S. farmers' losses, and frustration, pushed them to pressure the U.S. policy makers to seek an immediate solution to the crisis. Mexico, in turn, employed the Minute mechanism incorporated in the 1944 Treaty: it delivered to the U.S. its 50% share of the water originating from undesignated inflows to the Rio Grande and later provided more water through transfer of ownership from the two international reservoirs along the Rio Grande (IBWC, 2002). Between October 1999 and September 2000, 300,000 acre-feet of water were delivered through these means (IBWC, 2002). Using the minute mechanism also resulted in another minute (Minute 307), which obliged Mexico to deliver 600,000 acre-feet of water by September 30, 2001 (IBWC, 2002) and raised the need to develop new drought mechanisms for future crises (IBWC, Minute 307). However, only just over half of the water, assigned by Minute 307, was transferred to the U.S. (IBWC, 2002).

The Mexican government, aware of the difficulty it would have to pay its deficit, suggested amending the existing drought escape clause, through a new minute, with an escape clause that would allow Mexico to stop delivering water to the U.S. altogether in times of drought. This solution was advanced on the basis of reciprocity, since the U.S. has such a mechanism for the Colorado (Székely, 2001; Luévano, 2001). However, the U.S. has refused to accept this solution. An alternative suggested by the state of Chihuahua is to renegotiate the existing treaty. So far, the Mexican federal government has refused to pursue such a course as the treaty pertains to both basins, i.e., a renegotiation process over the Rio Grande may impact on the Colorado water deliveries to

[3] The current use of irrigated farmland in 1990 was 96,355 hectares (Kelly, 2001a), compared to 63,371 hectares predicted when the 1944 treaty was negotiated (Alba, 1945).

[4] This is based on the estimate that the 96,355 hectares of irrigated land in 1990-1991 used 1,261 million cubic meters of water (Kelly, 2001a); thus it can extrapolated that a 50% use above expected resulted in about 421 Mcm of water.

Mexico (Luévano, 2001). It was eventually agreed that the North American Development Bank (NADB) would provide money to improve Mexico's irrigation system in return for Mexico's water emergency deliveries to the U.S. (Pierson, 2002; Gregor, 2002). Consequently, during June 2002, 90,000 acre-feet of water were delivered to the U.S.

However, despite all these solutions, the Mexican water deficit for October 2002 stood at 1.5 million acre-feet (Texas Comptroller, 2002). Moreover, no bilateral emergency plan exists yet to optimize the use of resources in times of drought and there is a fear that this conflict may escalate if the U.S. takes retaliatory steps of withholding water along the Colorado (Taylor, 2002a; Texas Commission on Environmental Quality, 2002).

4. The Great Lakes

4.1 The 1909 Treaty and Its Climate-Uncertainty Mechanisms: A Review

In 1909, after three years of negotiations, the U.S. and Canada signed a treaty that set guiding principles for governing their shared boundary water (Fig 2), including determining priority of interests for the use of the water (Article VIII, 1909 Treaty). This treaty includes an escape clause to enable its unilateral revocation with 12 months' notice (Article XIV, 1909 Treaty). A binational organization – the International Joint Commission (IJC) – was established and granted the judicial, investigative, and administrative power to implement the treaty.

Its judicial power allowed the IJC to issue orders in response to applications for the use, obstruction and/or diversion of boundary water,[5] if such use affects the natural water level of flows on the other side (Article III, IV, 1909 Treaty). In addition, it could make binding decisions on matters of dispute referred to it by the two signatory governments (Article X, 1909 Treaty). But, neither commission approval nor specific agreement between the parties was required for the ordinary use of waters for domestic and sanitary purposes (Article III(2), 1909 Treaty) and the IJC's judicial authority was restricted mainly to boundary waters (Article II, 1909 Treaty).

Its administrative authority was restricted to the measurement and apportionment of the two-transboundary rivers, the St. Mary and the Milk (Article VI, 1909 Treaty). Article VI lays down principles for dividing these waters and gives the commission a role in applying these principles. It specifies that the water of the two rivers is to be apportioned equally between the two countries, but more than half may be taken from one river and less than half from the other, by either country.

The investigative power authorizes the commission, when called upon by the two governments, to investigate matters of differences (Article IX, 1909 Treaty). This is possible through a reference mechanism included by mutual consent that specifies the questions and restrictions to be investigated by the commission. Yet, this mechanism does not have an arbitral status, nor is it legally binding. Boards of Control can be appointed by the commission to report on compliance with orders, while study or advisory boards can be established to assist in executing references (Chacko, 1932).

[5] Boundary waters are defined as "the waters from main shore to main shore of the lakes and rivers and connecting waterways, or the portions thereof, along which the international boundary between the United States and the Dominion of Canada passes, including all bays, arms and inlets thereof, but not including tributary waters, and waterways, or waters flowing from such lakes, rivers and waterways, or the waters flowing across the boundary." (Preliminary Article, 1909 Treaty)

Fig. 2: U.S.-Canada transboundary watersheds

4.2 Underlying Reasons for Including and Excluding Mechanisms

Canada, which feared the U.S. as a powerful neighbor, advanced a comprehensive treaty that established a strong and permanent basin-wide authority with equal power for both sides (Gibbons, 1953; Commons Debate, 1909). This was to provide equal footing for Canada, thereby legally restraining the Americans from trans-basin diversions, which Canada was afraid would have a deleterious effect on Great Lakes levels, especially during drought conditions (The Mail and Empire, 1909; Third Report of the Canadian Section, p, 178).

Yet, because the Americans were influenced by the Harmon Doctrine[6] and concerned about restrictions over the Chicago Diversion,[7] they rejected the establishment of a joint body that might impinge on their sovereignty and limit their capacity to divert more of the Great Lakes' water in the future (Congressional Record, 1907). Consequently, they insisted on restricting the IJC authority to boundary water, which has resulted in the IJC having no jurisdiction over tributary diversions (Bloomfield and Fitzgerald, 1959; Bourne, 1974), including Lake Michigan and the Chicago Diversion (Dreisziger, 1974). In addition, the U.S. restricted the commission's findings and recommendations to the governments to be advisory only, which mitigated governmental fears of ceding sovereignty to a quasi-independent third party (Duda and LaRoche, 1997).

The Canadian concession of limits to the spatial jurisdiction of the IJC was in return for formulation of a treaty that included guiding principles for the entire border, not just along the Great Lakes, as the U.S. had wished, and inclusion of an arbitration provision despite U.S. fear of a judicial tribunal (State Department Memorandum, 1958; Carroll, 1988). But as the Americans feared a supranational body, this arbitration mechanism was conditioned on mutual consent by both sides, and the approval of permit applications for boundary diversions had to come through the two governments first. This left ambiguity as to whether the IJC could or could not independently intervene to stop a diversion project which had not gone through appropriate application procedures (Great Lakes Governors Task Force, 1985, p. 16).

Another issue that was left unresolved is how the transboundary water would divided in the future. This is since the treaty, except for the Niagara Falls and the St Milk and Mary Rivers, did not appropriate the water, but just set guided principles for how to governor the water. However, since Canada was seeking a comprehensive arrangement even to problems yet to develop, the option of appropriation for most of the boundary line was impossible.

Concerning the St. Mary and the Milk Rivers, the U.S. planned to divert St. Mary water through Canada to the Milk River in order to irrigate the lower valley in south-eastern Montana. In order to do so, it needed Canada's consent; otherwise, Canada could use these waters for its own use (Dreisziger, 1974,p 169-183). Canada was also dependent on the U.S. since it needed regulated water for irrigation along the St. Mary, where it depended on the U.S. as a lower riparian. These reciprocal needs eventually resulted in a holistic solution whereby the two rivers were treated as one stream, so as to afford beneficial use to each riparian.

[6] This doctrine, as first stated in 1895 by the U.S. attorney-general in relation to the Mexican claims on the upper Rio Grande, argues for the absolute jurisdiction of a nation over the water resources within its own territory.

[7] This diversion, initiated by the city of Chicago, already began diverting Lake Michigan water at the end of the 19th century. For more on this, see Naujoks, 1946; Injerd, 1993.

4.3 The Treaty and Mechanisms on Trial

The Great Lakes experienced severe drought between 1961-1964 (Changnon and Harper, 1994). The result of this below-average precipitation was a drop in the Great Lakes levels to an unprecedented point between 1963-1965 (Cohen, 1988). The drought along with the high-intensity use of the Great Lakes (International Great Lakes Level Board, 1973), caused reductions of 19-26% to hydroelectric utilities on the Niagara and St. Lawrence Rivers, a reduction of cargo load, and crop-yield reductions (Cohen, 1988).

As a response to this drought, both governments agreed to use the reference mechanism and to establish boards to investigate further regulation on the Great Lakes (Changnon and Harper, 1994). The IJC appointed a new panel of experts (the International Great Lakes Levels Board) to conduct the investigation. The board recommended a set of measures, including the need to investigate consumptive use and water diversions in the entire basin (IJC, 1976). As a result, in 1977 another reference was issued that in practice expanded the IJC's scope and geographical jurisdiction to investigate these issues at the scale of the entire basin and not just along the boundary lines, as the 1909 Treaty had designated (IJC 1981; IJC 1985).

The investigation acknowledged the need to legally and intuitively adapt to the changed hydrological and consumptive use conditions and, thus, recommended a bilateral data committee and task force (separate from the Commission) to monitor basin-wide diversions and consumption. It also recommended that, despite the incapacity of the 1909 Treaty to provide an adequate response to the current conditions, both governments should refrain from amending or renegotiating the treaty, as this could make national positions too rigid and finding practical solutions to practical problems more difficult. Instead, it recommended supplementing the treaty with clarifications and guidelines for further action (IJC, 1985). Consequently, the 1909 Treaty was supplemented with other international mechanisms. Among them were:

- The 1972 Great Lakes Water Quality Agreement, its 1978 amendment, and 1986 protocol aimed at adopting an ecosystem approach, thereby reinforcing the treaty with environmental interests ignored in the 1909 Treaty priority of interests (Natural Resources Canada, 2002)
- The Council of the Great Lakes Governors, its Great Lakes Charter and its annex aimed at achieving the basin-wide management not reached during the negotiations over the 1909 Treaty (Great Lakes Governors Task Force, 1985)
- The ongoing attempt of the IJC to establish transboundary watershed boards to gain joint comprehensive management both in scale and scope (IJC 2000a). Yet, this ambitious attempt was recently reformulated as the IJC realized that it did not have the support of all states and provinces along the shared watersheds**.** Instead, it focuses its attempts on the Rainey, Red and Souris watersheds where it receives local support (Bailey, 2002; Vechsler, 2002).

Yet, since domestic and sanitary use were excluded from the IJC judicial authority and since the Great Lakes Charter and its annex have not yet set standards for regulating these uses, there are no international barriers for limiting consumptive use. Consequently, the rate of consumption increases despite the growing fear of a future climate change (IJC, 2000b). In addition, there is no joint crisis plan to tackle droughts

or floods and neither government has a precedent for determining water allocation in the Great Lakes in times of low supply (Cohen, 1988).

5. The Jordan basin

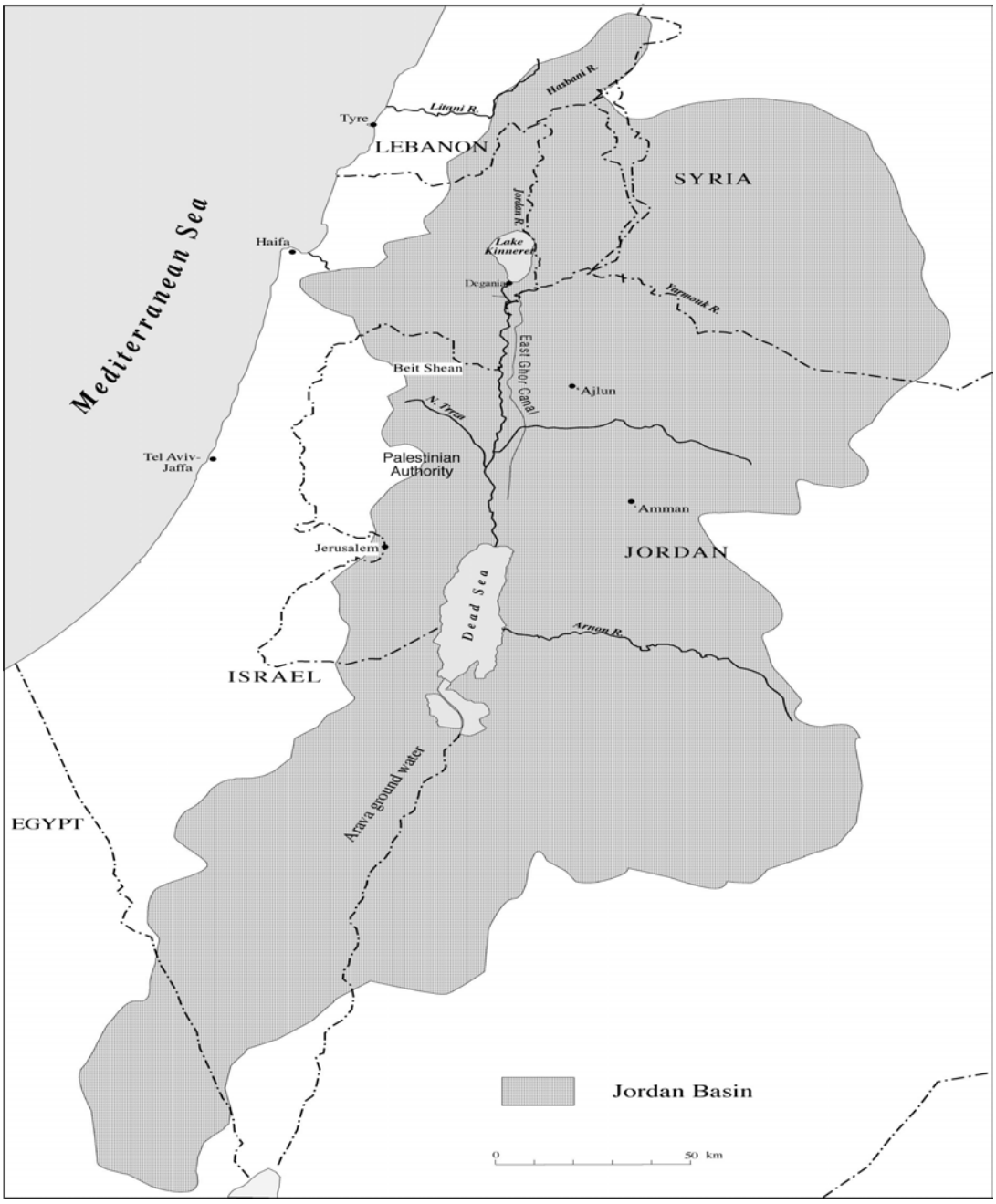
5.1 The Peace Treaty and Its Climate-Uncertainty Mechanisms: A Review

In October 1994 Israel and Jordan concluded a peace treaty, which included an annex addressing both water and the environment. A Joint Water Committee was established to implement the agreement pertaining to the shared water along the whole border, including the water of the Yarmouk and Jordan Rivers and Arava groundwater (Fig. 3). The treaty specifies that Israel deliver to Jordan in the summer period 20 million cubic meters (mcm) from Lake Kinneret (the Sea of Galilee) and 10 mcm in winter (Annex II, Article 2a and d). In addition, Jordan is entitled to store, during the winter period, a minimum average of 20 mcm of floods in Lake Kinneret, and both countries shall cooperate in finding sources for the supply to Jordan of an additional 50 mcm a year of potable-standard water.

In return for these waters delivered to Jordan, Israel will annually receive from the Yarmouk 25 mcm of water and may pump an additional 20 mcm from that river in the winter (Annex II, Article I). In addition, it may continue to use the wells in the Arava, despite their location on the Jordanian side of the border (Article IV) and even to increase their yields by 10 mcm per annum above the existing level. Israel is also entitled to maintain its current uses of Jordan River waters south of Lake Kinneret, but Jordan is entitled to an annual quantity equivalent to that of Israel, provided that Jordan's use does not harm the Israeli water needs.

The treaty also set the principle of mutual assistance to alleviate water shortage and refrain from harming the other party's water resources (Article VI). And it advanced several projects that would enhance the water supply, primarily to Jordan, including the building of a new dam beyond the Adasiya diversion to the King Abdallah Canal.

Fig. 3: The Jordan Basin



5.2 Underlying Reasons for Including and Excluding Mechanisms

As Israel had a larger storage capacity in Lake Kinneret and an urgent need to receive good-quality water in the Arava, which is beyond the reach of the Israeli National Water Carrier, it advanced an agreement based on a tradeoff. Under this tradeoff, Jordan provided Israel with groundwater from the Arava in the south in return for Israeli water from Lake Kinneret in the north (Haddadin, 2001, p. 395). Furthermore, Israel agreed to allow Jordan to use Lake Kinneret as a joint storage facility since Israel saw its use of the Yarmouk water in the winter in return for the water deposited by Jordan in Lake Kinneret during the summer (Haddadin, 2001).

Israel was afraid that exhausting negotiations with the Jordanians on the water deliveries from Lake Kinneret may have delayed the peace process between Israel and Jordan, and endangered the tradeoff between the Arava groundwater to Lake Kinneret water (Rosenthal, 2002). This, together with the belief that Lake Kinneret's storage capacity provides flexibility to cope with drought situations, motivated Israel to make concessions on Lake Kinneret, including refraining from a binding escape clause and a periodic review of the treaty. Instead, Israel favored a "gentlemen's agreement," by which both sides would share water deficiencies during a crisis and disputes would be resolved amicably though negotiations (Rosenthal, 2002; Wolf, 2001). Israel especially favored such an arrangement since in the past it had lost out to Egypt in the Taba arbitration (Hadadin, 2001, p. 389) and was afraid of any international tribunal that may impinge on its sovereignty (Rosenthal, 2002).

The inability to resolve many of the issues during the negotiation phase – especially because the Palestinians were excluded from the negotiations, and because the water balance and accounting technique on the Jordan Basin was controversial – left several issues unresolved (Shamir, 2002; Reisner, 2003). Among them is the scope of authority of the Joint Committee; the source of the annual additional 50 mcm; how the Dead Sea tributaries were to be divided; how much of the Jordan River's water south of Lake Kinneret each side would receive; and the right of Jordan to unilaterally further dam the Yarmouk. Since Israel wished to shift the water resources debate from the Jordan basin to other water resources, to be developed jointly (Beaumont, 1997), it seems that the constructive ambiguity language chosen concerning the source of the additional 50 mcm served its purpose. It seems that it also suited the Jordanian leaders, since the lack of specificity allowed them to go back to their constituents claiming victory (Reisner, 2003), as they did after the treaty was signed.

5.3 The Treaty and Mechanisms on Trial

For over three decades Israel has been in a water crisis situation (Israel Water Commission, 2002). This is the result of recurrent droughts events (Amiran, 1995), rapid development and, most significantly, decades of continuous over-extraction of water (Israel State Comptroller's, 1990; Israeli Water Commission, 2002). Jordan, not unlike Israel, is also under continuous crisis management (Hadadin, 2001, p 499; Beaumont, 2002) due to the large population increase (Hadadin, 2000) accompanied by deteriorating infrastructure and recurrent droughts.

Consequently, already in 1997, as the water stress in both countries increased, Jordan demanded that Israel provide it with the additional 50 mcm of water stipulated in the treaty annex (Hadadin, 2001, p. 419). However, since the annex did not specify by whom, how and when the water had to be delivered, a controversy around these issues arose (Hadadin, 2001, p. 419-427; Cohen, 1997). The tension was resolved when Israel, as a gesture of good faith, agreed to provide Jordan with an additional 25-30 mcm of water from Lake Kinneret over the next three years, pending the construction of a desalinization plant (Izraeli, 2002). An exchange of letters between both sides constituted the new agreement (Hadadin, 2001, p. 426).

In the same year, while the Jordanians wished to increase their water storage in Lake Kinneret and to build a diversion weir on the Yarmouk, the Israelis tried to amend the Water Annex. Israel felt that the restriction over Israeli use of Yarmouk waters

jeopardized Israeli interests in the Beit Shean area, and the use of Lake Kinneret as a joint storage facility had to be offset by Israeli water diversions north of Lake Kinneret (Hadadin, 2001, p. 437). The Jordanians, however, objected. In the end Israel agreed to increase the Jordanian storage in Lake Kinneret to 60 mcm and to approve the Jordanian's diversion structure on the Yarmouk.

The following winter, 1998/1999, was among the driest on record, with Lake Kinneret levels very low already at the beginning of the year (Mekorot, 1999). As the 1997 agreement implies that Israel has to provide Jordan with 55 mcm from this water source, which would take the lake levels to a dangerous point, Israel notified the Jordanians of its intention to reduce the water it planned to deliver that year by 60% (Ben Meir, 2002; Sobelman, 1999). The basis for such a reduction, Israel claimed, was the deficit Jordan had accumulated in delivering Yarmouk water to Israel – water that Israel interpreted as being in return for that provided to Jordan during the summer from Lake Kinneret (Izraeli, 2002).

However, Jordan, who received low-quality water from Israel, perceived such a unilateral water reduction as conflicting with the principles of mutual assistance and no significant harm contained in the treaty. Consequently, Jordan interpreted any reduction in the water deliveries from Israel as a violation of the 1994 Treaty (Sobelman, 1999). Furthermore, the decision makers of water policy in the two countries were not the people who had negotiated the 1994 further contributed to the lack of willingness to resolve the conflict amicably by sharing deficiencies as agreed upon in the 1994 annex (Wolf, 2001).
Israel, in the face of the strong Jordanian protest, found itself in a complicated situation: on the one hand, it was afraid that the impending conflict might reflect on both countries' relations since the water agreement is part of the Israeli/Jordanian peace treaty. But, on the other, Israel was afraid to set a precedent by which Jordan would receive Israeli water from Lake Kinneret in the summer without responding with an equal amount from the Yarmouk in winter (Izraeli, 2002). This quandary in fact softened both sides' position and a compromise was reached (Ben Meir, 2002) in which the water delivered to Jordan was reduced by just a few million cubic meters, to cover only the water deficit Jordan had accumulated (Izraeli, 2002; Mekorot, 2002). Yet, to deliver the water Israel had to low the red line of Lake Kinneret in another meter (Ben-Meir, 2002), what further increased the likelihood of salinization of the lake.

In 2000, when the three years of the 1997 agreement expired and the desalinization plant was not yet built, the question whether Israel should continue to provide the additional 25-30 mcm emerged. Again, the Israeli fear that any reduction in the water delivered to Jordan might impact on the peace agreement motivated the Water Commissioner to continue to make the deliveries, hoping that in the future the financial means to build the joint desalinization plant would be found (Ben Meir, 2002).

It seems that despite these solutions, which provided partial remedy to the various controversies during the water shortage, it is unclear how the treaty will function while the basin's upper riparians – which are not partners to this agreement (Syria, Lebanon) – increase their water use (Kliot and Shmueli, 1998). There is also uncertainty over how the treaty will function given Jordan's plans to further dam the Yarmouk and the treaty's lack of clarity pertaining to such an action.

6. The expected costs versus the benefits of mechanisms included

This paper has thus far identified several possible crisis-mitigating mechanisms and shown how they were excluded from treaties over shared waters, even if they were negotiated at some time. Among these mechanisms are the creation of a joint body with broad scope and geographical jurisdiction, a conflict-resolution procedure, deliveries of water based upon parentage of flow and a balancing mechanism. Such mechanisms were excluded from treaties because they were seen as posing a threat to national sovereignty, and thereby boosted the political cost of their inclusion. It seems that it is the powerful riparian who opposes a permanent supra-national authority and arbitration mechanism as these may impinge on its hegemony. This was the case of Canada and Mexico with respect to the U.S.: each aspired to a treaty and institutions comprehensive in scale and scope, but these were refuted by the powerful U.S.. This was also the case of Jordan, which had an interest in including an arbitration and multi-year deficit mechanism but was opposed on this by Israel. These experiences suggests that the political cost of such mechanisms increases in cases of unbalanced power relations.

Another factor that raised the political cost of including a few of these mechanisms was the process of negotiating all-boundary waters together and advancing linkages and tradeoffs across the border. This linkage strategy, intended to enhance cooperation, actually generated a fear that any attempt to discuss one part of the treaty would reflect on its other parts. The result is that the mechanisms of escape clause and periodic review process have been deliberately left out of international treaties aimed at safeguarding the interests of all signatory parties. This was the case of Israel which was afraid that adopting stringent escape clauses and a periodic review process on Lake Kinneret would be counterweighted by Jordanian insistence on the same mechanisms in the Arava, where it was crucial for Israel to receive water at any time (Rosenthal, 2002). Thus, Israel refrained from insisting on these mechanisms. Furthermore, in the Canadian-American case the package deal strategy has also resulted in setting uniform principles for all boundary waters, although the circumstances along the border may vary.

Another factor that has led to the exclusion of these mechanisms is the need to market the treaties to politicians. The Israeli case illustrates how the water experts were aware that marketing a treaty with “ifs” and “buts” was not feasible, because the politicians would reject it. As a result, a treaty based on deliveries of a fixed amount of water was advanced instead of focusing on flow percentage (Shamir, 2002). This tendency to allocate water based upon fixed amount also allowed Israel to maintain its water management independency, since Israel was afraid that flow percentage will allow Jordan to interfere with the Israeli water management (Reisner, 2003). These preliminary findings necessitate further study of the channels of communication between the professionals, who calculate the hydrological details of a given treaty, and the politicians, who market the agreement as a whole.

It should be stressed that the cost of some of the climate-uncertainty mechanisms can be decreased if their adoption is conditioned on a unanimous decision-making process. This occurred when the U.S. supported the Canadian wish to include a reference mechanism and to expand the IJC’s scope to include permit approval – these were to be conditioned on mutual consent and an application procedure that had to pass through both governments first. This was also the case when Israel agreed that Jordan could further dam the Yarmouk, conditional on joint consultation. It also appears that when the mechanisms adopted are not legally binding, the parties are more willing to accept them.

Examples include the case of the U.S. supporting a non-binding arbitration mechanism in the 1909 Treaty, when the riparians agreed to voluntarily adopt the Great Lakes Charter, and the case of Jordan agreeing to incorporate an informal "gentlemen's agreement" in its pact with Israel. These experiences highlight the role of "soft laws" in formalizing flexible agreements, as suggested by Abbott and Snidal (2000). The effectiveness of this mitigation measure in the water sector receives support from Dieperink (2000), who draws our attention to the 1987 Rhine Action Program, adopted by the International Rhine Commission. This program, which was not legally binding (except in a political sense), was almost fully implemented. This is in contrast to the many other initiatives to improve the state of the Rhine environment that were legally binding – and failed (Dieperink, 2000).

The decision to exclude climate uncertainty mechanisms or to compromise on less-stringent mechanisms is sustained by the tendency of policy makers to choose optimistic water-availability scenarios based upon average values and not upon extreme hydrological values. As the policy makers predict high water availability and low vulnerability of the resource, the uncertainty for the implications of excluding these mechanisms decreases, and in turn, the expected benefits of adopting these measures are reduced. This was the case when Israel assumed that Lake Kinneret's storage capacity provided sufficient flexibility to enable the delivery of 25-30 mcm of water to Jordan during the summer, especially in light of its belief that the additional 50 mcm would not come from this source. It was also clearly the case when Mexico predicted low development rates, high water availability, and short duration of droughts on the Rio Grande, reinforcing its decision not to adopt a more stringent escape clause. Furthermore, as evident from all three cases, these optimistic scenarios, by reducing the expected uncertainty, succeeded to elude a demand for intuitional centralization in the form of joint bodies with wide scope and geographical jurisdiction.

Yet, the study teaches us that it is the local pressure groups, which in case of a drought bear the burden of excluding these mechanisms, which highlight the cost of excluding these mechanisms in case of a drought. Thus, call for stringent escape clauses. For example, it was the Mexican agricultural sector that demanded a more stringent escape clause. This was also the case of the Israeli agricultural sector that wished to update the treaty with Jordan to accommodate the current water shortage. In the latter case, the opposition was sidestepped by the government decision to lower the red line of Lake Kinneret, which ensured that the water deliveries to Jordan were not to be provided by the Beit Shean-area farmers. In the case of Mexico the opposition was sidestepped thorough the federal government's optimistic water predictions.

Another factor that affects the tendency to prioritize the political cost over the expected benefits of including these mechanisms is timing. The cost of including them can be felt immediately, as this could delay or block the pending agreement, which may have ramifications – and therefore a price – on a string of other issues. In contrast to the potential benefits of including the mechanisms, if such benefits exist, will only be felt at some time in the future, during a crisis such as a drought. Short-term political gain is thus favored over long-term potential environmental benefits.

Given the fact that many of the mechanisms identified in the introduction were excluded in the treaties studied, the next section reviews how these treaties function.

7. Treaties' Function and Evolution

Drought followed the ratification of all three treaties, triggering the need to adjust the agreements to the new hydrologic conditions. In all cases, the option of renegotiating the existing treaties was excluded since all three were based on package deals. This nature of treaties as package deals has left an institutional and legal footprint in which one treaty and one institution were established for all the boundary waters. This raises the risk that any attempt to discuss one part of the treaty would reflect on its other parts, further hampering the possibility of updating the agreements to new conditions.

This package deal nature of treaties, combined with a belief that under today's conditions a better treaty will not be achieved, stops riparians from amending or renegotiating the existing agreements. This hesitation is despite acknowledging the treaties' limited capacity to accommodate climate-uncertainty conditions. The limited adaptive capacity the riparians have to update the treaties is a result of the long term implications of a linkage. Yet, an agreement was not possible unless the linkage was made. Thus, the question for further study is not whether or not to adopt a linkage, but rather how to reduce the cost of linkages.

Instead, riparians seek to use many of the mechanisms incorporated in the treaties to deal with crisis situations. Examples of mechanisms used include the reference and the minute, as in the U.S-Mexico case and that of the U.S. and Canada. Since their establishment the IBWC and the IJC have authorized 127 minutes and 44 references (IBWC, 2002; IJC, 2001, respectively). However, on some occasions employing these mechanisms raises questions about the legitimacy of their use. For example, Canada and the U.S. liberally used the reference mechanism in their treaty to expand the IJC's spatial jurisdiction to include the entire basin, although the treaty was designed as a boundary treaty (Bourne, 1974). This was also the case of the NADB money allocated to resolve the dispute along the Rio Grande, which resulted in a controversy over the legitimacy of such a mechanism (Taylor, 2002c).

In other cases even mechanisms that were built into treaties proved impotent in crisis situations. In the Israel and Jordan situation, the joint desalinization plant was not established[8] and the "gentleman's agreement" concluded in 1994 proved ineffective as the water officials who negotiated the treaty were replaced. As a result, Israel lowered Lake Kinneret levels to provide Jordan with an annual 55 mcm of water (Ben-Meir, 2002). In the case of the Great Lakes the IJC's judicial power to make binding decisions on matters of dispute has never been exercised, as the political cost of using the mechanisms was expected to be high (Council of the Great Lakes Governors, 1985). Another example concerns the escape clause for an extraordinary drought event on the Rio Grande. This clause was found to be not only inadequate for the Mexicans during a prolonged drought, but also resulted in a controversy between Mexico and the Texan agricultural sector is both nations concerning the conditions under which it may be invoked. This is because the treaty was left vague, without defining the threshold for extraordinary drought (Kelly, 2001b).

Yet this vagueness, which often leads to controversy around the interpretation of the treaties, may also broaden the treaties ability to accommodate climate change and, as was mentioned, may speed up the ratification process. Israel and Jordan left many areas

[8] It seems that the reason why the desalinization plant was never built is the lack of willingness of both Israel and Jordan to invest the money required along with the decision of Germany and Japan not to financially support the project.

unresolved in order to ratify their peace pact and this later provided both sides with the flexibility to decide, as they deemed suitable, on the scope of the Joint Commission and on the annual schedule of water deliveries (Izraeli, 2002). It was also this very ambiguity that enabled both sides to go back to their constituents and claim victory.

As a result of treaties' limited capacity to deal with conditions of uncertainty, this study illustrates how a controversy can develop when one side finds it difficult to meet its obligations. A controversy of this nature runs the risk of turning a water matter into a major political conflict. Such is the case of the U.S. and Mexico, where the failure of the latter to meet its treaty requirements resulted in the intervention of both countries' presidents[9] to prevent the matter from escalating into a conflict that would involve non-water issues as well. It was also the case of Israel and Jordan: the 1997 and 1998 controversies around the additional 50 mcm and the drought-related water crisis were resolved only when the high political level got involved.

Nevertheless, it is these conflicts that trigger amendments to the treaties, thereby introducing new mechanisms aimed at resolving future disagreements. One such example is the Great Lakes Charter, Commission and the Water Quality Agreement, supplementing the 1909 Treaty, triggered by a drought event. Another is the Israeli-Jordanian exchange of letters of understanding aimed at resolving the controversy over the additional 50 mcm. The Canadian-U.S. case, meanwhile, demonstrates that these mechanisms are often voluntary and their evolution slow; thus, they do not provide a real-time solution to a crisis.

8. Conclusion

This study teaches us that it is not a lack of awareness that prevents riparians from adopting climate-uncertainty mechanisms. In fact, these mechanisms are often negotiated even in conditions of apparent water abundance, such as the Canadian-U.S. case. Rather, it is the perceived threat to sovereignty, the nature of treaties as package deals, and regional water stress that stop riparians from adopting stringent escape clauses, allocating water according to percentage of flow, and adopting joint institutions with wide scope and geographical jurisdiction. By excluding these measures the anticipated political cost of an agreement decreases. However, in making this decision, policy makers must necessarily also address the potential benefits of including such mechanisms. By sketching optimistic water-availability scenarios and low resource sensitivity predictions, and emphasizing the immediate political cost instead of the future environmental benefits, the reasons for including mitigating mechanisms are reduced. This results in the notion that the political cost of these mechanisms' inclusion outweighs the environmental benefits associated with them. Thus, many of these mechanisms are excluded.

It seems that as the different sides cannot agree on many of the issues negotiated, they adopt vague and ambiguous standards instead of clear guidelines for dividing up their shared water. The present study is inconclusive regarding the implications of this situation since, on the one hand, this vagueness may speed up ratification, but, on the other, it often results in controversy. This was the case with Israel and Jordan: by leaving many issues unresolved, the two sides prevented major delays in signing their peace agreement and

[9] One meeting took place on March 16, 2001 and resulted in the signing of minute 307 (*Kelly, 2001b*; *Anonymous, 2001*); another meeting, in March 2002 at the Poverty Conference in Monterey, did not yield any result (*Texas News, 2002*).

later were able to show flexibility regarding the scope of the Joint Commission and the annual schedule of water deliveries (Izraeli, 2002). This same vagueness, however, also led to controversy over the additional 50 mcm and over Jordan's right to further dam the Yarmouk. This raises the need to further study the short-term benefits versus the long-term costs of such vagueness in many treaties, especially in light of the new proposed International Water Law seeking such a strategy of vagueness (Benvenisti, 1996, 2002).

Although these three case studies were negotiated under different circumstances, they share many similarities – in fact, all three treaties excluded and included the same mechanisms. Among those excluded are a periodic process review, basin-wide joint management and enforcement, and a trans-basin balancing mechanism. This highlights the high political cost associated with the inclusion of these mechanisms, which during the negotiation process seems to outweigh their hydrological benefits. Among the mechanisms included are the reference/minute mechanisms and the establishment of joint institutions; these highlight the political feasibility of adopting such measures. Yet, it seems that these mechanisms were adopted since they were not legally binding and were conditioned by unanimous consent. This necessitates further study for identifying and evaluating many of these measure to circumvent the political cost of the climate uncertainty mechanisms and especially how to change the existing balance that seems to favor short- term political gain over long term environmental profit.

The study also demonstrates that a treaty ratification need not be seen as the ultimate outcome. However, the treaty should be seen as a long-term process of getting people to engage in long-term goals of creating institutions and regulating the resource. Often, it takes decades for treaties to evolve and become effective by including new and more stringent mechanisms to address cases of climate uncertainty. This is the case for all three treaties studied here. During a crisis, each introduced new mechanisms aimed at resolving future disagreements. There is a need to examine whether this evolving process may actually retain greater flexibility in the face of future changes. Thus, there is a range of possible outcomes of initial negotiations and treaties. Falling short of a final treaty that includes all of the necessary mechanisms does not constitute a failure - it may even succeed when the longer-term perspective is taken.

In conclusion, treaties concerning natural resources are first and foremost political pacts and only later tools to regulate the natural resource. As such, many of the mechanisms that can enhance a treaty's flexibility to cope with climate uncertainty are deliberately left out, since their inclusion is associated with a high political cost. Yet it seems that in a crisis situation, both sides' ingenuity and mutual needs engender a desire for treaty flexibility, so as to provide temporary relief to the change in circumstances. In light of the growing need for treaties to meet the challenge of climate change, this study stresses the importance of using the mechanisms that are simultaneously politically feasible and hydrologically effective so that they may be successfully incorporated in future treaties.

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