Navigating International River Disputes to Avert Conflict

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Abstract
Building on the findings from the International Negotiation's 2000 issue on negotiations in international watercourses and the major advances in the field during the past nine years, this issue seeks to advance our knowledge about the management of international river disputes. Collectively, the articles in this issue move beyond the simple dichotomy of conflict and cooperation to suggest the possibility that both are often simultaneously present within a basin and should be studied as such. Using a diversity of methodological approaches from comparative case studies to single case studies to quantitative analysis, the articles also illustrate the growth of institutionalization within river basins and their contribution to conflict management. Moreover, the articles advance our knowledge of the role of the relative distribution of power within the basin on the resolution of water disputes and management of resources. Some scholars find power asymmetry important for treaty formation, while others suggest that issue linkages and side-payments can provide weaker riparians with the means to gain from cooperation.

Keywords
international rivers, conflict, cooperation, negotiating water disputes

The staggering violence in Darfur has captured the attention of the global community. This conflict, which has resulted in the death of some 200,000 civilians and displaced 2.5 million people, has spilled over to neighboring Chad and the Central African Republic. Although a combination of factors has contributed to this conflict, most experts agree that the competition over scarce freshwater and

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land is what ignited this local and regional turmoil (Baldauf 2007; United Nations 2006).

Securing access to freshwater has also been a source of cooperation in Africa. In the Congo, Zambezi, and Orange/Senqu River basins, negotiations between riparian states resulted in the creation of commissions to promote shared water management in the areas of water quality, flood control, technical assistance, and infrastructure development. Such cooperation is not a new occurrence in Africa; the 1990s marked a time of considerable success in negotiation efforts, notably in the Nile River basin (Scheumann and Neubert 2006; Whittington et al. 2005).

Since international rivers contain 60 percent of our planet’s freshwater supply and provide a home to 40 percent of the world’s population (Wolf et al. 1999), just about every country in the world must confront the management dilemma posed by sharing these rivers. This dilemma arises because as rivers cross borders they tend to impose interdependent and vulnerable relationships on their states that can compromise the ability to respond effectively to oncoming floods and droughts, maintain drainage systems, generate hydropower and allocate the domestic water budget (Zawahri 2008a). Due to these relationships, states are likely to confront the need to negotiate disputes continuously as they develop their shared river system to meet domestic demands for freshwater.

According to the United Nations, the lack of freshwater is likely to be a serious problem in the 21st century (United Nations World Water Programme 2003). In fact, some scholars have discovered that insufficient access to water can lead to conflict between states (Gleick 1993; Hensel et al. 2006) and at the sub-national level (Postel and Wolf 2002; Selby 2005). Yet, shared freshwater has also been a source of interstate cooperation, as the examples from the African states illustrate (Wolf et al. 2003; Wolf et al. 2005; Gerlak and Grand 2009; Zawahri 2009). Indeed the past thirty years have marked considerable international cooperation around water – from international meetings and conferences to new global water initiatives to activities of intergovernmental institutions, such as the Global Environment Facility, in assisting interstate cooperation (Grover 1998; Gerlak 2004, Verady and Meehan 2006, Conca et al. 2006).

In light of these developments and the uncertainty that still characterizes the exact mechanisms by which states arrive at conflict and cooperation, this issue of International Negotiation aims to further the dialogue around the management of international river disputes. Collectively, the articles in this issue explore substantively the interplay between conflict and cooperation, the growing institutionalization of river resources, and differing conceptions of power. Our authors employ diverse theoretical and methodological approaches, with particular attention to the value of comparative methods in understanding the politics and management of international rivers.
Past Trends in Navigating Water Disputes: A Review of the 2000 Issue

The contributors to the 2000 special issue of *International Negotiation*, titled “Negotiating in International Watercourses: Diplomacy, Conflict, and Cooperation” (Vol. 5, no. 2) examined both the macro- and micro-negotiation levels of analysis in an attempt to identify the variables propelling states to select a cooperation path to address water disputes (Dinar and Dinar 2000). An impressive array of experts, some with first-hand knowledge of the negotiation process in individual basins, identified factors that prevented states from reaching the negotiation table as well as factors that minimized the chance of signing a treaty, once at the table. Several lessons for the management of international river disputes can be gleaned from that 2000 issue. One lesson is the need to consider the broader macro-political environment when examining circumstances of conflict and cooperation. A history of animosity and conflict within a basin may be counterproductive to the signing of an agreement. For example, Israel and Jordan were unable to reach a formal agreement until the Israeli-Palestinian conflict, which had overshadowed the regional water dispute, was dealt with, at least temporarily, through the Oslo Accords (Haddadin 2000).

Another important contribution of the 2000 issue was to demonstrate that cooperation was not only possible, but to document its presence and provide some causal mechanisms to explain it (Dinar and Dinar 2000; Spector 2000; Wolf 2000). One possible path to cooperation highlighted in the 2000 issue was the role of third parties such as the World Bank or the United Nations, in facilitating negotiations between riparians by providing financial assistance to aid in the treaty’s implementation (Elhance 2000; Nishat and Faisal 2000; Browder 2000; Dinar and Alemu 2000). In the case of the Mekong River, third parties have been active in facilitating the negotiations, assisting in the establishment of commissions, and funding development projects since the 1950s (Browder 2000). The expectation of financial assistance from the donor community provided an incentive to India and Bangladesh to sign their 1996 treaty (Nishat and Faisal 2000).

The articles also revealed that for negotiations to have a chance at success, states must have an interest in reaching an agreement to formalize their relationship (Elhance 2000; Dinar 2000; Dinar and Alemu 2000) and the domestic political environment must be receptive to an agreement (Nishat and Faisal 2000). Another possible path to cooperation according to the 2000 issue is the need for a properly designed and empowered joint river commission to assist in the management of river disputes (Nishat and Faisal 2000; Browder 2000; Kibaroglu and Unver 2000). As some researchers discovered, the Joint Rivers Commission established between India and Bangladesh to manage the Ganges-Brahmaputra-Meghan Rivers was not provided with sufficient capabilities to fulfill its tasks (Nishat and Faisal 2000).
Indeed the 2000 issue substantially advanced our understanding of what propels states toward conflict and cooperation in the management of international rivers. However, since its publication nine years ago, much has been published on this subject.

**Scholarly Advancements in Navigating River Disputes Since 2000**

In the early 1990s, dire warnings were heard from world leaders and international organizations regarding the increased threat of water wars (Starr 1991; Bullock and Darwish 1993). A decade later, these predictions were questioned by scholars citing the lack of historical evidence and the economic irrationality of such actions (Wolf 1997, 1998, 2007; Brooks 1997; Amery 2002; Yoffe et al. 2003; Swain 2004). Nevertheless, an anarchic international system, weak international law to regulate states’ interactions in managing international rivers, and contested property rights left plenty of room for the potential of other forms of conflict between riparian states.

In an attempt to identify the forces contributing to conflict and cooperation around international rivers, scholars constructed new databases and released previously compiled databases that facilitated empirical analysis. Some neglected variables such as the impact of the relative distribution of power between riparians and the use of issue linkages to facilitate cooperation were reconsidered. Finally, there was a call to sharpen the definitions of conflict and cooperation.

The *Transboundary Freshwater Dispute Database* (TFDD), completed in the late-1990s and made publicly available in 2000, catalogs bilateral and multilateral treaties over shared rivers from 1870 until today (Wolf 2008). An analysis of this data reveals that most treaties address hydroelectric and water supplies, rather than water quality issues, and bilateral treaties outnumber multilateral treaties (Hamner and Wolf 1998; Beach et al. 2000). The *Basin at Risk Database* documents and scores over 1,800 events involving states’ interactions in the management of international rivers. Researchers found that incidents of cooperation outnumbered those of conflict and none involved any war over water (Wolf et al. 2003). The data also reveals that conflict between riparians is likely to arise when a rapid change in a basin is combined with a lack of institutional capacity, such as a treaty or river basin commission (Wolf et al. 2003; Yoffe et al. 2003).

These two databases have provided a foundation for much of the research on the forces contributing to the peaceful management of river disputes. Virtually every major examination of conflict or cooperation on river systems since 2000 either refers to them or combines their data with other databases to explore salient issues involved in conflict management. We consider a small sampling of such studies. Espey and Towfique (2004) examine the rise of bilateral agreements over international rivers and conclude that the significance of a basin to a state, eco-
onomic interdependence, and similarity in religion have a positive contribution on treaty formation. Song and Whittington (2004) consider the rise of treaties along bilateral and multilateral rivers. They discovered that the geographic feature of a river is important, with upstream/downstream and side-by-side rivers least likely to have a treaty. In their analysis of river treaties from 1950 to 2002, Tir and Ackerman (2009) found that economic interdependence, joint democracies, water shortage, and preponderance of power all have a positive impact on treaty formation. In the search for the forces leading to fragmented cooperation, Zawahri and Mitchell (2008) argue that a combination of interest, transaction costs, and relative distribution of power can account for the rise of bilateral agreements over multilateral basins.

The Food and Agricultural Organization (FAO) of the United Nations has also compiled a database on water treaties (WATERLEX 2008). Containing 235 treaties, this database was derived from a general database – FAOLEX – on food and agriculture issues, which became publicly available in 1996. FAOLEX contains about 5,000 records of legislation concerning water, including water treaties (Moauro 2008). Drawing on the TFDD and the FAO treaties database to generate a list of 62 agreements reached between 1980 and 2000, Conca et al. (2006) compiled a new database of the principled content of these accords. The data permits for the examination of any convergence in norms governing international rivers or concessions to general principles found in the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses. The authors discover that most principles or norms inherent in the 1997 watercourse convention have not been applied extensively by riparians, with the exception of the trend towards establishment of joint river commissions, environmental protection of the basin’s ecosystem, and incorporation of conflict resolution mechanisms (Conca et al. 2006).

The Issue Correlates of War (ICOW) database, which collects data on territorial, maritime, and river claims, represents an additional advancement in the field. Using only river claims made over shared rivers in Latin America, Europe, and the Middle East from 1900 to 2001, Hensel et al. (2006) examine the impact of institutionalization and water scarcity on the settlement of water disputes. They discover that water scarcity is likely to result in less institutionalization and militarized settlement of disputes, while an abundant supply of water improves the chance for the presence of institutions and peaceful settlements of disputes (Hensel et al. 2006). In their research, Hensel and Brochman (2008) discover that a decrease in the supply of water and an increase in demand are apt to increase the likelihood of conflict in the form of river claim onset and militarization, while the presence of a treaty decreases the potential for militarization. Using the ICOW database to examine the impact of third parties on conflict management of territorial, maritime, and river claims, Mitchell and Hensel (2008) find that the involvement of international organizations increases compliance with agreements.
Building on recent insight that the presence of institutions within a basin can assist to mitigate the potential for conflict (Wolf et al. 2003; Yoffe et al. 2003; Giordano et al. 2005), scholars are examining the rise, role and function of these regimes (Gerlak 2007; Dombrowsky 2007; Bakker 2008; Zawahri 2008c, 2009; Gerlak and Grant 2009). Gerlak (2007) maps river basin institutions – half of which were created since the 1990s – to find that some 180 organizations in 41 percent of the world’s transboundary basins vary considerably in their geographic scope and depth of cooperation. A catalog of these institutions has been recently added to the TFDD (Bakker 2008). Using this data, Bakker (2007) considers these institutional arrangements in the context of transboundary river floods to reveal an alarmingly low institutional capacity. In examining the rise of these institutional arrangements, scholars discovered that states tend to establish river basin commissions to implement treaties and maintain long-term cooperation (Zawahri 2008c, 2009). In fact, 60 percent of basins with treaties or accords have created these commissions (Dombrowsky 2007). Delving deeper into the factors that promote or inhibit the emergence of institutions between 1975 and 2000, Gerlak and Grand (2009) find that institutions are more likely to form in basins with larger numbers of states, basins exhibiting asymmetrical military capabilities, and ones containing predominantly democratic states. Basins accustomed to more formalized organizational structures and with sufficient economic capabilities seem to prefer to create more binding, formal institutions, while basins lacking either the experience or the resources make less stringent institutional arrangements.

Concomitant with the advancements made because of the establishment of these datasets is the integration of several methodologies – including quantitative, comparative, and single case studies – to consider previously neglected variables such as the contribution of issue linkages, side payments, and cost sharing to overcome the asymmetry of interest in reaching a successful conclusion during intensive negotiations. Initially discussed by LeMarquand (1977) in his landmark study and later developed by comparative case study analysis (see Bennett et al. 1998), the role of issue linkage has received renewed interest in recent years. Research suggests that negotiators rely on issue linkages and side payments in establishing water treaties (Beach et al. 2000). A different study of the content of treaties discovers that side payments are frequently used to offset asymmetry in geography produced by an upstream-downstream relationship (Dinar 2006). Scholars also examine the positive and potentially negative consequences of issue linkage as facilitators of negotiations (Bernauer 2002; Fischhendler et al. 2004; Dinar 2006; Dinar et al. 2007). In a study of the United States and Mexico’s international water disputes, Fischhendler et al. (2004) incorporated the element of time in their analysis of issue linkages to differentiate between the short and long-term consequences of their use. Although in the short-term issue linkages may assist in overcoming difficulties in the negotiation process, in the long-term they
can contribute to conflict if the treaty is inflexible and unresponsive to environmental changes.

Another variable that has received renewed interest in the international water policy literature is the relative distribution of power within the basin. In recent years, the London Water Research Group has revitalized the debate over the role of power in managing disputes (Zeitoun and Warren 2006; Zeitoun and Allan 2008; Warner et al. 2008). Their research builds on previous work that drew on hegemonic stability theory to argue that an asymmetry of power between riparians can contribute to cooperation and conflict depending on the location of the hegemon within the basin (see Lowi 1993; Frey 1993; Naff and Matson 1984).

Combining realist and constructive theories on the different faces and functions of power, the recent hydro-hegemony literature offers an examination of the possible impact of the presence of a hegemon within a basin. A hegemon can have either a negative or a positive influence, in that it can facilitate the negotiation and signing of an agreement that is perceived positively by all riparians. Alternatively, conflict can arise when the hegemon unilaterally imposes an agreement that consolidates its control over the resource and inflicts water scarcities on the weaker riparians (Zeitoun and Warren 2006). Hydro-hegemony also explores the different means by which a hegemon can use its authority to secure its interest and the possible responses by the weaker state in countering the hegemon’s authority (Zeitoun and Allan 2008; Warner 2008). The hegemon, for instance, can participate in international conferences in an attempt to empower ideas that further its ability to secure its own interests and permit its domination within a basin (Warner et al. 2008). International water law can also be manipulated during negotiations to legitimize the hegemon and the weaker state’s position (Daudy 2008).

Finally, scholars have warned that the lack of concise definitions of what constitutes conflict and cooperation over international rivers can complicate the ability to account for the peaceful resolution of water disputes (Postel and Wolf 2001; Uitto and Wolf 2002; Bernauer 2002; Yoffe et al. 2003; Dinar and Dinar 2003). In the search for finely tuned definitions, the traditional association of cooperation with the signing of treaties has been challenged because treaties can remain unimplemented or they may simply confirm the status quo (Bernauer 2002; Downs et al. 1996). Existing definitions of conflict over shared rivers – war, the mobilization of armies, military threats, firing guns, deterioration in relations, disagreements, and verbal recrimination (Mandel 1992; Haftendorn 2000; Brooks 1997; Gleick 1993) – have also been challenged. The challenge surfaced because the range of activities to categorize conflict is simply too wide, the activities do not constitute an equal or proximate degree of violence, and they do not capture what transpires between riparians after the firing of guns or deterioration in relations have occurred (Zawahri 2008b). As an alternative, some scholars are proposing new definitions of conflict and cooperation that focus on
the interactions of states in managing their international river disputes (Sadoff and Grey 2002; Zawahri 2008b; Zeitoun and Mirumachi 2008; Daoudy and Kistin 2008).

**Advancing the Field**

The articles that comprise this issue build on the earlier 2000 issue and subsequent scholarly work on international waters. Collectively, this current issue demonstrates five major themes:

**Theme 1: Examining Conflict and Cooperation Together**

The first major theme is the recognition that both conflict and cooperation may be present in a particular river basin within a specific period. This ebb and flow between cooperation and conflict is demonstrated in the case studies included here, such as the Indus, Euphrates and Tigris, Scheldt and La Plata River basins. In the Brochman and Hensel article, the presence of conflict and cooperation appear simultaneously – as river claims and the efforts to manage these specific disagreements. Warner and Buuren’s analysis of the Scheldt River also demonstrates the simultaneous presence of cooperation, or learning, and conflict, or fighting, which they argue can potentially improve the quality of the decision making process within a basin. Zawahri’s study of the Indus River classifies the oscillation between conflict and cooperation as a condition of unstable cooperation. Therefore, the articles in this special issue collectively demonstrate that it is not appropriate to view conflict and cooperation as only two separate and distinct outcomes, but also to see the possibility of their coexistence within a single basin during a specific time.

**Theme 2: Advancing the Comparative Approach**

A second theme advanced in this issue is the value of the comparative method to understanding the negotiation and management of international rivers. Unlike the 2000 issue, most of the articles in this issue go beyond the single case study to reveal the richness of comparing multiple cases across time and space. Sholmi Dinar looks across nine cases to explore the influence of power asymmetry on negotiations in river basins. Gerlak, Varady and Haverland trace the concept of hydrosolidarity in practice at various governance scales, including small-scale actions like river parliaments in India to the regional level, like efforts in the Nile River basin. Even the thorough and detailed case studies on negotiations in the La Plata and Indus River basins are enriched by contrasting the lessons learned in their cases with those in other basins. Brochman and Hensel examine river claims in the Americas, Western Europe, and the Middle East between 1990 and 2007.
Theme 3: Recognizing the Diversity of Theory and Data

Similarly, the articles presented here all explicitly recognize that no one body of literature is adequate to explain conflict and cooperation around water and the subsequent negotiation and shared management strategies. The authors rely on diverse theories and frameworks including theories of structural and bargaining power, negotiation theory, neoliberal institutionalism, third party mediation theory, and the literature on the management of international water disputes. Furthermore, the articles included here benefit from a variety of currently available datasets related to water resources, treaties, and conflicts, such as the TFDD database and ICOW. Some authors use primary sources and field interviews specific to river negotiations to provide a rich analysis. This pluralism in theory, methodology, and data within these articles is required to deal with the complexities associated with managing international river disputes.

Theme 4: The Growing Institutionalization of River Resources

A fourth theme of this issue is the emphasis on institutions and institutional mechanisms in the negotiations over disputes and management of shared rivers. Zawahri’s research underscores the importance of a third party mediator in assisting the negotiation and establishment of an effectively designed river basin commission. The absence of effectively designed river commissions may contribute to an environment of conflict and in the case of the Euphrates and Tigris Rivers, unilateral development. In this case, weak monitoring capacity and lack of dispute resolution mechanisms of the Joint Technical Committee have stymied cooperation, according to both Zawahri and Daoudy. Similarly, Kempkey, Pinard, Pochat, and Dinar reveal the need for a secure funding mechanism, permanent technical organization, dispute resolution mechanisms, and involvement of local stakeholders in the negotiation process, as evidenced in the La Plata case. This emphasis on the positive contribution of properly designed joint river commissions was also present in the 2000 issue as well (see Dinar 2000; Nishat and Faisal 2000; Browder 2000; Kibaroglu and Unver 2000).

Stinnett and Tir found that a high demand for cooperation, evidenced by water scarcity, coupled with good geopolitical conditions such as trade interdependence, encourages greater levels of institutionalization around shared waters. The concept of hydrosolidarity can be employed to support several features of transboundary water governance that relate to institutional features and processes, according to Gerlak, Varady and Haverland. Ultimately, a cooperative political environment fosters greater cooperation, according to Brochman and Hensel. Their research reveals that the presence of at least one treaty over the specific subject of a river claim provides an important starting point that greatly increased the likelihood of negotiations over such claims. Thus, institutionalization of river
resources can make an important contribution to negotiations over any disagreements that do emerge in the basin.

**Theme 5: Challenging Conceptions of Power**

Finally, the articles of this issue address the current debate on the role of the relative distribution of power and the use of issue linkages in the negotiations over shared waters. Gerlak and others explore the value of hydrosolidarity as a broad framework to ameliorate the upstream-downstream divide through its emphasis on dialogue. In their analysis of river treaties, Stinnett and Tir find little evidence that the upstream-downstream power relationship shapes the institutionalization of river treaties. In her analysis of negotiations along the Euphrates and Tigris Rivers, Daoudy concludes that power asymmetries do not necessarily determine the results of negotiations. She finds that the downstream-upstream power relationship cannot explain everything in negotiations. Rather, strategies like issue linkages between water and security concerns have propelled efforts at cooperation and helped to overcome the upstream-downstream power differential in this basin.

Warner and Buuren’s study of the Scheldt basin describes the different potential powers available to planners and non-state actors as they confront more powerful decision makers within their states. Shlomi Dinar challenges traditional conceptions of power that weaker states cannot influence the hydro-political context and international agreements. In his analysis of power asymmetries in negotiations along nine international rivers, he finds that even when the benefits of cooperation are not clear to the stronger upstream state, cooperation may be facilitated when strategic interaction is used in the bargaining process to offset the disincentives to cooperation. Similarly, he argues that downstream states may employ strategies that limit the alternatives available to an upstream hegemonic state, thus constraining its options. Multiple strategies – including issue linkage, reciprocity, and side payments – may all be used to promote cooperation in asymmetric contexts.

**Outlining a Future Research Agenda**

We call attention to four compelling issues of river management raised by our authors: climate change, domestic politics, water quality and transboundary aquifers. First, the consequences of climate change on the potential for conflict and cooperation over shared water resources require in-depth examination. Climate change, expected to aggravate the occurrences of floods and droughts in addition to decreasing the supply of freshwater throughout the world (United Nations 2006), will likely play a significant role in future negotiations around shared waters and may even threaten the present management regimes along many international rivers. Ultimately, these changes are anticipated to increase the likeli-
hood for domestic and regional conflict over freshwater (Barnett 2001; IPPC 2007; Brauch 2008). The expectation for conflict arises because scholars warned that a rapid change within a basin that does not have an institutionalized system, such as a treaty or river basin organization, increases the potential for conflict (Wolf et al. 2003). Indeed, riparians face significant obstacles to adopting flexible legal and institutional mechanisms necessary to respond to a crisis generated by climate change, including issues of sovereignty, water stress, and power asymmetry, among others (Fischhendler 2004). Research is needed to assess whether these findings can apply to the rapid changes expected by climate change or whether the anticipation of rapid changes may actually provide states with the incentive structure for preemptive negotiation in hopes of averting the potential losses they can incur. Recent research examining issues of adaptive capacity, vulnerability, and resiliency offer new insight into questions of governance and adaptation along transboundary river systems (Adger et al. 2003; Gunderson et al. 2006; Nelson et al. 2007; Janssen et al. 2006, 2007; Pahl-Wostl 2007; Raadegever et al. 2008). Yet, further case-specific research across a broad spectrum of river systems and geographic regions is sorely needed to better understand how climate change will shape future negotiations and management decisions.

Second, uncertainties about the consequences of climate change augment the need to move beyond the existing tendencies to ignore the impact of domestic politics on the management of international water disputes. In the 2000 issue, Nishat and Faisal (2000) and Dinar and Dinar (2000) argue that a favorable domestic environment is needed for leaders to sign treaties over their international rivers. In the current issue, Kempkey, Pinard, Pochat, and Dinar echo the importance of a favorable domestic environment for treaty negotiations in the La Plata basin. Similarly, Warner and Buuren discuss the role of planners and domestic non-state actors in the management of the Scheldt basin. Yet, these important conclusions on the role of domestic politics have received limited attention – perhaps because of the tendency to black-box the states and focus on the systemic level of analysis (Mumme 1985; Weinthal 2002; Dinar and Dinar 2003; Wolf 2007; Dinar et al. 2007). Given these findings on the role of domestic politics in both the previous and current special issues of this journal, it is necessary to move beyond the tendency to ignore the domestic level of analysis and to examine its impact on state behavior in the realm of conflict and cooperation over shared water resources.

Third, as the quantity of freshwater supplies decreases, the quality of the remaining resources will become more important (Giordano et al. 2003). Due to ineffective management, poor infrastructure, industrialization, and population growth, the quality of existing freshwater is deteriorating throughout the world. This increasing contamination of freshwater has contributed to the spread of waterborne disease and the death of some five to ten million people annually (Wolf 2007). To manage the deteriorating water quality, riparians need to coordinate their action, a step they have avoided even when designing treaties and institutions.
over their shared rivers (Shmueli 1999; Giordano 2003). Further research is needed to uncover the incentive structure influencing riparians’ interests to invest in improving the quality of shared water.

Finally, as with rivers, aquifers – such as the Disi residing along the Jordanian-Saudi Arabian border and South America’s Guarani aquifer – can also transcend international borders or they may be recharged by neighboring states. Between 20 to 40 percent of the world’s population is dependent on aquifers for their drinking water (United Nations 2006). As the pressure for freshwater from rivers increases globally, states are likely to turn to their shared groundwater in an attempt to meet their growing demands (Blomquist and Ingram 2003; Campana 2005; Jarvis et al. 2005). As quintessential common-pool resources, aquifers are subject to the tragedy of the commons because of the incentive to increase consumption. Combining the incentive to overexploat groundwater with the absence of property rights and a lack of international groundwater law results in an increasing potential for inducing conflict and cooperation between states (Ingram 2000; Matthews 2005). Moreover, bilateral and multilateral treaties regulating states’ management of international rivers either neglect to discuss groundwater that are hydraulically linked to these river systems or they fail to provide adequate measures to avoid the tragedy of the commons (Jarvis et al. 2005). The Indus Waters Treaty is a case in point. Although this treaty can be classified as successful in assisting India and Pakistan to manage peacefully their shared river system (Zawahri, 2009), it failed to discuss the vast groundwater beneath the Indus River and it failed to protect against its pollution (Salman and Uprety 2002).

There may be many impediments to reaching agreements on the management of shared aquifers, such as the role of domestic interests, a growing dependence on groundwater resources in many parts of the world today, and an insufficient understanding of the dependency and impacts of groundwater depletion (Feitelson 2006; Villholt 2006). Recent work of UNESCO’s International Hydrological Programme to map a global inventory of transboundary aquifers contributes to broader understanding of transboundary aquifer systems (Puri and Aureli 2005). Increasingly, there is evidence of modest efforts to promote cooperation around transboundary aquifers, including cooperation around Africa’s Nubian and Iullemeden aquifers, and more recent efforts in South America’s Guarani Aquifer (Kemper et al. 2003). Attention to these efforts and strategies for how states can avert the tragedy of the commons in managing transboundary groundwater is a much needed path for future research.

Further research is needed to investigate these vital issues. Indeed, water is a dynamic resource and the study of it is likely to be dynamic as well, changing and evolving to address new currents and flows.
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