
Towards a Global Transboundary Watercourse and Aquifer Agreement (GTWAA)

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Introduction

Much of the world's population depends on freshwater supplies that cannot be confined to one particular state, creating challenges for managing the use of these international transboundary watercourses and aquifers. As population and economic growth continues, measures are needed to establish a better framework for cooperation over these shared waters. Watercourse institutions can play an important role in promoting cooperation, resolving conflict, and providing a means for building and sharing benefits across national borders.

The objectives of this paper are to take stock of the discourse on existing international watercourses¹ agreements and to, specifically, propose a new Global Transboundary Watercourse and Aquifer Agreement (GTWAA). While watercourse institutions have gained acceptance as a tool to manage transboundary water resources and to help avoid and resolve conflict over these shared resources, many watercourses and aquifers (termed WAA) lack such a governing institution. The proposed GTWAA addresses some of the salient institutional and policy challenges that give rise to this gap.

The design of the GTWAA seeks to address at least three major problems related to transboundary watercourse and aquifer management: (i) absence of watercourse and aquifer institutions and organizations for every international WAA; (ii) limited knowledge transfer of WAA governance, particularly between states with established international watercourse agreements and those without prior relationships or agreements; and (iii) insufficient dialogue and research on potential benefits from cooperation around international WAA management, especially in light of the discussion to date that has focused almost exclusively on the economic *costs* of joint management. Important to note, we advocate for a global versus regional approach in the creation of an international WAA agreement, casting the net wide enough to include states with existing shared water resources governance structures. The structure of the GTWAA does, however, preclude existing or future international WAA agreements from creating regional institutions.

We propose a GTWAA to establish a watercourse agreement and an organization for each international transboundary watercourse and aquifer. The Agreement draws upon lessons learned from existing watercourse institutions and outlines broad principles upon which all new institutions should be based, recognizing ecological, geographic, climatic, economic, social, and political difference in countries. In addition to providing a structure through which to manage conflict among countries as they arise, WAA agreements also create mechanisms for states to share *benefits*, not just water, that arise from joint

management initiatives. As outlined in the Prescriptions segment (section five) of this paper, the GTWAA first calls for the creation of a watercourse or aquifer agreement among the states sharing the resource. Second, the GTWAA puts forth underlying fundamental principles, implementation activities, and soft law, or guiding principles, to which each signatory subscribes. The GTWAA should not be viewed as an exact blueprint for institutional creation, but rather as a starting point, from which states can adopt additional principles and agreements, accounting for specific factors relevant to each case.

Before delving into the details of the GTWAA, section two provides background on the current fragmented effort to manage international watercourses. Section three offers further background and elaboration on the role that institutions have played in providing a forum for cooperation on international watercourses. Section four outlines the key existing frameworks for transboundary watercourse sharing, pointing out strengths as well as limitations of some of these frameworks. This section also highlights water-related targets set in the Millennium Development Goals and the Johannesburg Final Report from the World Summit on Sustainable Development, recognizing that meeting the needs of the billions without access to safe drinking water and sanitation cannot be removed from discussions of transboundary watercourse management. The fifth section lays out a proposed GTWAA that calls for each watercourse to establish an agreement and set up an organization to oversee the governance of this shared resource. We emphasize the ways in which watercourse agreements can facilitate the sharing of economic, political, and ecological benefits, rather than focusing only on water allocation. This section also outlines the fundamental principles to which all signatories agree, followed by a discussion of GTWAA activities, guiding norms, and the mechanics of the agreement. Section six points to the next steps involved in launching the GTWAA.

Background on International Watercourse Challenges

Increasingly, water has gained attention for its potential to incite conflict. Within countries, pressures for a reliable source of clean water to meet diverse needs can result in intrastate tension. The jostling for water between agriculture, industry, urban and rural development, and domestic users, often leaves ecosystem needs to the side. As global population grows, water consumption patterns increase, and climate change portends greater water variability (extreme drought and flooding), pressures mount on this precious resource, creating further potential for conflict. Over the past century, population growth alone has led to a near 80 percent drop in per capita water availability (Gleick 2000; Wolf 2003) and currently over a billion people lack access to safe drinking water. Further complicating the picture, water does not adhere to political boundaries. More than 260 rivers worldwide pass through the borders of two or more nations and no less than 145 countries contain riparians to one or more of these international basins (Giordano and Wolf 2003). An unknown number of aquifers also span national boundaries. Forty-five percent of the land area of the Earth and forty percent of the global population lives within these international transboundary basins (Wolf 1999). Both developed and developing countries alike face the challenges of sharing watercourses and

aquifers. With such a sizable portion of the world's population residing in internationally shared basins, the stakes are high for international transboundary water resources management.

Although talk of water wars captures headlines, an historical look at international interactions over water suggests that cooperation, rather than international conflict, tends to dominate water-related interactions. In the past 50 years, for example, only 37 instances of violent disputes have occurred, while 150 water treaties were negotiated during the same time period (Wolf, Yoffe, and Giordano 2003). Moreover, the one and only example of outright interstate violence that has ever erupted over water resources dates back some 4,500 years ago (Gleick 2001). Further, historical analysis demonstrates that even in the midst of disputes over other issues, water conflicts tend to get resolved (Giordano and Wolf 2003). In fact, international water-related tensions are more likely to result from a gradual decline in water quantity and quality, which disrupts countries' internal stability and may spill out into the international arena. This scenario is more likely to arise than direct violence over water (Giordano and Wolf 2003).

Around the world, more than 3,600 international agreements (bilateral and multilateral) that tackle water-related issues are known (Vinogradov, Wouters, and Jones 2003). In the form of river commissions, basin-wide initiatives, or treaties among countries, these watercourse institutions provide forums for states to meet formally and negotiate terms of interaction and management. Just as watercourses vary in terms of climate, hydrology, geology, stark differences exist in the geopolitical interactions among watercourse-sharing states. These distinctions give rise to institutional variations in organizational structure, scope of mission, degree of rigidity, and governmental participation. In spite of these differences, studies have found that the presence or absence of watercourse institutions can be the most important factor to determine if countries cooperate over water (Giordano and Wolf 2003). According to a study led by Dr. Aaron Wolf (2003), leader of Oregon State University's Transboundary Freshwater Dispute Database project, institutions play an even more important factor than previously cited variables, including climate, population density, water availability, political orientation, and degrees of economic development (Wolf, Yoffe, Giordano 2003). Today, many of the world's international river basins have agreements between two or more countries, however, not all watercourses have an institutional structure, which would allow for ongoing interaction.

Those countries that lack an institutional arrangement over shared watercourses or aquifers may face a lost opportunity. In this global society, the impacts of instability in one country or region, and the resulting hardship and suffering, do not stay isolated. Economic systems and trade can face disruptions when political instability arises. Likewise, environmental degradation in one country cannot always be confined to political borders, giving rise to negative social and economic impacts experienced by states sharing the water resources.

Why Institutions Matter

As referred to above, the GTWAA calls for: (i) the establishment of an institution (specifically, an agreement that is formulated and implemented by all states of an international watercourse or aquifer); and (ii) the creation of an organization (a commission which employs professionals from each riparian and governs the overall management of the clauses stipulated in the specific watercourse agreement). As Ostrom (1999) explains, institutions are a collection of rules that guide the activities of one or more organization. The institutions and the organizations require clearly distinguished and, conceptually, that the rules (i.e. the institution) must be differentiated from the players (i.e. organizations such as political bodies, economic bodies, social bodies) (North 1990).

Ostrom (1990) reminds us of the three predominant models that suggest ways to govern public natural resources: the tragedy of the commons², the prisoner's dilemma³, and the logic of collective action⁴. Ostrom details another model called self-organizing common pool resource institutions and she compares institutions that have successfully, and less successfully, managed their own common pool resources⁵. Some of the principles of success include clearly defined boundaries, monitoring, mechanisms for conflict resolution, and congruence between rules and local conditions. The proposed GTWAA embraces the principles put forth by Ostrom.

Arguably, three aspects of international WAAs give impetus to develop shared watercourse and aquifer institutions and commissions for those currently lacking them and to strengthen institutions and commissions for those with existing WAAs: (i) conflict tends not to play out as full-scale violence; (ii) tensions can be averted if international organizations are established early on; and (iii) the resilience of these organizations tends to increase over time (Wolf undated; Wolf 1999).

Worthy of note, the GTWAA itself and the type of institutional structure it calls for (an institution for each international watercourse and aquifer) are both examples of formal – as opposed to informal -- institutions. The main features of formal institutions for resource management, such as water, include: a clearly bounded user group, a system of graduated sanctions imposed on those who offend the rules, and public conflict resolution mechanisms (Cleaver 1998).

Institutional structures that bring together watercourse states can promote resource protection and also contribute to a reduction in conflict over shared resources. A study by Yoffe et al. (2004) suggests that institutional capacity within a basin, whether defined as water management bodies or treaties, or generally positive international relations are as important, if not more so, than the physical aspects of a system. It is as “the rate of change within a basin exceeds the institutional capacity to absorb that change” that we find tensions and disputes increase (pp. 8).

Multilateral environmental agreements – a type of institution – have brought about environmental gains. Examples include the decline in ozone-depleting emissions following the establishment of the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer; the increase in the number of protected areas around the world as a result of the efforts pushed through the Convention on Biological Diversity; and the much improved control of transboundary movement of hazardous wastes as a result of the Basel Convention. However, the creation of such international institutions by no means offers a foolproof way to protect natural resources. Young's (2001) study underlines that although we cannot say conclusively that a certain multilateral environmental agreement caused a reduction in emissions or protection of a forest, we can be more certain that agreements do indeed yield positive gains, such as implementing legislation in member countries, promulgating national regulations, or creation of funds.

In order to provide a window into the way in which international institutions have governed shared watercourses, three examples follow: the Mekong River Commission, the Nile Basin Initiative, and the European Union Framework for Community Action in the Field of Water Policy.

Mekong River Commission

The potential for conflict within the Mekong and its tributaries exists, however, the Mekong River Commission (MRC) has so far been effective in staving off divisive actions and preventing conflict. Originally formed as the Mekong Committee in 1957, the organization has evolved over time, developing principles and guidelines to address water utilization and alterations to the main-stem of the river. The organization has functioned even in the midst of political turmoil, evidenced by the exchange of water-related data among countries throughout the Vietnam War (Giordano and Wolf 2003). In 1995, all member countries (which includes all riparians except for China and Myanmar, both of which have “observer” status) signed the Mekong River Agreement, after three years of negotiations (Molle 2005). The MRC has clearly defined expectations and procedures with respect to organizational structure⁶ (MRC 2005; Burchi and Spreij 2003). In addition to the MRC, each member state has created a National Mekong Committee, which plays an important role in the implementation of activities (Burchi and Spreij 2003). The cooperation among Mekong countries has led states to move beyond conflict toward integrative projects (Wolf undated; Sadoff and Grey 2002).

Nile Basin Initiative

A regional partnership among nine basin states of the Nile River, the Nile Basin Initiative (NBI) includes Burundi, the Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda. The Ministers of Water Affairs of these nine states signed the NBI in 1999. Although one of the Nile basin states – Eritrea – participates only as an observer, the government has expressed strong interest in joining the Initiative. Although Eritrea's observer status is similar to that of China and Myanmar in the MRC, China's position with respect to the MRC has much larger political, ecological, and economic ramifications than that of Eritrea's in the Nile River. A triad of

entities form the NBI's organizational structure: the Council of Ministers of Water Affairs of the Nile Basin Countries (Nile-COM, established in 1992), which formulates policy and is the main decision-making body; the Technical Advisory Committee (Nile-TAC, established in 1998), which supplies Nile-COM with technical advice; and the Nile Basin Secretariat (Nile-SEC), which provides administrative services to the Nile-COM and Nile-TAC (NBI 2005). The NBI derives its funding from two primary sources: contributions from the NBI countries themselves, and bilateral and multilateral donor support, the majority of which is channeled through the Nile Basin Trust Fund, managed by the World Bank. The set of NBI Policy Guidelines, adopted by the Nile-COM in February 1999, make up the main institution guiding NBI activities. The NBI faces numerous daunting challenges that range from coordinating environmental protection, to water allocation, to water storage.

European Union Water Framework Directive

In October 2000, the European Commission adopted the European Water Framework Directive (officially called, "Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy") (EU 2005). The Directive's aim was to create a single piece of framework legislation which reflected the salient concerns that emerged from 1996 Water Conference that brought together representatives of Member States, regional and local authorities, industry, agriculture, and, not least, and various environmental and consumer groups. The Directive is both comprehensive and innovative and it is worth highlighting a few of the chief elements of the Directive. First, the Directive calls for River Basin Management, promoting management on the scale of the watershed, or the natural hydrologic unit of the river, as opposed to political boundaries. The Directive calls for a River Basin Management Plan to be crafted for each river basin district. Second, and distinct from many other international agreements, the Directive puts forth a framework for the integrated management of both *groundwater* and *surface water* at the European level (a concept that has yet to be tried at the European level). Third, the framework directive approach allows for the consolidation of the European Community's water legislation. It replaces seven of the "first wave" directives⁷ such that the operative provisions of these directives will be taken over in the framework directive, allowing them to be repealed.

Existing International Water Law, Treaties, And Policies

This section outlines the array of international laws, treaties, and policies that target water. Existing international water law, treaties, and policies, as discussed below, offer a view of the types of water agreements that have been negotiated between countries, on a regional and even a global basis. The role of the GTWAA in the context of this diplomatic water history is to build on these efforts and to complement prior work and negotiations.

River management is political. It is therefore not surprising that the words "river" and "rival" arise from the same root; rival means dwellers on opposite banks of a river (Oxford English Dictionary; Grey and Sadoff 2003). Decisions about river and

watercourse use galvanize heated political discussions and strategic actions. This political dimension of watercourse management lends itself to international agreements and the formulation of water law. In fact, negotiations over water date back as far as AD 805 and 1221 (Mullally 1999). Many multilateral agreements exist as well, both on a regional and basin-wide scale. Some treaties provide a broad framework for transboundary waters governance and others target a specific watercourse or even a component issue related to a particular basin. What follows are key contributions from international watercourse treaties.

Key historical treaties

The 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses (IWC 1997) is the only global treaty focused on international water resources (Vinogradov, Wouters, Jones 2003). The main provisions of the Convention include exchange of information and data, notification of possible adverse effects, protection of ecosystems, and handling of emergency situations such as floods. A significant portion of the 1997 UN IWC Convention focuses on achieving “reasonable and equitable use” (Article 5) within a watercourse state with “a view to attaining optimal utilization thereof and benefits there from.” The discussions that led to the Convention focused on how to meet these goals while also honoring the obligation not to cause significant harm to human systems and ecosystems (Wolf 1999); as well, the 1997 UN IWC Convention established a basis for future international treaties (Vinogradov, Wouters, Jones 2003). Although the 1997 UN IWC Convention pertains to the system of surface waters and connected groundwaters, it does not govern “confined” aquifers, or groundwaters not connected to surface waters (Vinogradov, Wouters, Jones 2003). The treaty also excludes glaciers that cross the boundaries of two or more states.

Although the 1997 UN IWC Convention may be the flagship of multilateral agreements related to international watercourses, a fairly extensive history of international watercourse-related treaties dates back for nearly one hundred years. In 1911 the Declaration of Madrid “On the International Regulation regarding the Use of International Watercourses for Purposes other than Navigation” marked the earliest attempt to document the customary rules of international watercourse law (Vinogradov, Wouters, Jones 2003). The Declaration recommended, for example, that co-riparians establish permanent joint commissions; discouraging unilateral basin alterations and any changes that might have adverse impacts to international rivers (Giordano and Wolf 2003).

A half a century later the same organization responsible for drafting the 1911 Madrid Declaration - Institut de Droit Internationale – also adopted two resolutions:

- (i) The Salzburg Resolution, “On the Use of International Non-Maritime Waters,” (1961), which recognizes that states sharing a watercourse have a “right to utilize waters which traverse or border its territory.” However, Article 4 of the Resolution posits that a state may not impair another state’s ability to benefit from

the waters or watercourse basin. This article arises from the resolution's preface, which establishes an "obligation not to cause harm to others" as a basic precept.

(ii) The Athens Resolution, "On the Pollution of Rivers and Lakes and International Law" (1979), which establish a "duty to cooperate" among watercourse sharing states. This resolution emphasizes data sharing, consultation, and notification to other states. Likewise, both the 1961 and 1979 Resolutions suggest a role for commissions to help resolve disagreements. The Athens Resolution explicitly calls for the creation of "international commissions with the largest terms of reference for the entire basin," under Article 7 (duty to cooperate).

In 1966, the International Law Association (ILA) adopted the Helsinki Rules on the Uses of the Waters of International Rivers, which developed the principle of "equitable and reasonable share in the beneficial use" of international watercourses (Vinogradov, Wouters, Jones 2003). Additional resolutions that focus on specific aspects of transboundary water resources have supplemented the Helsinki Rules (e.g., flood control, regulation of flow, pollution, and administration).

In addition to the drafting of international principles and rules pertaining to shared watercourses, regional multilateral treaties have also emerged to guide the use of transboundary watercourses. In 1992, the UN Economic Commission for Europe reached agreement in Helsinki on the "Convention on the Protection and Use of Transboundary Watercourses and International Lakes," which targets member countries of the Economic Commission for Europe (ECE). The Convention calls for cooperation among riparian parties through the establishment of "joint bodies," where they do not exist, or the adaptation of existing bodies on the basis of a shared watercourse. Each joint body takes on a series of tasks such as collecting, compiling, and evaluating data pertaining to pollution sources and impacts (Article 9). As the title indicates, the 1992 Helsinki Convention pertains to lakes as well as rivers.

In recent years, efforts to identify and better understand the international aquifer systems have grown substantially. Groundwater serves as one of the primary water sources for human consumption and often does not need to undergo the same regiment of treatment as surface waters, in order to make supplies fit for human consumption (Anton 1993). However, over-pumping can lead to devastating problems for crops and can impair the world's future availability of freshwater (Anton 1993; Hamner and Wolf 1998). In spite of human dependence on water from confined aquifers, few bilateral or multilateral agreements deal with groundwater sources. The 1986 Seoul Rules on International Groundwater, adopted by the International Law Association, went further to apply the 1966 Helsinki Rules of equitable use to all groundwater systems—whether or not they were hydrologically linked to surface water systems. In 1989, an independent group created the Bellagio Draft Treaty, in an attempt to establish a document of "soft law" to provide a framework to address groundwater negotiations (Wolf undated; Wolf, 1999).

The treaty calls for the joint management of the watercourse, and puts forth eight factors for consideration in the allocation of groundwater. The issues that should gain consideration are: 1) hydrogeology and meteorology; 2) existing and planned uses; 3) environmental sensitivity; 4) quality control requirements; 5) socio-economic implications; 6) water conservation practices; 7) artificial recharge potential; 8) and comparative costs and implications of alternative sources of supply (Wolf, "Criteria for equitable allocations," 1999). Since an international forum did not commission the treaty nor has it been ratified by any nations, it lacks enforcement capabilities.

While numerous bilateral and multilateral agreements have emerged to focus on integrated water resources management to protect and conserve the quality and quantity of transboundary waters, several global agreements target uses for basic human needs.

Major United Nations water-related initiatives

The landmark environment and development conference – the 1992 United Nations Earth Summit in Rio de Janeiro – addressed the management of freshwater resources in Chapter 18 of the outcome document, Agenda 21 (UN 1992). However, the Dublin Statement, a product of International Conference on Water and the Environment in Dublin, organized in preparation for the Earth Summit, generated greater momentum to underscore the importance of international transboundary water management (Giordano and Wolf 2003). The Principles formally established water as an essential, finite, and vulnerable resource necessary for all life and development. As well, water and all of its competing uses have an economic value. They also highlighted the importance of participation from water users at all levels when undertaking water development and management plans. Similarly, the Millennium Development Goals (MDGs), which emerged from the UN Millennium Summit in 2000, put forth a number of targets and timetables specifically geared toward reducing global poverty. Goal Seven, for example, ensures environmental sustainability. To do this, three targets were established, including: "[h]alve, by 2015, the proportion of people without sustainable access to safe drinking water" (UN STATS 2005). In Johannesburg at the World Summit on Sustainable Development in 2002, ten years after the Earth Summit, delegates bolstered the MDGs by including a clause to decrease by half the proportion of people without basic sanitation (WSSD, 2002). The proposed GTWAA strives to establish linkages between these grand international efforts in order to mobilize action, funds, and political will at the watercourse and aquifer level.

Out of the thousands of bilateral and multi-lateral agreements pertaining to international transboundary waters, several principles have emerged, including data sharing, duty to cooperate, and reasonable use of water. The treaties fall short in a number of respects, however, including enforceability. The biggest gap that the GTWAA seeks to tackle, therefore, relates to the lack of existing institutions and related organizations for each and every watercourse and aquifer

Prescriptions in the GTWAA

Watercourse institutions have gained recognition for their role in preventing conflict and facilitating dispute resolution. As watercourses and aquifers face added pressures from population expansion, climate change, and increased emphasis on economic development, water quality and availability will likely face further impairment, leading to additional tensions over shared resources. But the development of new international watercourse and aquifer institutions such as the GTWAA strengthens existing agreements and bodies and endeavors to meet the goals of human security and sustainable development around the world (Wolf, Stahl, and Macomber 2003).

Given the variations associated with each watercourse, the GTWAA establishes minimum principles for each agreement, anticipating that nations may adopt additional principles or guidelines according to unique climate, geopolitics, and economic resources. The primary aim of the GTWAA is to expand the number of institutions and governing organizations so that each international transboundary watercourse has an institutional structure. A secondary goal is to strengthen existing agreements and organizations.

The GTWAA consists of five sets of prescriptions, which are described in detail below:

- Shifting the emphasis to benefits sharing
- Overarching principles
- Transboundary aquifer management
- Guiding norms of the GTWAA
- Mechanics of the GTWAA

(i) *Sharing benefits*

Cooperation between and among transboundary watercourse and aquifer states has the potential to yield positive gains. In contrast to past international watercourse negotiations, the GTWAA prioritizes benefits sharing as a critical component to building cross-border agreements. Studies find that watercourse negotiations that have focused primarily on allocating water among users have tended to generate heated debates over hydrography and chronology. That is, disputes emphasize questions of where the river or watercourse originates and how much falls within a given state, or who has been using the water for the longest period of time (Wolf 1999). A common dynamic follows: upstream nations (e.g. Ethiopia, a Nile Basin riparian, and Turkey, a Tigris-Euphrates riparian) make right-to-water arguments on the basis of absolute sovereignty while downstream states, which often receive less rainfall (e.g. Egypt, a Nile Basin riparian, and Iraq, a Tigris-Euphrates riparian), argue on the basis of historic rights to water (Wolf 1999). Among other factors, the outcomes to the hydrography/chronology dispute depend upon the location of a watercourse state as well as the power it wields in relationship to other nations sharing the resource.

Future watercourse negotiations that emphasize sharing benefits, and not just sharing water, will offer greater incentive for states to enter into agreements. Often beneath debates over how much water a nation obtains are concerns over the extent to which other states will have access to the *benefits* and *opportunities* obtained from the watercourse (Sadoff and Grey 2002). A paradigm shift away from the perception of a zero-sum gain in terms of water allocation to one that increases the overall gains possible will allow states to view a new bundle of benefits, ranging from ecological to economic and from social to political (Sadoff and Grey). While physical water resources in a watercourse are finite, management decisions that stem from cooperation can increase the amount of available water resources (Sadoff and Grey 2002). By expanding the focus of discussion from water allocation to examine other aspects of water management, including ways that nations might benefit from these management decisions, increases the size of the proverbial pie, creating more possibilities for gain (Susskind 1994).

In many cases, ecosystem health stands to improve from increased inter-state cooperation. Both domestically and internationally, consensus has grown around the importance of managing a river on the watershed scale since actions taken in one part of the river impact the health of other parts of the system. Population and industrialization pressures take their toll on rivers and the lands within the watershed by degrading water quality, destroying fisheries, decreasing flow rates, and over-extracting aquifers. Land-use patterns throughout a basin often increase the vulnerability to flooding and drought, which can exacerbate suffering among human communities, particularly impacting the poorest sectors of the population. However, greater coordination among states can, in some cases, provide another set of options. The Rhine Action Plan, an initiative of the late 1980s that brought together the eight European countries that share the river, led to a restoration of the heavily polluted system. Known in the mid-1800s for its salmon fisheries, the river underwent subsequent degradation as a result of industrialization—to the point that it was referred to as “the sewer of Europe.” The efforts launched by the riparian ministers, however, have led salmon to once again live and spawn in the Rhine (Sadoff and Grey 2002). Rivers systems are resilient, but when they pass through or border more than one nation, the short and long-term health relies on coordination among states. Cooperation efforts to protect watercourses, including safeguarding land-use, may prove less costly than remediation efforts.

Cross-border watercourse and aquifer cooperation may also produce economic and social advantages. In addition to the ecological gains from protection and rehabilitation of Rhine fisheries, cooperation among states created opportunities for positive economic and social gains. Joint initiatives around shared watercourses can also help mitigate the social and economic impacts of drought and flooding. In 2000, the southern African country of Mozambique experienced devastating floods, which destroyed transportation and communication infrastructure and left thousands of people without homes or safe water. Adding insult to injury, a subsequent cholera outbreak occurred, leading to a massive public health crisis. Mozambique shares nine out of the fifteen river basins of the Southern Africa region and is located downstream of all but one (Carmo Paz 2000;

Republic of Mozambique 2002; Sadoff, Whittington, Grey, 2002), making them particularly vulnerable to actions in upstream states. Haunting stories point to basic communication failures during the 2000 floods, which resulted in the late release of upstream dams. This sent a surge of water down river that broke through Mozambique's dams and levies, exacerbating the impacts of the heavy rainfall and cyclone conditions. Cooperation among southern African states that establishes clear protocols and lines of communication could help avert the economic costs and breadth of damage resulting from future and expected annual floods.

Transboundary waters cooperation can lead to other economic gains in the form of joint infrastructure investment. For example, Mali, Mauritania, and Senegal co-own a dam in the Senegal Basin, and share the resulting economic benefits, in spite of the fact that it is located within the boundaries of Mali (Sadoff and Grey 2002). Cooperation between Lesotho and South Africa are jointly constructing infrastructure in the Lesotho Highlands on the Orange River. Through the project, South Africa can provide lower cost water to support its industry and Lesotho gains royalties to the tune of five percent of the country's GDP (Sadoff and Grey 2002).

The political nature of rivers also results in expended and opportunity costs, which, in some cases, could be reduced or avoided through cooperation. In extreme cases, where tensions among nations are ripe and water is scarce, such as the Jordan basin, states allocate monies to protect water resources. Even when state funds do not directly support the military, losses play out in the form of opportunity costs. Tensions between and among countries tend to prevent regional integration, leading to fragmented markets, infrastructure, transportation systems, labor flows, and telecommunications, which can impair all the economies of all riparians (Sadoff and Grey 2002). Cooperation and coordination among watercourse states can create an entirely different picture where trade, power, transport, and labor can flow between countries—not just water (Sadoff and Grey 2002).

Although the costs of cooperation may not always outweigh the gains, greater attention to the potential for shared benefits opens opportunities for creativity in managing international watercourses at the most appropriate unit: the watershed. A shift away from a conception of river interactions as a zero-sum gain toward one that yields positive sums may open the prospects for garnering greater assets than could be realized without transboundary cooperation. In many cases, the zero-sum framework impairs possible gains for all riparian states within a watercourse by further promoting regional and economic fragmentation. It is useful to view cooperation on international transboundary watercourses as a continuum ranging from information sharing that can prevent or reduce harm caused by events such as flooding, to shared ownership, operation, and management of infrastructure investments (Sadoff and Grey forthcoming). Cooperation will best suit situations where the gains—whether ecological, political, economic, or social—are great and the distribution of these benefits is perceived of as equitable (Sadoff, Whittington, and Grey 2002).

(ii) Overarching principles

Significant debate has arisen in negotiations over the specificities of transboundary waters resources management. Since all watercourses vary according to many factors, including climate, hydrology, geopolitics, economic and social needs and capabilities, the GTWAA points to the most basic principles to which all signatories will be held when crafting each watercourse or aquifer institution. Since the principles draw from existing international agreements and rules (e.g. the Helsinki Rules, 1997 Convention on Non-Navigable Waters), most watercourse institutions currently in existence already receive guidance from these rules.

The first two principles listed below are fundamental obligations of states in terms of transboundary water resources according to international customary law (Vinogradov, Wouters, and Patricia Jones 2003). However, all four principles are binding for all signatories except for those states that have existing agreements and decide to maintain their own agreements rather than signing on to the GTWAA.

Equitable distribution and use of fresh water:

Drawing from existing watercourse agreements and analyses, the principle of equitable distribution and use of freshwater represents an important legal principle for inclusion in the Universal Convention. In particular, the principle provides a counterpoint to power imbalances that exist among watercourse-sharing states as it aims to promote equity among users. Most often, upstream nations, or otherwise “dominant users” (e.g. Egypt), emphasize sovereign rights as a means to exercise full control over water resources that fall within the territorial boundaries, however this approach jeopardizes the uses possible from downstream or less powerful co-watercourse states (Mullally 1999; Wolf 1999). Based upon the 1997 UN Transboundary Watercourse Convention on Non-navigable waters, seven factors are relevant to the equitable and reasonable utilization of the watercourse and the water contained therein:

- 1) Geographic, hydrological, climatic, ecological and other natural factors;
- 2) Social and economic needs of each riparian state;
- 3) Population dependent on the watercourse;
- 4) Effects of use in one state on the uses of other states;
- 5) Existing and potential uses;
- 6) Conservation, protection, and development and economy of use and the costs of measures taken to that effect;
- 7) The existing availability of alternatives, of corresponding value, to a particular planned or existing use (IWC 1997, Articles 5 and 6; Wolf 1999; Vinogradov, Wouters, and Jones 2003).

(This order does not reflect a prescribed weighting. Watercourse and aquifer states will negotiate to determine an appropriate way to prioritize these factors relevant to equitable and reasonable use.)

It is important to note that although previously established international agreements and law have outlined factors important to “equitable use” of water resources, the terminology within the international legal framework remains obtuse. Consequently, the creation of any WAA institution and subsequent commission, shall require parties to engage in dialogue to establish common definitions and understandings of terminology, heeding concepts of fair distribution of water among nations sharing the WAA (Mullally 1999). Under many circumstances, nations will enter these discussions with clearly prescribed lists of how the state will prioritize water resources. For example, some nations may give agricultural uses of water primacy, while others will give greater weight to industrial uses. South Africa stands as an anomalous state in that the national water policy requires that each citizen have access to a minimum quantity of water, as a facet of the “right to life.” Consequently, when engaging in discussion to parse out how much water the country sees as necessary, a component of the calculations will account for 20 liters per capita per day—the established minimum allotment.

Obligation not to cause significant harm to any party:

Again, drawing from existing international negotiations, the principle not to cause significant harm is critical for the establishment of all watercourse and aquifer institutions that emerge from the GTWAA. Under this principle, signatory states agree to take all appropriate measures to prevent harm to other watercourse states (IWC 1997, Article 7). In cases where significant harm does result from the actions of a watercourse state on another, the state that has inflicted such harm has the duty to eliminate or mitigate such harm. Where appropriate, the state that caused harm or impaired the ability for another state to realize benefits from the watercourse or aquifer, may have the duty to compensate. This principle applies not only to the amount of water extracted or released (as in the case of dam), but also to impacts that arise from pollution, supporting the “polluter pays” environmental legal principle.

As with the principle of equitable distribution of use, the parameters for definitions remain hazy, which therefore requires signatory parties to establish common interpretations of the terms. The principle of no harm does, however, interface with the principle of equitable distribution. That is, in theory, a state that causes harm to another, also violates the principle of equitable use (Mullally 1999). However, in cases of high water availability, such as conditions of low flows, nations may argue that they cannot attain sufficient quantities to meet national demands. Given the tension around water allocation decisions, discussions may make greater progress by focusing more attention on how to undertake measures that will increase water *availability* (e.g. through demand-side planning) or otherwise engage in activities that will increase the basket of benefits possible to all states. To a large extent, the task of building cooperation among WAA nations requires a shift in social and cultural norms away from a zero-sum notion of water-use activities to the possibility of positive-sum outcomes.

Duty to cooperate:

The duty to cooperate principle encompasses a number of essential aspects to watercourse agreements. The principle dovetails with the creation of a watercourse commission, the organizational mechanism that facilitates cooperation on relevant measures, and also establishes agreed upon procedures on how to approach new information or unexpected circumstances.

The duty to cooperate incorporates principles related to the sharing of data and information. Signatory states that have drafted a watercourse agreement shall include provisions for the regular exchange of readily available data and information related to the condition of the watercourse. The import of regular data sharing and exchange cannot be overstated, particularly since many watercourses experience significant variability in terms of flows, which makes water-use planning especially challenging. Of particular importance with respect to data exchange is information related to the hydrological, meteorological, hydrogeological, and ecological (including water quality measures) nature of the watercourse. Information exchange shall also include expected forecasts, to assist watercourse and aquifer states in appropriate basin planning where possible (IWC 1997, Article 9).

Watercourse states with plans for development or modifications also have the duty to cooperate with respect to notifying other watercourse states of their “planned measures.” Planned measures include all activities or projects carried out within the borders of a particular state, making it applicable to private initiatives as well as state projects. Furthermore, the duty to notify applies not only to communication about river dams and diversions, but also to groundwater extractions. In cases where a proposed project or initiative has the potential to cause adverse impact to other watercourse states, the notifying state shall be required to share all data and findings relevant to the potential impacts of the planned measure (e.g. environment impact assessment). In these instances, prior agreement may be necessary before developments proceed and the notifying state is required to give the impacted states at least six months prior notice to allow time for review and evaluation of the studies. Potentially impacted states have the option of requesting an additional six months time for further review. During the review period of six months to one year, the notifying state is not permitted to undertake any planned measures without the consent of potentially impacted nations. In cases where urgent implementation of planned measures is called for, the process of notification and consultation is expedited. The notifying state is required to declare the reason for urgent action and provide all data and information to watercourse sharing nations. If a consultation process is needed, it shall occur on a much shorter timescale.

The duty to cooperate also includes strategizing ways so that watercourse states can expand the possibilities for benefits sharing among all watercourse states. While increasing research explores the possibility of sharing benefits among watercourse nations, the potential for countries to engage in cooperative agreements depends upon the perceived quantity of gains as well as how these benefits will be distributed among

parties (Sadoff and Grey 2002). In this context, the duty to cooperate aims to promote creativity and flexibility to identify ways that cross-border cooperation can occur in a manner that equitably distributes benefits. Where appropriate, this might play out by expanding the “baskets” of benefits beyond a sole emphasis on water (Wolf 1999; Wolf undated). India and Nepal have negotiated baskets of benefits in 1959 on the Bagmati and the Gandak, and in 1966 on the tributaries of the Ganges (the Kosi). These treaties created provisions for many water projects such as hydropower, irrigation, navigation, fishing, transport, and upstream tree planting (in Nepal) in order to prevent downstream sedimentation. By including a wide scope of provisions, the resultant treaties were more creative (Wolf 1999).

Unlike other international water treaties, the GTWAA explicitly includes international transboundary confined aquifers. Given the existing scientific limitations with respect to understanding current delimitations and conditions of groundwater supplies, a special section of the Convention refers explicitly to aquifer management. The separate treatment of aquifers, however, does not preclude application of other minimal principles to transboundary aquifers. Rather, it points to anticipated challenges and delays with respect to groundwater data exchange and information sharing. Furthermore, due to data limitations, uncertainty exists around the degree to which developments in the aquifer basin will impact or alter the quantity or quality of water available. Cooperation to the best effort possible is called for in situations where data and scientific information is limited. The GTWAA also serves as impetus to galvanize political will and financial resources from multilateral and bilateral sources to increase the scientific study of groundwater sources in order to create longer-term avenues to establish transboundary aquifer institutions and commissions for each of these supplies. (Please see below for further attention to transboundary aquifer activities.)

Environmental protection and management:

The GTWAA includes provisions for the protection and preservation of ecosystems, as called for in the 1997 IWC. States are called upon to both individually and, where appropriate, jointly engage in efforts to protect and preserve the ecosystems of international watercourses. States are also required to reduce and control pollution, which includes any alteration or decline in quality of the waters, which results from human actions, either directly or indirectly. States are also called upon, where appropriate, to take part in joint pollution reduction and control efforts, when conduct causes harm to the living organisms of the international watercourse, or to human health or safety. Any state may request consultation to establish mutually agreed upon measures and methods to prevent, reduce, or control pollution. Requests for consultations may include: 1) setting joint water quality objectives and criteria; 2) establish techniques and practices to address pollution from point and non-point sources; 3) establish lists of substances that if introduced to the international watercourse would be prohibited, limited, investigated, or monitored (IWC 1997, Articles 20 and 21). Signatories also agree to prevent the introduction of species, alien or new, which may have detrimental effects to the ecosystem, resulting in significant harm to other watercourse states (IWC 1997, Article

22). The GTWAA also reaffirms international rules and standards with respect to the protection and preservation of marine environments, including estuaries, which are some of the most diverse and productive ecosystems in the world (IWC 1997, Article 23). At any point, a watercourse nation may request consultation of another watercourse sharing state concerning the watercourse management toward the end of planning for sustainable development plans and implementation measures (IWC 1997, Article 24).

(iii) Transboundary aquifer management

Just as the GTWAA proposes an institution and commission for each watercourse, so too does it prioritize the creation of similar structures for all confined aquifers, or groundwaters not connected to surface waters. However, current data and knowledge limitations present barriers to implementation of this priority. While many outstanding questions persist with respect to surface watercourse management and how to balance ecosystem and human-related water needs for the short and long terms (e.g. lack of baseline knowledge of the types and prevalence of species, limited understanding of the ecological impacts of human developments), the holes are greater in size and quantity with respect to groundwater systems. Given the importance of aquifers as a water source to a sizeable proportion of the population, and the existing problems of over-extraction in parts of the world, the proposed GTWAA underscores the need to actively fill in knowledge gaps. Specifically, priority shall go toward delineating transboundary aquifers and their recharge areas; estimating volume and flow rates; and testing water quality. In order to move this new set of priorities forward, political and financial support are needed. Linkages with existing universities and other existing institutions creates channels through which finances, training, and human capital can be directed toward specific projects such as mapping and modeling projections.

(iv) Guiding Norms of the GTWAA

Capacity building

Effective water governance requires skill, training, and experience; features that the GTWAA promotes through soft law tenets, or the guiding norms. Both financial resources and information offer essential means to provide training and opportunities to exchange information and data with the water managers of other countries within the shared watercourse or aquifer boundaries. The GTWAA urges WAA nations to develop the means for states to take part in training programs as well as global water discussions (e.g. World Water Forum, Stockholm Water Week). Existing programs, such as the Universities Partnership for Transboundary Waters, a joint initiative through Oregon State University and UNESCO, offers an in-depth opportunity to examine different facets of transboundary watercourse management and train water managers. The Secretariat (see the Mechanics section (v) below) will provide guidance to signatory countries to find the financial means to take part in trainings, conferences, and educational programs to improve the capacity for water governance and management, including opportunities for data collection and analysis. Funding sources may come from multilateral or bilateral arrangements. Some assistance might also be available from foundations and academic institutions.

Communication

Each watercourse and aquifer commission will develop a communication strategy within six months of their creation. Initially, the purpose of the communication strategy will be twofold. First, it will include bi-annual reports to the GTWAA Secretariat on the progress of projects and various activities that the states have jointly initiated. These reports will be made publicly available; moreover, the reports will be sent to other commissions with the aim to foster cross-commission transfer of knowledge. Second, the GTWAA should also serve as a node of information for the general public in each co-watercourse or co-aquifer state. The manner in which commissions provide information to the public will be left to the devices of each commission; it will likely vary according to the degree of organization within the civil society of a given country or region.

Intergovernmental communication among the co-watercourse or co-aquifer states will also be promoted. Clear and continuous open channels of communication among states that are members of a commission is crucial since the activities within one state may easily affect the quantity and quality of flow running to other states of the shared water resource. Although the GTWAA requires communication and transparency among states, the GTWAA upholds the sovereignty of each and every nation and acknowledges that states do not have the authority to infringe on the domestic water sector decisions of any other state.

Balance integrated water resources management direct human needs

Poverty, environmental health, and economic development intertwine. The fact that more than one billion people around the world lack access to safe drinking water and 2.4 billion do not have basic sanitation requires consideration in watercourse and aquifer agreements. The GTWAA promotes the harmonization of integrated water resources management considerations with measures to ensure that basic human needs for water are met.

Historically, the fields of integrated water resources management and the water and sanitation sector have remained distinct, creating limitations in terms of the design of solutions. Watercourse and aquifer-wide interactions among uses and users, between upstream and downstream, surface and groundwater, quality and quantity, require systemic approaches to water management that integrate all of the different considerations (Molle 2005). Central, but often left out of these discussions, is the relationship between poverty and effective water management and governance. Water for basic human needs, in the form of drinking water, and safe construction of sanitation systems is critical for long-term health of ecosystems and societies. Through the promotion of benefits sharing and creativity, the GTWAA endeavors to help governments undertake efforts that protect short and long-term health of humans, communities, and ecosystems.

(v) *Mechanics of the GTWAA*

Significance of signing the GTWAA

Given that a number of countries are parties to existing international water agreements and that not all states that share a watercourse or aquifer will sign on to the GTWAA in unison, the significance of the GTWAA will depend upon which states sign and when. Below is a description of the various scenarios that might emerge with the establishment of the GTWAA:

If all states of a certain shared watercourse or aquifer become signatories within the same timeframe, they then start jointly drafting a watercourse agreement and creating a commission.

Countries that already have watercourse institutions can choose to maintain the current status of their agreements. Alternatively, if all member states of an existing agreement determine that the GTWAA offers a preferable model to their own, then they may all opt to become parties to the GTWAA. This option will not hold unless each and every member state of an existing arrangement agrees to sign the GTWAA.

For those countries that lack agreements, some but not all nations sharing a watercourse or aquifer may wish to sign the GTWAA. In this case, the following chain of events will apply:

- Country A signs the GTWAA.
- Six months from the day after the first signature, the treaty remains open for signatures from the other states that share a watercourse or aquifer with country A.
- At the end of this six-month period, if not every state has signed on, the Secretariat attempts to build support among non-party states to join the GTWAA. In these activities, Secretariat staff will be matched with watercourse/ aquifer countries to provide information and respond to questions.
- The Secretariat engages in dialogue (for a period of up to 12 months) with those states that have not signed the GTWAA about the conditions under which they would consider signing.
- At the end of the twelve-month period, if all states have become signatories then they are obliged to proceed with the treaty requirements. However, if not all of the states have become signatories then the Secretariat assesses whether an arrangement of signatories and observers is viable to proceed with the creation of a watercourse or aquifer treaty. This mixed arrangement would proceed, provided that they adhere to the following clause: “[w]here some but not all watercourse States to particular international watercourse are parties to an agreement, nothing

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in such agreement shall affect the rights or obligations under the present Convention of watercourse States that are not parties to such an agreement” (IWC 1997).

An institution for each shared watercourse and aquifer

As noted previously, the convention aims to establish an institution for every watercourse and aquifer. For each WAA, all states that border or share the watercourse or aquifer enter into negotiations to reach an agreement. The agreement shall provide a formalized structure through which WAA states can equitably allocate, manage, and use the fresh water resources of international transboundary basins. The establishment of a per-watercourse institution also creates a mechanism through which economic, political, social, and ecological benefits can be shared among basin-sharing states, emphasizing the sharing of advantages and not just water usage. The principles upon which the agreement shall be based follow in a later section. However, it is worth noting that the principles included in the general framework represent the baseline treaty components. Co-watercourse states are encouraged to incorporate other principles and specifics that pertain to the particular watercourse. Those states that have already entered into agreement over watercourse use, allocation, management, and protection may use this convention as an impetus to strengthen existing institutions and, if applicable, create a watercourse commission.

A per-Watercourse Commission

While the per-watercourse institution establishes an agreement for use, management, protection, and allocation among basin-sharing parties, a watershed organization provides the organizational means for implementation of the watercourse treaty. Every watercourse commission shall include official representation from each state and provide a forum through which states can create and strengthen opportunities for benefits-sharing as well as address concerns and grievances as they arise. By institutionalizing regular meeting times, it creates a medium for ongoing communication, which may help address challenges and disputes *before* they reach a state of crisis. Likewise, it establishes a mechanism for data and information sharing, which will be discussed in the context of minimum principles.

GTWAA Secretariat

The interim Secretariat for the GTWAA will be housed at the United Nations Educational, Scientific and Cultural Organization (UNESCO) headquartered in Paris, France. The GTWAA will be administered by UNESCO’s Division of Water Sciences, specifically within a project of the Division of Water Sciences called “From Potential Conflict to Co-operation Potential” (PCCP). PCCP embodies the overarching goals of the GTWAA in that it seeks to tackle the challenge of sharing water resources, and develops decision-making and conflict prevention tools for the future.

Dispute Resolution

The GTWAA calls on all signatories to bear in mind the importance of devising clear mechanisms for resolving conflicts as this has been shown to be a prerequisite for effective, long-term basin management (Giordano and Wolf 2003). Tensions between countries that share a watercourse or aquifer may be exacerbated as a result of a disparity in economic development, infrastructure capacity, or political objectives. Wolf et al., (2003) note that studies on the relationship between climate and water-related conflict show that extreme events of conflict over shared water have been more frequent in harsh climates with highly variable hydrologic conditions, whereas the less extreme climatic conditions experienced a more moderate level of conflict over shared water.

Compliance

The GTWAA includes only one compliance measure: that all parties to the GTWAA comply with the four overarching principles (discussed above in section (ii)): equitable distribution and use of fresh water; environmental protection and management; obligation not to cause significant harm to any party; and duty to cooperate. To date no existing global treaty includes legal mechanisms for enforceability. That said, the watercourse scale presents a more appropriate level at which legal instruments can be crafted and tailored. It is important for per-watercourse agreements and their parallel commissions to explicitly identify enforcement instruments if they deem them necessary.

Next Steps

In order to move the GTWAA to the negotiation phase, UNESCO, serving as the sponsor, will bring the idea of establishing an international watercourse and aquifer agreement to manage transboundary waters to the UN General Assembly in New York in September 2006 and suggest that it act as Secretariat in the interim. UNESCO makes the recommendation that eight countries convene at UNESCO in Paris and draft a first version of the GTWAA. Based on the initial meeting, UNESCO asks that one country host the first conference of the parties (COP-1) of the GTWAA where the initial text will be negotiated by all nations that are represented. And a Chairman who is a national of the host country facilitates that COP-1. UNESCO might suggest that for future COPs, a three-person chairmanship exist that would be comprised of the current Chair, the incoming Chair, and the previous Chair, such that continuity of ideas and knowledge would be maintained. This would serve to ease the transition of incoming Chairs and make him or her more effective during their term.

Conclusion

In conclusion, this paper has outlined the rationale for, and intricacies of, a GTWAA. The GTWAA is a policy construction that first calls for the creation of a watercourse or aquifer agreement among the states sharing the resource. Second, the GTWAA puts forth underlying fundamental principles, implementation activities, and soft law, or guiding principles, to which each signatory subscribes. It is worth restating that the GTWAA should not be viewed as an exact blueprint for institutional creation, but rather as a

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starting point, from which states can adopt additional principles and agreements, accounting for specific factors relevant to each case.

It is also worth noting that each of the five sets of prescriptions towards establishing a GTWAA (shifting the emphasis to benefits sharing, overarching principles, transboundary aquifer management, guiding norms of the GTWAA, and the mechanics of the GTWAA) is key to the success of a GTWAA. However, we suggest that those involved in establishing a GTWAA prioritize advancing the prescriptions related to shifting the emphasis to benefits sharing because this might be the most challenging to achieve but might yield the greatest dividends in terms of more effective management of shared watercourses and aquifers.

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End Notes

¹ The 1997 United Nations International Watercourse Convention defines an international watercourse as a “system of surface waters and related groundwaters, parts of which are situated in different states. An attempt to extend the application of the conventional provisions to confined groundwaters (aquifers) failed” (IWC, 1997). For the purposes of this paper the authors refer to both watercourses and aquifers, using WAA to denote both.

² The tragedy of the commons highlights that giving multiple users access to a common-pool resource will lead to more resource units withdrawn than what is optimal; the prisoner’s

³ The prisoner’s dilemma underscores that individually rational strategies lead to collectively irrational outcomes.

⁴ The logic of collective action contends that individuals with common interests would voluntarily act so as to try to further those interests.

⁵ Common-pool resources yield benefits where beneficiaries are hard to exclude but each person’s use of a resource system subtracts units of that resource from a finite total available for harvesting. By contrast, “public goods” usually yield nonsubtractive benefits that can be enjoyed jointly and simultaneously by many people who are hard to exclude from obtaining these benefits (Ostrom, 1999).

⁶ The MRC expectations and procedures include representation from each member country and a rotating chair, regular meetings, and a secretariat with the capacity to cover areas that include natural resources development planning, finance and administration, environment, and technical matters.

⁷ The first wave directives include directives on surface water; two related directives on measurement methods and sampling frequencies and exchanges of information on fresh water quality; directives on fish water, shellfish water, and groundwater; and the directive on dangerous substances discharge.