TOWARDS A BETTER UNDERSTANDING OF WATER QUALITY MANAGEMENT IN INTERNATIONAL RIVER BASINS

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ABSTRACT: A healthy river ecosystem is the definitive mark of success in international water quality planning and management, but until the world's international river basins achieve this kind of success, there must be other means to assess progress. In this paper, a theoretical background establishes the complexities inherent in water quality management, specifically the myriad of factors that influence perceptions of sovereignty and equity in international basins. By linking the physical and political realities of water quality management, two questions can be explored: 1. "How can progress in international water quality management, as presented in treaties, be assessed?" and 2. "What factors influence treaty creation and content?"

I examine water quality treaties using a framework for general treaty evolution and models for domestic water resource planning and management. The application of different frameworks suggests greater understanding of progress could be achieved by adapting the models to the particulars of international water quality management. In addition, I consider factors that influence the creation and content of treaties with water quality provisions, thereby proffering a framework of incentive and capacity for identifying opportunities and constraints to meaningful international cooperation. Improved consideration of the sovereignty, equity, incentive, and capacity challenges in managing international river basins is critical to encouraging more substantive water quality treaties, therefore protecting and enhancing water quality.

I. INTRODUCTION

A healthy river ecosystem is the definitive mark of success in international water quality planning and management. However, until the day when the world's major river basins meet the ideal of biological, chemical, and physical integrity, there must be other means by which to assess progress in international water quality management. The first question explored in this paper is, "How can we track progress in a way that reflects the physical and political aspects of water quality management?" The second question of interest - "What factors influence treaty creation and content?" - tackles the present day fact that few international river basins have water quality treaties.

Current research suggests international river basin management is still in its infancy. The majority of international river basin treaties lack an integrated approach to water resource management, tending to focus on water quantity exclusively or addressing quality per se in a less than detailed manner (Giordano 2002). Naturally, there is a logical evolution to the degree and type of interest a government may show in its water resources. Utilization is highly dependent upon population pressures and economic development within a country. As population and economic demands increase the quantity of water used, one can expect a concurrent decrease in water quality. As diminished quality may reduce effective quantity availability, it may be posited that an increase in treaties that equitably allocate quantity among co-riparians coupled with continuous population and economic growth will result in a proportional rise in the number of treaties that substantially address quality. The treaty record supports this line of reasoning.

Giordano's research reveals a significant increase in the number of treaties that address water quality in the last quarter of the twentieth century, as the world witnessed a burgeoning population. However, the majority of these water quality treaties show a marked lack of sophistication either in institutional complexity or in the development of water quality standards.

In this paper the challenges inherent in managing water quality are explored within a context of sovereignty and equity. By linking the physical and political realities of water quality management, success can be gauged and the means for moving international basin negotiations forward may be identified. I examine the advancement of water quality treaties in several frameworks including general environmental agreement negotiations, categories of water quality treaties, and domestic water resource planning and management models to better understand international water quality management trends. I consider factors that influence the creation and

content of treaties with water quality provisions thereby proffering a framework for identifying future opportunities and constraints to meaningful international cooperation.

II. THEORETICAL BACKGROUND

A. GENERAL WATER QUALITY MANAGEMENT ISSUES

Water quality is best understood as a demand-side management issue. Societal expectations of water quality are dependent upon prevailing needs and values. Definitions of water pollution abound but most are founded on an interference with man's ability to make use of the resource (Novotny and Olem 1994, 12). For example, non-use interest in water is typically associated with wealthier countries that have already captured the water they deem necessary to achieve national economic and social goals.[1] And, many human-based needs can be met with water of varying and dubious quality, assuming the country has the financial and technological resources to treat the water prior to use. Consequently, water quality represents a moving target whereby what is judged equitable, reasonable, beneficial, or harmful continually changes over space and time thereby eluding clear and easy delineation of standards and obligations by managers.

Water pollution requires varying degrees of scientific and technological sophistication to characterize as well as to ascertain its scope and origins. Scientific knowledge and certainty about the nature of water quality problems has increased dramatically over the past few decades but there is still a distinct lack of data, either long-term data to assess trends or to ascertain background quality; and background water quality, particularly in large basins, may be highly

[1] Non-use interest may be understood as goals for broad environmental health, irrespective of utility to humans, as opposed to water quality standards based solely on narrowly defined human uses for a water body. For example,

variable throughout the river system. Plus, what one requires in terms of water quality is not always precisely quantifiable. Hence, policy-makers are often left to bargain for standards in the face of both scientific uncertainty as well as a complex array of site-specific variation. Although scientific uncertainty is an ever-present reality that should not be used to justify a lack of action, it is easily manipulated to slow or dissuade environmental negotiations in its early stages of problem identification and designation of objectives.

In addition to the challenge of reaching agreement on the character of a water quality problem, managers face an equally daunting task of assigning responsibility to remedy the problem. Water quality degradation is intimately associated with the land use practices throughout a basin rather than just along the main stem of the river. For example, regulating point sources of pollution such as industry or municipal sewage treatment plants is relatively straightforward. Pollutants can be traced to their source and standards are primarily dependent upon the best available technology (Ferrey 1997). Standards and compliance mechanisms can be created to treat industrial or other sources within an economic sector in an equitable fashion. However, non-point sources of pollution such as runoff from agricultural land require looking beyond the banks of the river and across the entire landscape of a drainage basin. It is a substantial scientific effort to trace a particular pollutant to a responsible party and an even more substantial political endeavor to design and maintain compliance with standards to control the release of non-point source pollutants across jurisdictions in an equitable manner (Link 2000).

The relationship between watershed health and land use necessitates local implementation and compliance efforts while other types of water quality problems need to be addressed at the national or regional level (Young, et al. 1994). Subsidiarity – an idea often

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water quality objectives for industrial withdrawals may be less comprehensive than management goals for improving the long-term viability of an ecosystem.

associated with the European Union and its environmental policies as well as the Dublin Principles – seeks to address water resource problems at the lowest level that is most appropriate to the problem (Jupille 1998, Young et al. 1994). Similarly, Novotny and Olem (1994, 996) contend that non-point source pollution abatement programs should echo the principles of fiscal federalism by using local funds for local problems and federal funds where national benefits may be derived or where transboundary issues predominate. In the United States, for instance, there is a delegation of responsibility from the federal to the state and local level in order to address non-point sources of pollution.[2] Much of it is based on voluntary actions and ambient water quality standards as opposed to point source management with its reliance upon technological-based restrictions and end-of-pipe quality criteria (Ferrey 1997, Environmental Law Institute 1997). Both ideas of subsidiarity and fiscal federalism capture the need for different, yet integrated, regulatory and management institutions to work at multiple spatial scales.

In sum, managing water quality requires a sophisticated institutional capacity that can garner the financial, scientific, and technological resources necessary to identify problems, design and implement programs to address the problems, and monitor compliance. It is a daunting task at the national level. At the international level things are complicated further by the unique characteristics of each basin state and fundamental issues of sovereignty and equity.

B. SOVEREIGNTY AND EQUITY ISSUES AT THE INTERNATIONAL LEVEL

Water quality management requires government to play important roles at multiple levels. The externality issues associated with water pollution abatement defy market forces thereby requiring public institutions to regulate for water quality (Novotny & Olem 1994). The myriad complexities inherent in adopting international water quality standards is aptly described

[2] For example, the federal Environmental Protection Agency delegates authority to state entities to interpret and

by Gunaji (1995, 113), an expert on transboundary water issues between Mexico and the United States:

> Adoption of water quality standards influences the cost of development, quality of life, and the selection of judicious standards and requires a thorough knowledge of the receiving environment. In addition, technology, financial requirements and degree of protection need sound understanding of the political, legal, social, and financial situations in both countries.

Most of the challenges described above, including cost of development, quality of life, and judicious standard selection, are manifestations of issues of equity and sovereignty. For example, financial disparities between co-riparians, an issue of equity, may cause disagreement about what constitutes a judicious standard or what actions are deemed socially or politically palatable. And sovereignty, because it is entails not only the rights of a state but also its responsibilities – both internal and external, demands a sovereign government to act in its public's benefit (Kuehls 1996, 67). In the U.S. the sovereign's responsibility is described as the duty to protect the public's health, interest, and welfare (Sax 1970). What constitutes an issue of domestic or international public benefit – be it health, welfare, or interest - for a population will inarguably change over time and between locales. Thus, the duty of the sovereign to cooperate with a neighbor over an international river basin is going to vary considerably dependent upon a nation's incentives and capacity for change.

Savenije and van der Zaag (2000, 14) describe the "sovereignty dilemma" as a question of, "to what extent may individual countries develop and use resources found within their territories, and to what extent do they have to consider interests of riparian countries, and the common interest of the river basin as a whole?" Absolute sovereignty, epitomized by the Harmon Doctrine, has been rejected by practically all countries as they allocate their international waters and has been replaced primarily by two principles of customary international

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carry out federal policies like the Total Maximum Daily Load (TMDL) program (Link 2000).

law (Utton 1973). Equitable and reasonable utilization as well as an obligation to not cause significant harm are the guiding principles in international river management today (Abu-Zeid 2001, Utton 1973, Wolf 1999).

It is clear that international cooperation is necessary to protect and restore the quality of international rivers. Reliance upon voluntary action between co-riparians to initiate and forge agreements that will substantially address a dynamic resource issue like water quality is less than ideal. The multiplicity of factors inherent in addressing international water quality concerns defies unilateral or voluntary efforts. For example, voluntary reliance upon the international, intergenerational, precautionary, or any other charitable principle is no guarantee that effective change will be made (see Savenije and van der Zaag, 2000 for an annotated list of international water management principles). Each of these principles is based on a self-imposed responsibility to downstream users or future generations to clean up what one has polluted. These principles may be practicable at the national level since benefits and costs, while they may shift intra-regionally, still serve national interests. But, dependent upon their relative geographic position within a basin, a country may lack any incentive, economic or otherwise, for concerning itself with the quality of a water body beyond its own borders. Although altruistic principles are worthy qualities to nurture, they are not a sound basis for a concerted effort to clean up fouled waters or to prevent degradation.

A logical approach to settling water quality concerns between basin states is to establish a supranational basin-wide institution that can provide the services of identification, standard setting, implementation, and monitoring and compliance typically associated with domestic natural resources agencies. It certainly offers the advantage of tailoring its resources to the site-specific needs of that basin but fails to satisfy sovereign needs.

Utton dismisses supranational authorities as utopian because it is highly unlikely that any combination of states would surrender so much of their sovereignty. He suggests countries would be more amenable to "flexible, open-ended, cooperative agreements" whereby the international entity functions to guide the process by gathering information and recommended policy for co-basin states (Utton 1973, 303). The states would then be responsible for administering and implementing the policies. Fortunately, the demands of both the political and physical environment mirror one another at this stage. Domestic implementation satisfies technical management needs as well as political will. Thus far, basin states pursue Utton's flexible and cooperative agreements by crafting treaties to meet their particular regional needs and interests. Treaties are a significant type of international agreement thereby offering a means for evaluating progress and for gaining insight into improving coordination in international river basin management.

III. EVALUATING PROGRESS IN INTERNATIONAL WATER QUALITY TREATIES

A. TREATY EVOLUTION

Principles for international river basin management have made significant advancements in recent history with statements like the Helsinki Rules (1966), Agenda 21 (1992), and the Dublin Principles as expressed in 1996 by members of the Global Water Partnership's Technical Advisory Committee (Giordano 2002, Wolf 1997). However, international law concerning water quality management in international river basins is still described as vague and lacking in adequate detail and institutional mechanisms to implement meaningful reform (Biswas 1999). Although the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses (UN Convention) recommends incorporating a comprehensive and balanced list of

factors to consider in basin-wide management, Biswas (1999) suggests there is ample opportunity for basin states to interpret and apply these factors quite differently. Consequently, international law and principles do not necessarily settle the challenging issue integral to resolving water quality problems – the mutual identification of problems and clarification of objectives.

Thus far, countries adopt the generalized international principles such as those in the UN Convention to only a limited extent, instead relying upon circumstances specific to their basin to negotiate and design treaty provisions (Giordano and Wolf, 2002). Treaties, legally binding agreements between two or more sovereign governments, have satisfied state needs for mutually satisfactory standards because of their ability to accommodate the localized, and often specialized, needs of co-riparians and, as a result, have come to be recognized as customary international law (Utton 1973, Duda & La Roche 1997). Yet not all treaties are equal, neither in scope, institutional components, nor environmental targets. For this reason it is helpful to categorize treaties in an effort to discern patterns that may illuminate progress in international water quality management.

Treaties with water quality provisions for international basins will be evaluated within a framework of international environmental agreement evolution. Congleton (2001, 247) has identified four stages of negotiating international environmental issues. His premise is that international environmental problems cannot be understood through strict economic analyses alone. The externality problem typically associated with domestic pollution issues is one of economics but at the international level it is also a function of government failure (Congleton 2001, 242).

Based on the complex political sovereignty challenges of international environmental issues, he describes a linear progression of negotiating environmental problems whereby the political will and cooperation between states increases. There is opportunity to sign a treaty after each of the first three phases of negotiation. The first stage is Symbolic where each country recognizes a common problem and in so doing may provide some joint benefits. The second stage is Procedural whereby institutions, however basic, are created to evaluate policies at a shared bargaining table. The third stage is Substantive inasmuch specific regulations or environmental quality targets are outlined. The fourth stage, Domestic, is so called because specific targets are designated and the individual countries must create and enforce domestic policies to meet their agreed upon requirements.

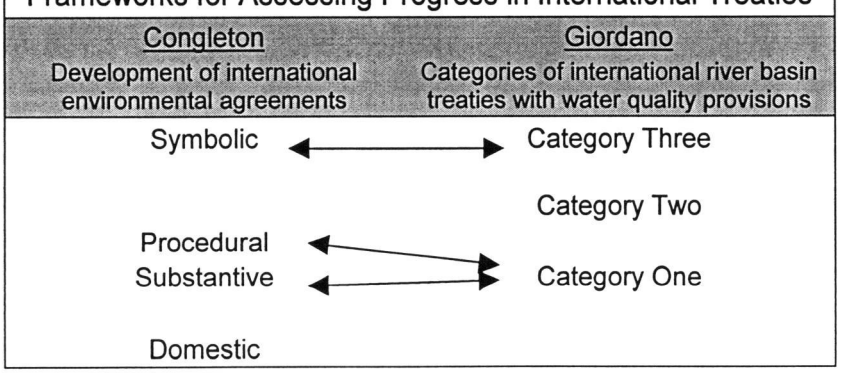
Congleton's framework approximates a linear process whereby an agreement in a higher stage would include elements resulting from preceding phases. There are rationally always more Symbolic and Procedural agreements than Substantive ones because not all negotiations necessarily move forward. There is, therefore, more opportunity to sign agreements in the lower stages. Yet there is no evidence to suggest that all negotiations will eventually arrive at the Substantive and Domestic stages, especially given the paucity of implementation records by nations that have signed Substantive agreements (Congleton 2001, 252).

As one means of measuring progress, international basin treaties with water quality provisions are examined within Congleton's framework. Treaties and their related accords represent only a portion of international environmental agreements. Many of the basins selected for study have other water quality related agreements. Protocols, annexes, work plans, conventions, and other legal instruments can all serve to refine commitments or specify more stringent criteria. Hence, care must be taken not to assume the agreements discussed throughout

this paper represent the definitive or most comprehensive accords in place. Rather, treaties are a significant *type* of agreement and their use allows analysts to draw comparisons and ascertain patterns across spatial and temporal scales.[3]

Oregon State University Department of Geosciences, under the direction of Dr. Aaron T. Wolf, has developed the Transboundary Freshwater Dispute Database (TFDD) to document international treaties related to non-navigational uses of water in international river basins. Giordano (2002) surveyed the approximately 300 international freshwater treaties, spanning 1874 through 2000, in the TFDD. Sixty-two treaties were found to include water quality provisions.[4] Giordano grouped these 62 treaties into three categories that roughly approximate Congleton's stages of agreement evolution.[5] Although only two of Giordano's three categories have clear counterparts among Congleton's four stages, both frameworks track an incremental progression in the content of environmental agreements.[6]

Figure 1: Linkages between Congleton's and Giordano's Frameworks for Assessing Progress in International Treaties



Consistent with Congleton's argument, there are more water quality treaties found in the initial phases of negotiations.

[3] Agreements other than TFDD treaties are not reviewed in this paper. In the case of a single basin analysis, I recommend the review of all types of basin-specific international agreements to form an accurate portrayal of progress in water quality management.

[4] See Giordano 2002 for a detailed explanation of survey methodology and findings. Few of the treaties were exclusively concerned with water quality. Most were drafted to resolve other issues such as the management of frontier waters or water abstraction and water quality is mentioned as one of many factors to be addressed.

[5] Category Three is equivalent to Congleton's Symbolic treaties. However, Category Two, which includes agreements that give water quality-related actions, lacks a faultless match in Congleton's framework. And Category One treaties, which may include standards, action plans, and/or comprehensive management frameworks, encompasses both Procedural and Substantive stages.

[6] The only treaty Congleton identified as substantive that is also found in the list compiled by Giordano, is the 1978 Great Lakes treaty.

Thirty of Giordano's sixty-two water quality treaties fall under Category Three, twenty-four are Category Two, and only eight agreements fit into Category One. However, many of these water quality treaties concern only segments or sub basins of international river basins and include numerous combinations of states as signatories, some no longer in existence such as the former USSR. And, since *river basin* management is the focal point of interest - not just the cooperation of particular states - it is worthwhile, if not necessary, to organize these treaties by international river basin to analyze them within Congleton's framework.

Thirty-seven specific international basins are covered by this collection of treaties but only sixteen basins appear in more than one treaty (see the Appendix for a complete list).[7] Of these sixteen, only nine international basins have treaties that fall into two or more Categories. Thus, 24% of all water quality treaty basins show a linear evolution akin to Congleton's phases. Of the eight Category One treaties, only five specific basins are covered and one, Lake Victoria, is not preceded by any other water quality treaties.[8] Of the 14 basins that fall into Category Two, only five are preceded by Category Three treaties. These nine basins are tracked by category and signatories in Figure 2. Meanwhile, 35% of all treaty basins move laterally within a single category.[9] This lateral movement can be attributed to the fact that most treaties have a broad or separate focus such as management of frontier waters.

[7] There are over 260 international river basins globally. The water quality basins represent 14% of all TFDD basins.
[8] Reasons for this are explored in the next section. See Figure 6.
[9] All three categories have cases of lateral treaty movement. Eight of these 13 cases have the same signatories.

Figure 2: CASE STUDY
TRACKING TFDD Water Quality TREATIES BY BASIN (Giordano 2002)

Highlighted entries are treaties that include the same signatories over the course of more than one category of agreement. These most closely approximate Congleton's environmental agreement negotiation framework.

BASIN	CATEGORY	YEAR SIGNED	SIGNATORIES	Did all basin states sign?
COLORADO	One	1973	Mexico, United States	Yes
	One	1972	Mexico, United States	Yes
(includes Rio Grande and Tijuana)	Three	1944	Mexico, United States	Yes
DANUBE	One	1994	Albania, Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Italy, Moldavia, Poland, Romania, Slovakia, Slovenia, Switzerland, Ukraine, Yugoslavia	No
	Two	1987	Austria, Germany	No
	Two	1971	Romania, USSR	No
	Two	1967	Austria, Czechoslovakia	No
	Two	1956	Austria, Hungary	No
	Two	1955	Romania, Yugoslavia	No
	Three	1958	Bulgaria, Yugoslavia	No
	Three	1956	Albania, Yugoslavia	No
	Three	1955	Hungary, Yugoslavia	No
	Three	1950	Hungary, USSR	No
	Three	1949	Romania, USSR	No
(includes Newman, Vistula, & Lava-Pregel)	Three	1948	Poland, USSR	No
(includes Elbe & Oder)	Three	1926	Germany, Poland	No
RHINE	One	1976	European Economic Community, France, Germany (FRG), Luxembourg, Netherlands, Switzerland	No
	Two	1998	European Union, France, Germany, Luxembourg, Netherlands, Switzerland	No
	Three	1960	Germany (FRG), Netherlands	No
ST. LAWRENCE (Great Lakes)	One	1978	Canada, United States	Yes
	One	1972	Canada, United States	Yes
(includes Columbia)	Three	1909	Canada, United States	Yes
ARAL SEA	Two	1993	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	No
	Three	1998	Kazakhstan, Kyrgyz, Uzbekistan	No
	Three	1998	Kazakhstan, Kyrgyz, Uzbekistan	No
ELBE	Two	1990	European Economic Commission, Czech and Slovak Federative Republic, Federal Republic of Germany	No
(includes Danube and Oder)	Three	1926	Germany, Poland	No
JORDAN	Two	1995	Israel, Palestinian Authority	No
	Two	1994	Israel, Jordan	No
	Three	1953	Jordan, Syria	No
MEKONG	Two	1995	Cambodia, Laos, Thailand, Vietnam	No
	Three	1975	Cambodia, Laos, Thailand, Vietnam	No
NIGER	Two	1980	Benin, Cameroon, Chad, Cote d'Ivoire, Guinea, Mali, Niger, Nigeria, Upper Volta	No
	Two	1964	Benin, Cameroon, Chad, Cote d'Ivoire, Guinea, Mali, Niger, Nigeria, Upper Volta	No
	Three	1963	Benin, Cameroon, Chad, Cote d'Ivoire, Guinea, Mali, Niger, Nigeria, Upper Volta	No

Assuming integrated water resource management is the ultimate goal, all basin states should ideally participate in international water agreements where maintaining or improving water quality is an objective. However, this is rarely the case. Sixty-six percent of the water quality treaties are bilateral yet the only bilateral basins in this study are the Colorado and St. Lawrence. An historical preference for bilateral agreements partially explains the proliferation of treaties in the Danube basin. All but the Category One agreement are bilateral treaties in a basin with 17 co-riparians. The Danube is represented in 13 different water quality treaties (21%) yet even at its highest stage treaty (Category One/Procedural and Substantive) it is still one basin state shy of integrated coordination.

Closer inspection reveals the lack of multilateral participation is not entirely disappointing. A few of the treaties provide interesting exceptions; while they do not include all riparians, they do involve all the major basin states as signatories. For example, the Category One *Agreement on Joint Activities in Addressing the Aral Sea* includes all states with any significant portion of the watershed within their country. China, the only basin state to not sign, has a mere 40 square kilometers of territory within the headwaters of the Aral Sea basin (Wolf, et al. 1999). Similarly, the Rhine basin's Category One agreement *Convention on the Protection of the Rhine against Chemical Pollution* does not include the three upstream states contributing the least amount of land to the basin. Italy and Liechtenstein have less than one percent of the Rhine basin within their territory and Austria has less than two percent of the watershed in its land base (Wolf, et al. 1999).

In summary, the majority of water quality treaties are in the Symbolic/Category Three stage and those international accords with water quality provisions that have progressed to Category One/Procedural and Substantive stages are, save for one unique exception, preceded by

other less sophisticated agreements within the same basin. This suggests there is some lateral learning among co-riparians. In addition, five of the nine basins with treaties covering more than one category consistently include the same signatories; implying treaties are a significant type of international agreement in the pursuit of improved water quality management.

Pairing Congleton's and Giordano's frameworks offers one means to assess progress in international water quality management. However, these frameworks are not tailored to either the water resource planning process nor incorporate a full consideration of water management institutional roles and responsibilities. The next section attempts to ascertain whether domestic planning and management schemes may help customize existing frameworks for evaluating progress.

B. WATER RESOURCES PLANNING AND MANAGEMENT: FROM THE DOMESTIC TO THE INTERNATIONAL ARENA

All aspects of the water quality planning and management processes are captured at the domestic level. For this reason, it is worthwhile to compare the domestic water resource planning process and management agencies to the content of water quality treaties. As a result, future analyses of international water quality agreements may benefit by adapting Giordano's and Congleton's categorizations to reflect water quality planning processes and management institutional roles.

I hypothesize that the physical and political realities of managing for water quality limit the role of international agreements to particular stages or activities. To best appreciate what is possible and what is practiced, the discussion will move from an overview of water resource planning and institutions for management at the domestic level to theories and findings in international treaties.

1. DOMESTIC WATER QUALITY PLANNING AND MANAGEMENT: Planning for water resources is described as a "logical series of steps, beginning with identification of needs, proceeding to recommendations for action, and culminating in implementation and monitoring" (Dzurik 1996, 89). Figure 3 provides a description of the nine major steps in the water resource planning process (WRPP).

Figure 3:
Domestic Water Resources Planning Process

1. Problem identification
2. Data collection and analysis
3. Development of goals and objectives
4. Clarification and diagnosis of the problem or issue
5. Formulation of alternative solutions
6. Analysis of alternatives
7. Evaluation and recommendation of actions
8. Development of an implementation program
9. Surveillance and monitoring

Source: Dzurik 1996, p. 89

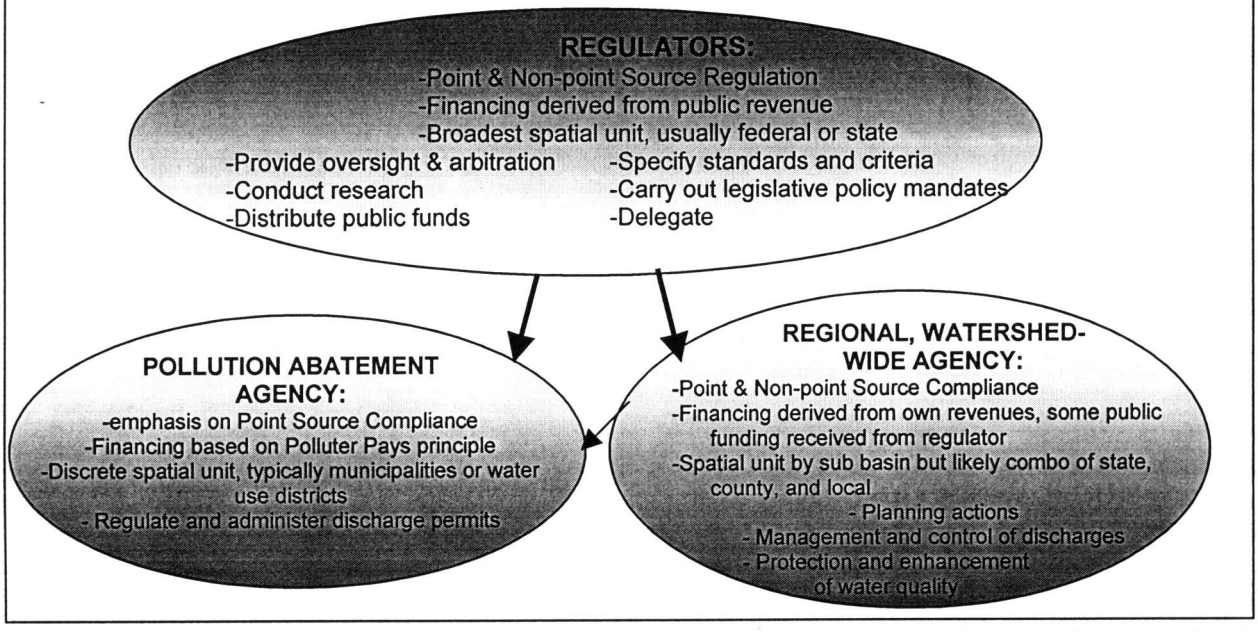
Some stages prove to be more problematic than others. For example, Dzurik (1996, 91) suggests defining goals and objectives is one of the most difficult steps given "competing and often conflicting objectives" among parties. Yet once a plan has been developed, change will only occur if it is implemented.

Novotney and Olem (1994), in their discussion of water quality management in the United States, suggest three types of institutions are needed to manage impaired watersheds.[10] Regulators, waste dischargers, and regional watershed-wide agencies form a grouping of management characterized by a spatial hierarchy and functional division of responsibilities. See Figure 4 for a description of these institutions and their relationships to one another.

Regulators represent the highest division of management and have the power and oversight to create and "carry out the legislative policy mandates, specify standards and criteria, provide oversight, arbitration, research, provide and distribute grants when federal and state interests in water quality remediation are involved, among other activities" (Novotney and Olem 1994, 1003-1004). The authors state with emphasis "This agency *should not manage the water*

resources or pollution abatement (Novotney and Olem 1994, 1004). Rather, management is delegated to regional and local level agencies. The waste dischargers are those entities, people or organizations, which generate waste leading directly to a watercourse. The regional agencies are responsible for managing discharges and ambient water quality in addition to coordinating other local multiagency efforts. Although the regional agency is ideally based on basin boundaries rather than political ones, it rarely exists as a comprehensive, single entity.

Figure 4: Domestic Institutions for Integrated Management of Impaired Watersheds Source: Novotney and Olem (1994, 1003-1005)



The need for a functional separation between regulatory and implementation agencies is identical at the international level (Savenije and van der Zaag 2000, 27). Given the sovereignty and equity limitations inherent in managing international water resources, it is apparent that basin states must decide what steps in the planning process they can coordinate and which management roles they can assume jointly to effectively protect and enhance the natural resource

[10] Although the type and structure of government within a country influences this discussion, this model is, for the most part, applicable to any nation given the technological, financial, and institutional requirements of water resource management.

for its participant riparians. The following section is a review of treaties to ascertain what water quality planning and management aspects are addressed at the international level.

2. INTERNATIONAL WATER QUALITY PLANNING & MANAGEMENT: The "sovereignty dilemma" (Savenije and van der Zaag, 2000) implies sovereign states do not necessarily consider the implications of their actions on fellow riparians nor design their domestic policies and regulations with outside interests in mind. This study offers insights into the types of activities and areas of cooperation pursued by international basin states.

Based on the theoretical arguments presented in Sections II and III, I hypothesize only select steps in the water resource planning process (WRPP) and aspects of management institutions are handled at the international level. In particular, WRPP Step Eight, the implementation stage, is out of the purview of international cooperation because political and technical needs demand domestic implementation. And any international river basin organizations created are going to function largely as a type of Novotney and Olem's Regulator but lack enforcement powers.[11]

For this case study I reviewed the nineteen Category One and Category Two treaty basins from Giordano's collection of water quality treaties for corollaries to Dzurik's planning steps and to the management roles in Novotney and Olem's framework.[12] There are considerable differences between these treaties in their scope, detail, and objectives. They range from vague statements denouncing pollution to comprehensive lists of contaminants to be addressed. For this reason, the same planning steps and management roles can mean quite different things. For

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[11] The Dublin Principles indicate that international river basin management institutions should be based on the same principles as a domestic basin institution (Young et al. 1994, 154).

[12] I looked only at treaties that moved beyond the Symbolic/Category Three stage and that cover specific international basins. I did not review agreements that give no specific basin. These are international agreements

example, data collection and analysis, the second step in the water resource planning process, vary from establishing joint monitoring sites at the border to plans for harmonizing domestic data collection and interpretation efforts throughout the basin. Clearly, a treaty is not a planning document nor work plan for a management institution so only facets of a step or role are outlined. Nevertheless, the treaties reveal some patterns.

All steps in the water resource planning process, except for Step Eight, appear in the case study treaties but a few appear most frequently. Many of the treaties give only vague mention to attenuating pollution in transboundary waters, thereby limiting their water quality provisions to the problem identification and, perhaps, action recommendation steps. The most typical example is the recommendation that municipal wastewater and industrial effluent be treated prior to release. Another common provision is to establish a basin-wide warning system or assurance co-riparians will alert one another to hazards like chemical spills.

Data collection and analysis (WRPP Step 2) are a key subject in the greater part of the case study treaties. This topic typically manifests itself as a plan to harmonize domestic monitoring programs through standardizing methods to collect, manage, and analyze data. General reference to sharing data and information also fell under this step. The prevalence of data collection and coordination efforts is not surprising given it is essential to properly diagnosing water quality problems and prescribing mutually acceptable objectives. But data coordination, while a necessary *function*, may also be beneficial as a *process* (Savenije and van der Zaag 2000, 27 and Uitto and Duda 2002). The steps involved in joint fact finding and information sharing allow basin states to improve upon their working relationships thereby increasing both incentive and capacity for future, more sophisticated negotiations.

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concerning general river basin management principles such as the *Convention on the Protection and Use of Transboundary Watercourses and International Lakes.*

Although treaties may specify actions (WRPP Step Seven), the precursor planning steps are not always explicit. The majority of the case study treaties merely propose the signatories coordinate on WRPP Steps One through Seven. Only a handful, such as the Great Lakes, Rhine, and Danube, appear to give sufficient detail and direction to implement the steps suggested in their treaties. WRPP Step Nine, surveillance and monitoring, appeared the least, likely because a program must first be implemented in order to evaluate success.

There must be established means of coordination to oversee and conduct these steps in water resources planning and management. The majority of the case study treaties establishes, or benefit from, preexisting joint commissions and are characterized by similar responsibilities and roles.[13] These joint commissions exist to coordinate activities, particularly research; provide oversight; arbitrate disputes; and develop or recommend standards and criteria. Surprisingly, not all treaties that establish commissions offer means for dispute settlement. Where no joint commission is established, a plenipotentiary is, at the least, designated for each basin state with duties to coordinate their domestic activities to meet treaty obligations.

In summary, the findings are consistent with my hypotheses. All steps in the water resource planning process, save for implementation, appear to various degrees in international water quality treaties. And international basin institutions closely resemble Regulators, except their authority does not supersede any domestic institutions and they lack enforcement powers. Applying the domestic planning process and management institutions to international work offers another means for framing progress and identifying mechanisms for reform.

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[13] Joint commission, unless otherwise specified in this paper, refers to any type of multilateral river basin working group, regardless of its scope or directive. Many of the joint commissions are institutions for integrated water resource management whereas others focus on particular aspects such as development or data exchange. Some have legal personality whereas others are impermanent working groups.

As a result, future analyses of international water quality agreements may benefit by devising a categorization scheme that reflects international water quality planning processes and management institutional roles. The challenge will be to adapt the evolutionary phases found in Congleton's and Giordano's frameworks to reflect the varying degrees of sophistication found for similar planning and management steps in treaties. Eventually, this may assist states as they work to harmonize their domestic water quality policies and programs with international negotiations and agreements.

In the end, managing for water quality in an international basin requires identifying where and when international cooperation is required or mutually beneficial in relation to domestic activities and agencies.[14] Tracking general trends allows researchers to gauge progress but does not illuminate reasons why only certain international basin states craft treaties and why they differ in their basin-wide evolution and water quality provisions. The next section explores factors that may affect the potential for creating different types of water quality treaties.

IV. FACTORS INFLUENCING TREATY CREATION & CONTENT

Terms and scope vary significantly among the approximately 300 treaties included in the Transboundary Freshwater Dispute Database. Given the earlier discussion on the management issues peculiar to water quality, especially at the international level, I propose there must be a combination of incentive and capacity to spur a riparian nation into signing an international treaty and that influences a treaty's content.

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[14] A future trend among international joint river basin commissions may be towards a geographic devolution. For example, the International Joint Commission is proposing to create watershed boards for every major transboundary sub basin along the Canadian-US boundary (International Joint Commission 2000, De Villiers 2000). Growing emphasis on an ecosystem approach to watershed management and greater demands for local, stakeholder participation are two compelling forces behind this proposal. Creation of the international watershed boards would not transfer power away from the IJC but, instead, emulate its institutions for dispute resolution and encourage its

Incentive (immediate or foreseeable) for protection or improvement of water quality and capacity (existing or potential) for meeting that need must exist. Incentive is manifested as a need or interest – environmental, social, historical, and political – in changing the status quo through international cooperation. Capacity is determined as the ability - financial, scientific, technological, and institutional - to affect change that is demanded by international cooperation.[15] Incentive and Capacity interact to influence the likelihood of creating treaties as well as their content. For example, low Capacity, despite Incentive, in many countries around the world may partially explain the predominance of Symbolic/Category Three type treaties.

Shmueli (1999, 439), one of the few researchers to analyze reasons for the creation of transboundary water quality agreements, identified four major influencing factors - financial capacities, flash-points, political windows of environmental opportunity, and globalization. Also, Van der Zaag and Savenije (2000, 48) state that advancements in integrated international water resource management can be attributed to "crises and political opportunities" such as scarcity and regional economic integration.

Based upon these and other readings for this paper, I propose several factors as issues of Incentive and Capacity for the creation and content of international water quality treaties.[16] The list of variables in Figure 5 is intended to encourage further discussion and analysis. Clearly,

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duties, like joint fact-finding, to also occur at the local level thereby creating stable, working relationships throughout boundary basins.

[15] Capacity is relevant assuming treaties are not pursued for reasons of political expediency or, in other words, are not "cheap talk". Congleton (2001, 252) argues the treaty record is not "consistent with a cheap talk interpretation".

[16] I originally planned to compile quantitative data on each basin for a comparative case study using a few factors like wealth and population. However, it quickly struck me as unsatisfactory because of the unique situation found within each basin. Although it appears there are some commonalities between basins, some factors are of greater import at a given point in time. I subsequently developed an equation using factors I considered important (and that had readily available data) that attempts to balance the relative significance of each factor within each basin state. Need + Capacity = Potential for Treaty where Need = [Population + GDP by sector + relative geographic position + freshwater ecosystem health + % irrigated land in basin] and Capacity = [GNI/capita + membership in international economic groups + # of regime changes]. Each factor is numerically ranked. For example, upstream position is a lower rank than a downstream position and a high number of regime changes results in a lower rank than few changes. The sum of these ranks gives the degree of interest a basin state may have to craft an international treaty with water quality provisions (a higher number = greater interest). Figure 5 is the result of these brainstorming sessions.

physical, social, economic, and political factors converge at a moment in time to create an atmosphere of international cooperation.

Figure 5: A combination of Incentive and Capacity serves to encourage or hinder the creation and content of international agreements concerning water quality in international river basins.

Below are suggested factors that can be measured quantitatively or assessed qualitatively, ranging from the economic, social, physical, and political to the historical. Some factors are more relevant to the content of a treaty whereas others may best explain willingness to enter into an international agreement, regardless of its content.

INCENTIVE	CAPACITY
• Relative geographic position within an international basin (e.g., downstream) • Population density (within basin) • GDP by sector (e.g., high services sector often associated with increased non-use interest in environmental quality) • Freshwater ecosystem health (e.g., environmental crises) • Historic and current relations with co-riparian(s) • Role and activity of stakeholders and non-governmental organizations in political processes • Value derived from the waterbody (e.g., economic or religious)	• GNI/Capita • Political structure/stability • Affiliations with international organizations or participation in international agreements (e.g., regional economic group like SADC) • Indicators of scientific and technological ability to create, manage, and maintain domestic water quality programs. (e.g., % of population with access to improved water sources and services; existing state of domestic water quality policy, planning, and management)

Each factor will play a more or less significant role depending upon the particular situation at a given point in time. More often than not, one or a few factors may be discernable as driving forces among the assortment of variables. A driving force can serve to counteract a seemingly insurmountable obstacle or provide an incentive that is only tangentially linked to the issue of water quality. For example, a severely degraded resource may act as an impetus for reform inasmuch as it hinders full development of the resource thereby bringing formerly hostile neighbors to the negotiating table (Giordano 2002). Or, a co-riparian stands to gain much economically and politically by agreeing to cooperate on water pollution, as in the case of the Elbe basin where the Czech Republic receives assistance from its wealthier neighbor Germany and gains favorable recognition from the European Union (Shmueli 1999).

Affiliation with international organizations, particularly regional economic coalitions, stands out as an important linkage and one that can arguably rest on either the Incentive or Capacity side of the equation. The economic lure of joining the European Union (EU), for example, may increase Incentive for an individual nation whereas existing membership in the EU may augment Capacity by offering funds that would not otherwise be available domestically for water quality improvements. Multilateral economic accords also provide a new medium by which to address international pollution issues, providing a platform for such discussion where the opportunity may not have previously existed. International assistance organizations may also significantly increase Capacity by facilitating negotiations and contributing funds. Examples include the role of the United Nations Environment Programme (UNEP) in the case of the Zambezi river system, the United Nations Development Programme (UNDP) and its work in the Mekong River Basin, and the part of the Global Environment Facility (GEF) in Lake Victoria (Biswas 1999, Shela 2000, Uitto 2002).

Arguments can be made for the relative importance of different factors but ultimately, understanding the creation and content of international water quality treaties will result from examining the circumstances in individual basins. Figure 6 explores possible driving forces for Incentive and Capacity in each of Giordano's Category One water quality treaty basins. Because these treaties represent the most substantive of all water quality treaties both Incentive and Capacity are likely to act in concert to affect the extent of treaty provisions.

Figure 6: DRIVING FORCES IN SELECT INTERNATIONAL RIVER BASINS
Category One Water Quality Treaty Basins from Giordano, 2002

TFDD Basin	Year of Treaties	Signatories	Driving Forces
Colorado	1973, 1972	Mexico and United States (all riparians)	**INCENTIVE:** Extremity of environmental situation (high salinity levels) of Colorado river water flowing from the U.S. into Mexico and the economic havoc wrought upon the basin in northwestern Mexico. **CAPACITY**: Rather than address large-scale issues like out-of-basin water transfers and non-point source pollution generated by irrigated agriculture, the U.S. used its technological and financial resources to build a desalinization plant to treat water as it leaves its territory. Although never put into regular use, it is a spatially discrete solution to a basin-wide problem.
Rhine	1976	European Economic Community, France, Germany (FRG), Luxembourg, Netherlands, and Switzerland (basin states Austria, Belgium, Italy, and Liechtenstein are not signatories but Belgium and Italy were members of the EEC)	**INCENTIVE:** Demands from environmental groups and other private stakeholders for pollution abatement have elevated water quality issues basin wide (Savenije and van der Zaag 2000). Major regional navigation corridor and economic resource. High population density throughout basin. **CAPACITY:** The Rhine basin states have a long history of cooperation and coordination in managing their shared water resources (Huisman, de Jong, and Wieriks 2000). EU membership among signatories creates close political and economical ties (van der Zaag and Savenije 2000).
Danube	1994	Albania, Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Italy, Moldova, Poland, Romania, Slovakia, Slovenia, Switzerland, Ukraine, Yugoslavia (basin state Bosnia is not a signatory)	**INCENTIVE:** The main stem runs through or forms part of the border of ten countries with tributaries extending into seven additional countries with significant economic and social importance to the region (e.g., transportation corridor, drinking water source, sturgeon fishery, hydroelectricity, etc.). Accelerated industrialization under communist-rule contributed to increased pollution over the decades and the Serbian-Croatian conflict ten years ago has been described as "an environmental catastrophe" (Tarpy 2002, 77). **CAPACITY:** Political changes in the late 1980s/early 1990s in the formerly socialist countries of central and eastern Europe have forced economic and social restructuring issues to the forefront in regional planning efforts (Nachtnebel 2000, van der Zaag and Savenije 2000). These political changes and the growth of the European Union have promoted greater multilateral coordination and cooperation. In addition to creating an atmosphere conducive to negotiating comprehensive treaties, the European Union has provided funds to the Danube Commission, established by the Belgrade Convention which has coordinated river navigation issues since 1948, to aid in the cleanup of the Danube (Shmueli 1999, Tarpy 2002). Outside funds may be particularly important in the Danube given economic, technical, and institutional disparities between basin states (Nachtnebel 2000, van der Zaag and Savenije 2000).

TFDD Basin	Year of Treaties	Signatories	Driving Forces
Nile (Lake Victoria)	1994	Kenya, Tanzania, and Uganda (upstream basin states Burundi and Rwanda are not signatories)	**INCENTIVE:** The world's largest freshwater fishery and other economic activities are imperiled due to diminished water quality and ecosystem health. **CAPACITY:** The presence and activity of the Global Environment Facility (GEF) has been a catalyst for international cooperation (Uitto 2002). Without GEF it is dubious whether this, the first treaty covering Lake Victoria water quality, would have been as detailed or comprehensive. This basin is unique among the study basins inasmuch it was not preceded by other TFDD treaties which typically serve to establish mutual acknowledgement and identification of problems.
St. Lawrence (Great Lakes)	1978, 1972	Canada and United States (all riparians)	**INCENTIVE:** The Great Lakes comprise a large portion of the Canadian/U.S. frontier and both countries have high population density within the basin with major centers of economic activity. Enactment of the Federal Water Pollution Control Act (renamed the Clean Water Act in 1977) in 1972 provided legal recourse for mounting environmental awareness and advocacy in the U.S., the larger polluter of the two basin states. **CAPACITY:** The countries share relatively similar technological, financial, and institutional capacity and the two basin states have a long record of cooperating over shared water resources, (e.g., the International Joint Commission was established in 1909) (De Villiers 2000).

A final note on assessing factors concerns differences – real or perceived – between basin states. Policy-makers and citizens may hold very different views from policy analysts and researchers about the feasibility of creating mutually satisfying agreements between specific countries. For example, in choosing seven international basins to study for water quality agreements, Shmueli dismisses the Canada-U.S. treaties on the grounds that the two countries lack the complex political, social, or economic differences that hinder international water treaties elsewhere. Yet Murray Clamen, acting secretary of the International Joint Commission from Canada is quoted as saying, "We're dealing with a country that's ten times our size (in population). Yet the word 'equal' is used in the treaty. In what other document are you going to get two countries that are quite mismatched come together and reach a decision?" (Spears 2000, B1).

V. CONCLUSION

The complexities inherent in international water quality management limit joint efforts and shape treaty creation and content. One may expect to find water quality standards or obligations clearly delineated in circumstances where each party's sense of the equitable distribution of costs and benefits are addressed and where each party does not perceive to be burdened with excessive or distinct limitations on its sovereignty. Since a myriad of factors influence perceptions of equity and sovereignty it is necessary to assess these issues within a framework of incentive and capacity for cooperation and improved management. Improving capacity, particularly domestic scientific, technical, and financial, is a critical area of need and offers great rewards for both the river system and the people who depend upon it. However, the dismal state of the lower Colorado and its delta demonstrates that no amount of capacity can compensate for a lack of incentive. In spite of its ample financial and technical resources and the unequivocal treaty criteria for salinity, the United States still fails to fully meet its treaty obligations to Mexico. Clearly, the multidisciplinary nature of water demands multidisciplinary approaches.

This study illuminates a few ways water quality management may be evaluated in international basins. Whether following international treaties towards domestic implementation or assessing the type of water resources planning steps and management institutions found in treaties, it is evident that greater progress is attainable. Those interested in realizing water quality improvements in international basins should focus on the water resource planning process and guarantee that management institutions are given the breadth of powers necessary to ensure

success. If so, international treaties will inevitably move through the succession of stages identified by Congleton and Giordano.

Greater understanding of the sovereignty, equity, incentive, and capacity challenges in managing international river basins is critical to encouraging more substantive water quality treaties and, consequently, protecting and enhancing water quality. The American Chief Commissioner of the Canada-U.S. International Joint Commission perhaps best summarizes the challenge:

> What we have, and what we tell the others, is that there has to be a willingness on the part of all participants to reach a fair and equitable agreement. And it's difficult – water is such a precious commodity. (De Villiers 2000, 255)

APPENDIX

List of all international basins found in Giordano's (2002) compilation of treaties with water quality provisions. This table gives the number of different treaties a basin appears in as well as the type of water quality categories assigned.

International basins found in Giordano's water quality treaties	# of times basin appears in a water quality treaty	Type of water quality categories covered
Amur	1	3
Aral Sea	3	2, 3
Atrak	1	3
Colorado	3	1, 3
Columbia	2	3
Danube	13	1, 2, 3
Elbe	2	2, 3
Fly	1	3
Har Us Nur	1	3
Incomati	2	3
Indus	1	2
Jordan	3	2, 3
Kunene	1	3
Kura-Atraks	1	3
La Plata	2	3
Lake Chad	1	2
Lava-Pregel	1	3
Lielupe	1	2
Maputo	1	3
Mekong	2	2, 3
Mississippi	1	2
Newman	1	3
Niger	3	2, 3
Nile (Lake Victoria)	1	1
No Specific Basin	4	1, 2, 3
Oder	2	2
Okavango	1	3
Orange	2	3
Pu-Lun-To	1	3
Rhine	3	1, 2, 3
Rio Grande	1	3
Sepik	1	3
St. John	1	2
St. Lawrence (Great Lakes)	3	1, 3
Tigres-Euphrates/Shatt al Arab	2	3
Tijuana	1	3
Torne/Tornealven	1	2
Vistula	2	2
Zambezi	1	2

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