AN ABSTRACT OF THE DISSERTATION OF

Biniam Iyob for the degree of Doctor of Philosophy in Geography presented on July 21, 2010.

Title: Resilience and Adaptability of Transboundary Rivers: The Principle of Equitable Distribution of Benefits and the Institutional Capacity of the Nile Basin

Abstract Approved:

_____

Aaron T. Wolf

Biophysical, socioeconomic and geopolitical pressures from population growth and economic development are leading to an increase in tensions regarding the sharing of water within transboundary basins. Transboundary basins are surface rivers and groundwater resources that are shared among sovereign nations and autonomous regions. This dissertation focuses on surface water in several river basin organizations (RBOs), with focus on the Nile Basin. Various international principles and rules have been proposed to build resilience and adaptive capacity in order to promote cooperation among stakeholders sharing river basins. In this dissertation, resilience is defined as the ability of a transboundary water management system to maintain its basic functions when subjected to biophysical, socioeconomic, and geopolitical pressures. Adaptability is defined as the capacity of an institution, such as a transboundary basin organization, to be resilient. This dissertation: 1) assesses the extent to which the principle of equitable distribution of benefits (EDB) contributes to resilience and 2) evaluates the institutional capacity of the Nile Basin Initiative (NBI) to be resilient under biophysical, socioeconomic, and geopolitical pressures. A review of the literature about managing transboundary rivers (Chapter 2) describes: 1) stakeholder interests, 2) current and potential trends in conflict and/or cooperation, 3) transboundary security, 4) management strategies, and 5) institutional capacity in shared rivers. The chapter discusses the difference in responses to these challenges among stakeholders across differing spatial (international, national, provincial and

local) scales. It asserts that institutions, especially RBOs, play a key role in managing transboundary rivers. The EDB principle is evaluated with respect to the most cited international rule on rivers, the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses (Chapter 3). We propose a broad approach for implementing the EDB in transboundary river basins. The chapter argues that the EDB requires an assessment of the distribution of potential benefits, while simultaneously considering sustainable management strategies including as many factors as possible. The EDB principle is ambiguous, making it difficult to implement in the Nile Basin (Chapter 4). These ambiguities include poor definitions of terms such as equity and benefits, and few details on how to implement benefit sharing. Nevertheless, the principle has tremendous potential for maximizing benefits and promoting cooperation in the Nile Basin. In Chapter 5, we assess the institutional capacity of the NBI (an RBO formed by nine of the ten Nile countries) to be resilient in the face of probable biophysical, socioeconomic and geopolitical pressures. The resiliency of the NBI was assessed using five criteria: 1) vision statement, 2) doing research, 3) proposal of specific projects, 4) implementation of projects and 5) monitoring of projects. The chapter finds that the NBI has mixed resiliency strengths ranging from no resilience (where none of the five criterions are achieved) to achieving all of the five criterions (very high) in mitigating biophysical, socioeconomic and geopolitical pressures. In conclusion, this dissertation shows that development aspirations, sustainable water management, poverty alleviation and conflict resolution objectives could be met more successfully through an equitable benefit sharing framework rather than water quantity allocation and improving the institutional capacity of RBOs.

Key Words: Adaptability, Equitable Distribution of Benefits, Nile Basin Initiative, Nile River Basin, Resilience, Transboundary Rivers

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Resilience and Adaptability of Transboundary Rivers: The Principle of Equitable Distribution of Benefits and the Institutional Capacity of the Nile Basin

by
Biniam Iyob

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Biniam Iyob, Author

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CONTRIBUTION OF AUTHORS

In addition to my advisors, Patrick MacQuarrie (PhD candidate, Department of Geosciences, Oregon State University) and Dr. Aaron T. Wolf (Department Chair, Department of Geosciences, Oregon State University) have contributed on the second chapter. Dr. Mark Giordano (from the International Water Management Institute, Colombo, Sri Lanka), and Dr. Itay Fischhendler (from the Department of Geography, The Hebrew University of Jerusalem, Israel) have contributed on chapter 4. Patrick MacQuarrie contributed in the creation of the outline, writing section 2.5 (Transboundary Water Security), and editing and advising of the chapter. Dr. Wolf contributed in conceptualizing the objectives, editing, and advising of the chapter. Dr. Mark Giordano (from the International Water Management Institute, Colombo, Sri Lanka), and Dr. Itay Fischhendler (from the Department of Geography, The Hebrew University of Jerusalem, Israel) have contributed on chapter 4. Dr. Fischhendler helped in conceptualizing the objectives and editing as well as advising of the chapter. Dr. Giordano helped in the conceptualization, organizing the authors and securing funding resources for funding travel to Ethiopia. All other works are from the author of the dissertation.

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Resilience and Adaptability of Transboundary Rivers: The Principle of Equitable Distribution of Benefits and the Institutional Capacity of the Nile Basin Initiative

1 GENERAL INTRODUCTION

1.1 The need for transboundary rivers management

Transboundary basins are surface river and groundwater resources that cross international borders or borders between autonomous regional states. The focus of this dissertation is on river resources that cross international boundaries. There are 276 international basins shared among 145 countries (TFDD 2009b). Due to growing demand associated with population growth and development needs, water users have been depleting scarce water resources at increasing rates. Assessing the miracle of the Green Revolution, Sandra Postel pointed out that the more than twice increase in world grain land yield was correlated with almost twice the increase in water use due to irrigation (Postel 1999). After a decade, due to predicted population growth, almost a fifth of the 40 percent increase in future water use will be transferred to food production (Palaniappan and Gleick 2009). According to an estimate from the United Nations Environment Programme (UNEP), a significant portion of the world's population is experiencing an acute shortage of water (Palaniappan and Gleick 2009; UNEP 2007).

Socioeconomic and geopolitical pressures (e.g., population growth and economic development) are leading to increasing utilization of surface rivers that cross national boundaries. In addition, biophysical pressures, such as drought and flooding, affect the quantity, quality, and timing of water, which affects the stakeholders involved in transboundary rivers. The stakeholders involved in transboundary negotiations have responded differently to the increased usage of shared river resources. First, occurrences or anticipated actions lead stakeholders to realize that increased utilization of water might have detrimental effects on them. Next, stakeholders take stances that they have the right to utilize the river or that utilization by other stakeholders should

not cause significant harm to them. These stances may lead to conflict and/or cooperation among countries sharing transboundary basins (PCCP 2010).

In order to build resilience and adaptability to the pressures, various international rules, regulations, and principles have been proposed to resolve disputes or conflicts and enhance cooperation. Resilience may be defined as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" while adaptability is defined as "the capacity of actors in the system to influence resilience" (Walker et al. 2004). The application of the principle of equitable distribution of benefits (EDB) is an international framework to enhance resiliency of transboundary basins. The EDB principle advocates the sharing of benefits derived from transboundary rivers rather than allocation of water quantity. The objectives of this dissertation are (1) to assess whether the EDB principle enhances resiliency and (2) whether River Basin Organizations (RBOs) have adequate institutional capacity to remain resilient in the face of pressures. This dissertation argues that if countries share the benefits derived from shared basins rather than water quantity alone, and if they strengthen the institutional capacity of RBOs, they will enhance the ability of RBOs to meet the following stakeholder needs for: 1) development aspirations, 2) poverty alleviation, 3) sustainable water management strategy, and 4) conflict resolution. This dissertation assesses: 1) the overarching management issues in transboundary waters, 2) whether the EDB principle aligns with commonly accepted rules, thus enhancing the likelihood of its implementation, 3) whether stakeholder countries aspiring to implement the EDB principle in the Nile have the right conditions to do so, and 4) whether the Nile Basin Initiative (NBI), an RBO formed by nine of the ten Nile countries, has an institutional capacity that promotes resiliency.

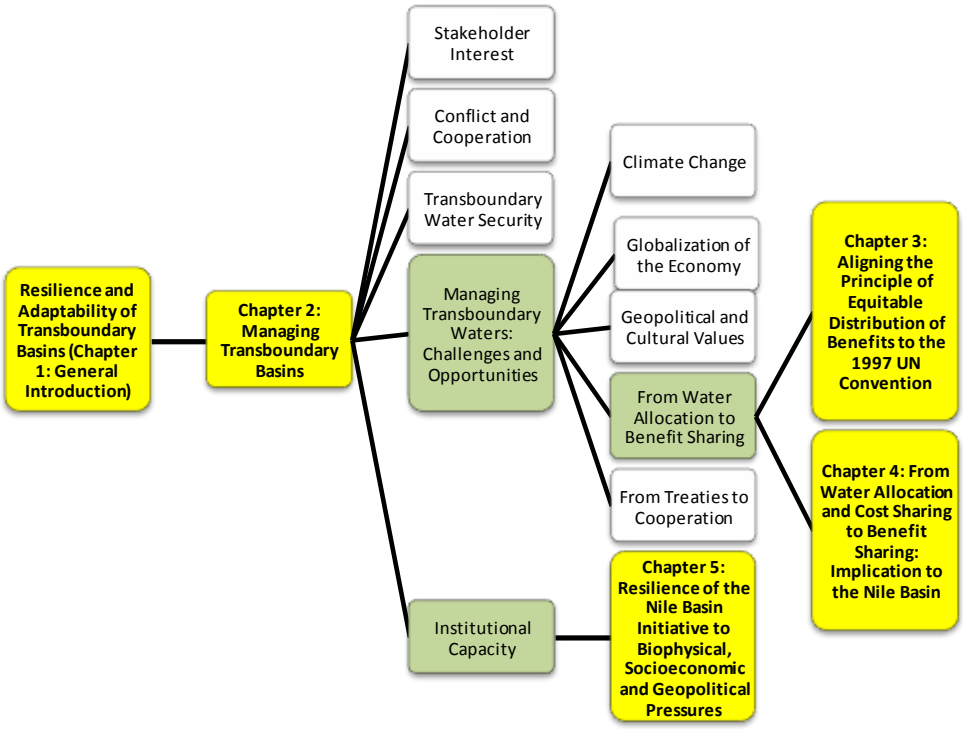


Figure 1.1: Dissertation organization and linkage: the first chapter discusses five sections, of which, the fourth, "Managing Transboundary Rivers" addresses the benefit sharing principle in its fourth sub-section. This subsection is linked to the third chapter, which discusses the alignment of the principle with the 1997 UN Convention. The fourth assesses the ambiguities and necessary conditions of the benefit sharing principle specific to the Nile Basin. The fifth chapter assesses the institutional capacity of the Nile Basin Initiative

1.2 Dissertation organization

The dissertation is divided into six chapters, including this introduction chapter and a conclusion chapter (Figure 1.1).

Chapter 2 reviews the literature on management of transboundary waters. It discusses challenges and opportunities in transboundary rivers management. The chapter identifies the major challenges and opportunities for transboundary water management and suggests management strategies for each.

Chapter 3 assesses the extent to which the EDB principle is consistent with the United Nations 1997 Convention on the Law of the Non-Navigational Uses of International Watercourses. Principles that align with existing laws and regulations are more resilient and have higher likelihood in getting implemented. The 1997 Convention, although not yet ratified, is the most commonly adhered-to international rule during transboundary negotiations. This chapter focuses on identifying commonalities and suggesting new ideas that align with the 1997 UN Convention and thus enhance the likelihood regarding implementation of the EDB.

Chapter 4 evaluates ambiguities associated in implementing the EDB principle in the Nile basin. The analysis utilizes six measures to assess whether the conditions are right or not for the countries sharing the Nile basin to implement the EDB principle: the availability of cooperation facts, agreements or treaties, funding, sustainable management implementations, economic integration, and geopolitical security. The chapter draws on successes and challenges from the Columbia, Aral, and Ganges Basins.

Chapter 5 assesses whether the NBI has the institutional capacity to enhance the resilience to biophysical, socioeconomic and geopolitical pressures. Various factors that can be used to manage resilience (adaptability for each of the three pressures) are

selected from literature, the NBI website, and insights gained from visit to the NBI and International Water Management Institute (IWMI) in Addis Ababa, Ethiopia. The institutional capacity of the NBI is evaluated using five criteria: 1) vision statement, 2) the planning and researching, 3) project research, 4) implementation of projects, and 5) monitoring or evaluation stages.

2 MANAGING TRANSBOUNDARY RIVERS

Biniam Iyob, Patrick MacQuarrie, and Aaron T. Wolf

2.1 Abstract

The challenges of our global society place immense strains on scarce transboundary water resources. Managing these resources efficiently, pragmatically, and equitably is increasingly becoming a priority for policy decision processes. This chapter identifies 1) interests of stakeholders, 2) trends in cooperation and conflict, and 3) issues of transboundary water security. It also suggests management strategies and institutional capacity-building concepts for assessing the following major future challenges and opportunities: 1) climate change, 2) globalization, 3) geopolitical and cultural values, 4) trend shift from treaties to cooperation, and 5) increased emphasis on shared benefits rather than contesting claims over quantity.

Key Words: Conflict, Cooperation, Stakeholders, Transboundary Rivers, Water Security

2.2 Transboundary rivers

Freshwater scarcity is an imminent ecological dilemma facing our increasingly interrelated global society. The bulk of fresh water currently available is from rainwater, groundwater, and surface rivers, and its availability, distribution, quantity, and quality vary considerably over space and time. Demands for fresh water have been increasing due to economic development and population growth. In some regions of the world, climate change has resulted in large-scale flooding, which has brought to the foreground major questions about the urgency of transboundary water management (Bakker, 2007). This chapter focuses on the opportunities and challenges facing national and international entities seeking to maximize benefits while minimizing conflict over the distribution and allocation of this finite resource.

Freshwater rivers whose tributaries or watershed basin are shared by more than one country or political entity are defined as transboundary basins. There are over 276 recognized transboundary rivers (TFDD 2009b) (Figure 2.1). Some of these are shared between 2 countries (e.g., the Columbia River is shared between Canada and the United States of America), while others are shared between many (e.g., the Danube is shared among 18 countries: Romania, Hungary, Austria, Serbia, Montenegro, Germany, Slovakia, Bulgaria, Bosnia and Herzegovina, Croatia, Ukraine, Czech Republic, Slovenia, Moldova, Switzerland, Italy, Poland, and Albania) (TFDD 2009b). Water is a finite resource without which life would not be possible, and it is considered to be of the highest national importance for all riparian nations whether they are post-industrial nations or developing nations struggling to ascertain ownership and usufruct rights.

Utilization of water sources by an upstream nation can lead to a decrease in water quantity and quality for a downstream nation. In situations where there are disparities of technological power and institutional capacities, fear and distrust may foster strained relations. In contrast, efforts to ensure equitable access through enhancing

institutional linkages among nations may nurture cooperative relations. This chapter seeks to systematically identify cooperation and conflict in transboundary rivers at different geographic scales, with the overall objective of enabling policymakers to comprehend and negotiate viable resolutions to imminent threats.

A number of international laws and treaties have been proposed to facilitate cooperative relations between riparian nations. Institutions such as river basin organizations (RBOs) and global organizations such as the United Nations have gradually, especially since 1997, established protocols and conventions to enhance cooperation among nations sharing freshwater rivers. Rather than analyze the numerous international proposals and laws that have emerged in the 20th century, this chapter focuses on a major international convention, the 1997 United Nations (UN) Convention on the Non-Navigational Uses of International Watercourses, which is most frequently cited in negotiations, treaties, and implementation of international agreements of transboundary water sharing.

Although the 1997 UN Convention has not yet been ratified, it has emerged as a significant guiding framework for long-standing transboundary conflicts by both upstream and downstream countries. Its appeal to all claimants is based on its careful balance of two interrelated issues: 1) avoidance of significant harm to downstream riparian nations from resource use by other nations and 2) reasonable and equitable utilization of transboundary resources. Downstream countries regard this convention as protecting their rights by limiting upstream stakeholder use in such a manner that it would cause significant harm. Upstream countries also accept the convention as a guiding framework because they view its statement on “reasonable and equitable utilization” as one upholding their right to use water resources in a fair way. The convention pragmatically articulates the adage “Do no significant harm” and links it to “equity”, which makes it an excellent toolkit with which to address water policy challenges.

In addition, this chapter will also discuss: 1) claims of the stakeholders to shared resources and their utilization of transboundary water resources; 2) trends toward cooperation and/or conflict among nations and potential mechanisms to enhance cooperation; 3) biophysical, socioeconomic, and geopolitical threats to transboundary water securities; 4) proposed management solutions to address the imminent ecological threats and peace among nations; and finally; 5) ways to improve institutional capacity enabling stakeholders to successfully incorporate the proposed management strategies.

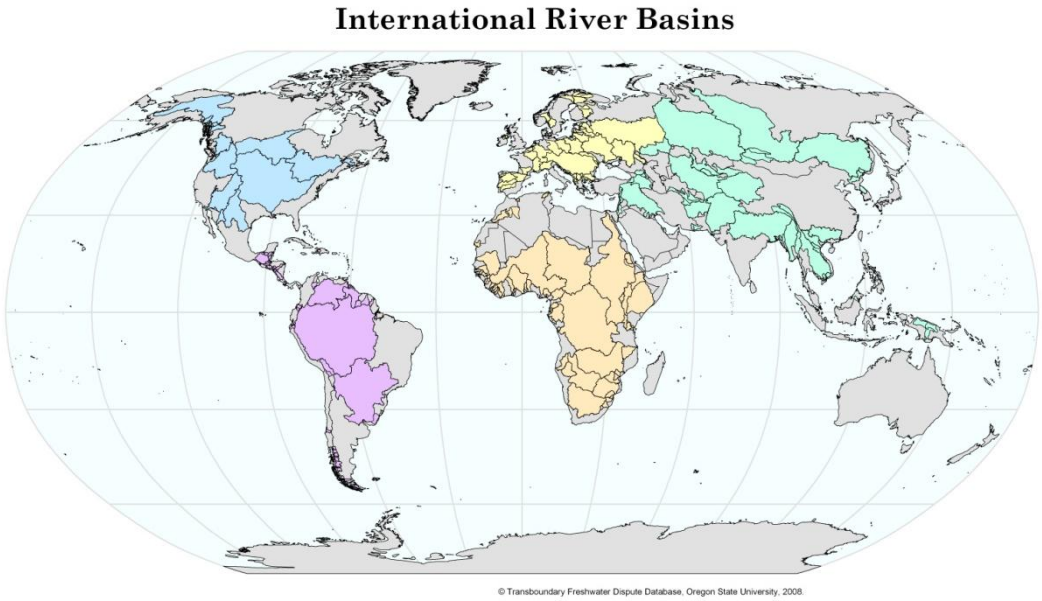


Figure 2.1: International river basins of the world (Source: (TFDD 2009b)).

2.3 Stakeholders in transboundary rivers

Transboundary river resources are used directly and indirectly by many stakeholders. Direct uses, which can be both tangible and intangible, include irrigation, hydropower, ecological habitat for wildlife, fisheries, navigation, domestic water, industrial, cultural (legacy) value to future generation, ecotourism/leisure, and esthetic and spiritual. Indirect uses include industries and ecologies that depend on direct user output. For example, an urban population whose income depends on selling products to farmers is an indirect user of irrigation water. These direct and indirect linkages indicate the multiplicity of users and beneficiaries from a finite source like water.

The benefits associated with (direct and indirect) types of use can be assessed quantitatively or qualitatively. One method of describing the benefits quantitatively is through the concept of "virtual water." Virtual water can be defined as the volume of water required for the production of goods and services ranging from food to building materials (Hoekstra and Chapagain 2008). Social, anthropological, and ecological perspectives could be used to describe benefits qualitatively. These embedded benefits make transboundary rivers a crucial political issue because the allocation and distribution of national water resources is tied to the priorities of a nation's policymakers and the nature of the political elites' relationship with their counterparts in the other riparian states. Despite significant differences in geographical size, political ideology, economic development, and culturally based patterns of water use, contemporary nations sharing transboundary water resources demonstrate similarities in the diligent pursuit of "a national share" accompanied by the acknowledgement of the urgent need for collective responsibility to replenish and preserve the source of life and livelihoods. An example may be seen in the Nile Basin, where downstream Egypt and Sudan want the share agreed upon in 1929/59 to be recognized by upstream countries (Wolf 1999). Meanwhile, the upstream countries are protesting that they deserve an equitable share of Nile water resources (Wolf 1999).

For the purpose of this chapter we have identified four scales within which a matrix of direct and indirect usage of water resources take place (Figure 2.2). The following discussion will address the interests and direct and indirect types of use by local, provincial, national, and international stakeholders.

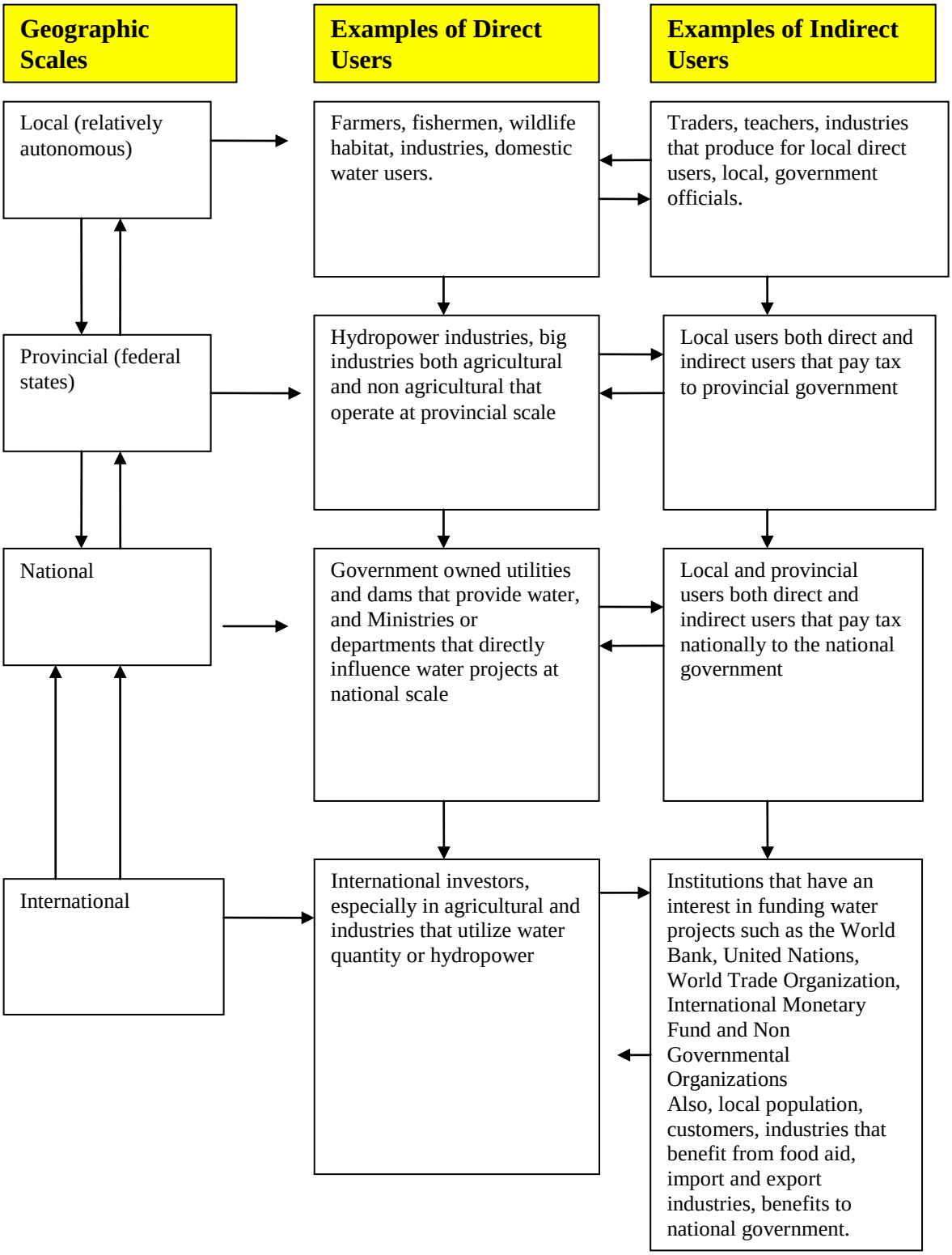


Figure 2.2: Examples of direct and indirect users at different geographical scales.

2.3.1 Local

It is important to consider local use of resources in order to have good transboundary rivers management strategy. In this chapter, the term "local" refers to areas smaller in scale than the provincial or state level where inhabitants have only limited political autonomy over their land. Local areas in politically centralized regions with relatively limited political autonomy are discussed only at the national scale since the differences between local- and national-scale politics are not institutionally distinguishable. Similarly, those areas that do have substantial political influence over their national politics, such as British Columbia in Canada or the 50 states in the United States of America, will be discussed in the next section, Provincial or Federal Scale. Both direct and indirect uses of water occur at the local scale. Direct users include farmers, fishermen, wildlife habitat, industries, and households, while indirect users include traders, teachers, industries that produce for local consumers, and government officials (Figure 2.2). Local current and potential uses of transboundary rivers differ from each other.

Currently, at the local scale, shared rivers are being used to irrigate farms, for fishery activities, and for domestic drinking water. In developing countries, local populations are eager to use more water to irrigate their fields and thus are building more micro dams. Local-scale transboundary river use has an effect (or due to effect on irrigation, fishery and others), especially at the provincial level, but also at national, regional, and international scales. The effect of local water usage at the transboundary scale is not yet clear. Depending on the number or extent of local uses, the effect at the international scale may or may not be significant. For example the decision by the Ethiopian government to allow local governments to build more earthen dams on the Nile River tributaries was regarded by some as cause for potential conflict with Egypt (Waterbury and Whittington 1998). Yet, despite a long tradition of regarding the Nile as a gate which could be closed at will by generations of Ethiopian and Egyptian elite(s), the building of micro dams has yet to trigger the envisioned conflicts between the two nations. The role of a major stakeholder, the Sudan, must also be taken into

consideration before policy to address this presumed conflict can be formulated. A comprehensive understanding of both current and potential local uses is needed to formulate the equitable use of transboundary resources.

In the future, an examination of patterns of water use will more likely indicate a shift from subsistence farming to relatively larger, irrigation-style water uses due to development pressures, as has occurred in most developing nations (Attwood 1987). In rural areas, the shift to larger farm areas requiring irrigation will result in increased withdrawal of water from both surface and groundwater. This, in turn, will also fuel urban demands for domestic, hydropower, and industrial usages.

Current and potential interests, which maintain or amplify local uses, need to be considered in the management of transboundary rivers. A crucial step in achieving the stated objective is through stakeholder participation. Federal and/or provincial-level stakeholders have in many cases been recognized as important actors, but local areas (and their smaller but equally significant users and stakeholders) have yet to be incorporated as integral parts of the intra-national dialogue on the utilization of resources, as well as the prevention of localized conflicts in areas that may spill over beyond national boundaries. Successful local stakeholder participation could be achieved through the following benefit criteria: 1) improved quality of decision making, 2) improved credibility and public support, 3) improved implementation and monitoring, and 4) early warnings of potential challenges (Earle and Malzbender 2006).

2.3.2 Provincial or federal state

In decentralized political systems, provincial or federal-state government interests may differ significantly from national interests (which will be discussed in the next section) if the elite exercise significant levels of political autonomy. Provincial-scale transboundary water users include hydropower industries and large agricultural and non-agricultural corporations. Indirect users include local taxpayers, neighboring federal states that have trade relationships, and individuals and entities that export and import products at quantities and qualities that encompass provincial scale (Figure 2.2). The interests of all of these users must be considered, with special attention to the convergence or divergence of interests that emerge from their overlapping use of their shared resources. Although the current and potential uses of water at this scale are very similar to those at the local scale, there are some differences that can be identified as the basis for cooperation or triggers for conflict.

Similar to the local scale, shared rivers at the provincial level are being used to irrigate farms, maintain fishery activities, and for domestic drinking water; the difference between the two scales, however, is in the political influence of these entities. Provincial stakeholders have unequal power in influencing transboundary decisions among different political systems. For example, Canadian law allows provinces political power in determining how resources within their jurisdiction can be used (Muckleston 2003). British Columbia (BC) would not accept the Columbia River Treaty (CRT) as agreed between the Canadian and United States governments (Muckleston 2003). Thus, it was not until negotiations with BC were finalized that the CRT was put into effect in 1964. This is not always true for all provinces in federal systems. Unlike their Canadian counterparts, Ethiopian provinces does not enjoy the same amount of power to influence Nile Basin politics, as the nation is currently a fledgling democracy.

In the future, especially in the developing world, one would expect an increase in the empowerment of different ethnic groups and provinces. These trends are evident from

the adoption of the federal political system by many countries. It may be that in the future, provinces will enjoy greater influence over resource use at the international level, as in BC. Increasing urbanization is also more likely to increase provincial political power. The more the urban population is concentrated under the jurisdiction of a city, the more that city will hold political sway over the political decisions of the province. This might not be the case, however, if the city itself is a decentralized system, such as in the East Coast states of the United States.

In developing nations, the interests of provincial stakeholders are more likely to favor larger irrigation plants, hydropower generation, and increased urban water supply compared to developed ones. In most developing countries, since the majority of the population lives in rural areas, irrigation emerges as a higher priority for policymakers than other uses. In richer nations, the interests, although similar, are shifted relatively more toward industrial, environmental, and municipal uses. For example, public opinion in support of restoring salmon habitat (Lackey, 1999) by increasing river flow may significantly harm irrigation users in the Pacific Northwest (USA). The question that must be considered carefully is how to maintain a balance between the needs of the environment and those of the urban populace.

2.3.3 National

National-level stakeholders emerge as key actors in either the fulfillment of demands for the equitable use of shared resources or as sources of provincial and local grievances due to real and perceived costs imposed on them by rival claimants. National policymakers are faced with the challenges of meeting the numerous needs of their constituents as well as facilitating cooperation and/or preventing conflicts arising from shared finite resources. Transboundary water resource users are similar to users at the local and provincial scales, but differ in the magnitude of the use. Examples of direct water users at the national scale include government owned or regulated utilities that provide water, government-owned dams, and ministries or departments that

directly influence water projects. Some examples of indirect water users include industries that obtain hydropower energy from government utilities and users of infrastructure built from income obtained by government owned utilities (Figure 2.2). Current and potential uses are different from local and national scale stakeholders in that decisions about relations with fellow riparians are generally made at this level.

Current uses at the national level differ geographically and economically. Nations sharing the same basin do not utilize their shared resources at the same level or with the same intensity. In the Nile Basin, for example, Egypt has numerous uses for water, including irrigation, hydropower generation, industrial use and domestic purposes. Ethiopia, which shares the same basin, does not use the water for hydropower or irrigation at the same level as Egypt. Another example is the Mekong River basin, where China (PRC) is developing the hydropower potential of the Mekong, while Vietnam is currently using the water more for delta farming and fishery purposes. Similar to the local and provincial scales, nations at a higher stage of economic development are more likely to use their water to meet the needs for urban rather than rural areas. This is because in these nations, the urban population is stronger politically.

Nationally, potential water uses are very important to analyze because, depending on the magnitude of the water projects being envisaged, they can significantly influence the transboundary water relations with other riparian nations. Generally, very small water projects at low numbers are not viewed as significant. Large projects, on the other hand, may be viewed with suspicion by other stakeholders because they could have an impact at the transboundary or international level. Developing and developed countries have different priorities in their water usage. In developing countries, potential uses are tilted towards large projects in order to meet the increased demand due to economic and population growth pressures. In the Nile basin, achieving food security through irrigation, as in the New Valley Project in Egypt to increase irrigation area, is expected to drive national interest policy. In economically developed

countries, potential uses are more likely to shift to ecological restoration and meeting the needs of biodiversity. This trend is not necessarily true everywhere, however. In France, unions of farmers have lobbied for increased availability of water, which could possibly lead to greater utilization of water resources in the rural areas. For other case studies regarding national stakeholders interests, please refer to Table 2.1.

Indirect uses of shared resources pose serious challenges in the identification of national-scale interests because the nodes of conflict and/or cooperation are embedded in resources that are not directly related to the water use. For example, in the Jordan Basin, land disputes and Israeli settlements might have a higher priority to the stakeholders than water does. Thus, in order to understand the responses – towards either cooperation and/or conflict – by national and local stakeholders, it is extremely important to go beyond levels and patterns of water use and examine secondary issues, such as land disputes and disposal of waste materials, in order to avoid triggering seemingly unrelated conflicts among stakeholders. Going beyond the usual parameters of water management issues among transboundary stakeholders will be useful in pinpointing issues of convergence or divergence over resources other than water, which, in some cases, may not be the primary driver in negotiation processes.

2.3.4 International organizations

International stakeholders in transboundary rivers are many and the water users are interlinked with players at other scales. Direct actors may include international investors, especially those who invest in agricultural and industrial activities that utilize water quantitatively for irrigation or for hydropower energy. Examples of direct actors are the World Bank, the World Trade Organization (WTO), the International Monetary Fund (IMF), and non-governmental organizations (NGOs). These transnational entities can be regarded as indirect users because they influence water policies through their funding; in return, they gain through the fulfillment of the objectives of the entities. Indirect users can include both international stakeholders and

the local populace. At the local scale, some examples of indirect users include the local population, customers, and industries that benefit from food or development aid, import and export businesses, and national governments who get significant tax gains from international organizations (Figure 2.2). Current and potential uses by international stakeholders differ from the other scales as their interests and influence are more felt in developing countries.

Currently, the level of influence by international organizations is significant, especially in using water quantity or benefits and particularly in economically developing regions. The World Bank, for example, is the biggest donor to the Nile Basin Initiative (NBI), an organization formed in 1999 to increase cooperation among riparian countries (NBI 2009). It is also the guarantor of the Indus River Treaty. Organization size does not determine long-term impact, however, since small and medium-sized organizations – especially NGOs – have in many cases funded local projects such as the installation of small irrigation projects.

In the future, the influence of these international organizations, especially the large ones, is expected to grow, with more emphasis in poor regions. This is due to the dependence of poor countries on international organizations in regards to funding and to the globalization of the world economy. For example, water quantity and benefit trades might grow in significance and may even be subject to WTO rules in the future. Meeting the interests of international stakeholders is crucial because they provide crucially needed funding resources for water projects. Some of these interests include meeting strict environmental guidelines, accountability of funds, and cost effectiveness.

Table 2.1: Selected transboundary basins and national interests.

World Region	Basin name and riparian countries (Source: (Wolf, United Nations Environment Programme., and Food and Agriculture Organization of the United Nations. 2002))	Priority interests
Africa	Nile (Egypt, Sudan, Eritrea, Ethiopia, Sudan, Uganda, Kenya, DRC, Tanzania, Rwanda and Burundi)	Upstream irrigation requirement to increase agricultural productivity; Downstream assurance that upstream ambitions do not negative effect
	Limpopo (South Africa, Botswana, Mozambique and Zimbabwe)	Drought prevention and economic alleviation through dam building
	Niger (Nigeria, Mali, Niger, Algeria, Guinea, Cameroon, Burkina Faso, Benin, Ivory Coast, Chad, Sierra Leone)	Irrigation and reservoir dams for farming
South West Asia	Jordan (Jordan, Israel, Syria, Egypt, Lebanon and the Palestinian Entity)	All of the riparians use the water in the basin for domestic, irrigation and hydropower extensively
	Tigris-Euphrates (Turkey, Iran, Syria, Iraq, Jordan, Saudi Arabia)	Irrigation (all riparians), and hydropower (Turkey and some in Syria)
	Kura-Araks (Azerbaijan, Iran, Armenia, Georgia, Turkey, and Russia)	Pollution and Hydropower
South and Central Asia	Indus (Pakistan, India, China, Afghanistan, and Nepal)	Irrigation (especially for Pakistan), hydropower (especially for India) , and religious (for Hindus in India especially) values
	Ganges-Brahmaputra-Meghna (India, China, Nepal, Bangladesh, Bhutan, and Burma)	Flood control, delta farming
	Aral (Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, Afghanistan, Turkmenistan, China, and Pakistan)	Water quantity recovery, pollution, Irrigation and hydropower (for Kyrgyzstan, and Tajikistan especially)
East and South East Asia	Mekong (China, Laos, Thailand, Cambodia, Burma and Vietnam)	Maintain current uses for delta farming, fishery, navigation and irrigation. Future need to develop hydropower especially by China, Laos, and Vietnam
	Amur (Russia, China, Mongolia, and North Korea)	Water quality, and hydropower
Europe	Danube (Romania, Hungary, Austria, Serbia, Montenegro, Germany, Slovakia, Bulgaria, Bosnia and Herzegovina, Croatia, Ukraine, Czech Republic, Slovenia, Moldova, Switzerland, Italy, Poland, and Albania)	One of the main uses of the Danube is navigation. It is also used for domestic (drinking consumption). Recently there has been a focus to improve the quality of the water to restore healthy ecology through the EU water directive framework
	Rhine (Germany, Switzerland, France, Belgium, Netherland, Luxembourg, Austria, Liechtenstein, and Italy)	Similar to Danube
	Dnieper (Ukraine, Belarus and Russia)	Pollution
North America	Columbia (United States of America and Canada)	Ecological restoration, hydropower, irrigation, navigation and industrial
	Colorado (United States of America and Mexico)	Irrigation, hydropower, ecological restoration and water quality
South America	Amazon (Brazil, Peru, Bolivia, Colombia, Ecuador, Venezuela, Guyana, and Suriname)	Environmnetal protection, fisheries and navigation
	La Plata (Brazil, Argentina, Paraguay, Bolivia, and Uruguay)	Flood control, and industrial Usage

2.4 Conflict and cooperation in transboundary rivers

Understanding the factors that drive conflict and/or cooperation among stakeholders is critical to the maintenance of agreements governing the use of transboundary water resources. Literature about these factors has been growing; some argue that water disputes can lead to war while others counter that conflict is not necessarily the only outcome to dispute over shared resources (Delli Priscoli and Wolf 2009). This paper suggests a systematic assessment of the increase in current trends of cooperation, which may yield new insights into the factors that have led to the prevention of new conflicts over shared transboundary rivers. Preliminary findings suggest that the willingness of human beings to negotiate and solve water-related problems, as well as the formulation of guidelines regarding shared transboundary river resources, has significantly led to increased cooperation rather than conflict. As an astute researcher aptly said, "The laws of nature and the laws of humans both dictate that water, an ambient resource, must be shared by those who depend on it" (Dellapenna 2007).

Before discussing examples of conflict and/or cooperation in the next sub-section, the terms used in the discussion should be clearly defined. The definition of conflict can range from extreme cases, such as the declaration of war, to strident verbal rhetoric, such as "mild verbal expressions displaying discord in interactions" (Yoffe 2001). The definition of cooperation can range from extreme cases, such as "voluntary fusion into one nation," to strident verbal rhetoric, such as "minor official exchanges, talks or policy expressions- mild verbal support" (Yoffe 2001). The definition of cooperation can also be gauged by the willingness to enter into agreements, as well as by proactive steps taken by stakeholders to ensure the implementation of treaties. This is especially of interest to local, national, and international actors who need to have a clear understanding of the root of conflict based on resource allocation, as well as regional factors that may lead to open disagreements that may spill over to the economy, ecology, geopolitics, and, ultimately, national, regional, and international security.

The process of assessing trends of conflict and/or cooperation can be done in various study areas. This section focuses on the spatial and temporal methodology. It will address the changing aspects, current and potential, of conflict and/or cooperation at two spatial scales (local and international), as well as temporal (current and potential) aspects.

2.4.1 Trends of conflict and cooperation

Current trends in cooperation and/or conflict show differences, depending on scale. At the local scale, although there are records (Gleick et al. 2009b), there is no substantial and comprehensive literature or data analysis of conflicts and/or cooperation regarding shared rivers. However, there are many incidents where there were reports of violence regarding water at national scale. For instance, there are records of fatalities in North Eastern Kenya among herders over water resources (Gleick et al. 2009b). In Somalia, conflict over water has resulted in 250 fatalities (Wax 2006). Aside from Kenya, this conflict over water has also embroiled local populations in Uganda, Ethiopia, and Somalia (Selva 2006). Some researchers postulate that competition for water was one of the drivers for the Darfur conflict in Sudan (BBC July 18th 2007). On the other hand, a perception of water abundance and a history of water sharing or cooperation can be seen in the eastern United States (Gramling 2008). In the arid southern parts of the United States, there has been conflict over water at both local and state scales (Delli Priscoli and Wolf 2009). Some researchers have argued that the rate of conflict is higher at more local scales than at the international scale (Giordano, Giordano, and T 2002; Sneddon 2002; Lebel, Garden, and Imamura 2005; Trottier 2005). This may be a result of the higher number of stakeholders involved in local versus international scales. The likelihood of local-scale intensity affecting national and international conflict needs further assessment.

Conflict and/or cooperation trend analysis literature and data are more abundant and are more vigorously discussed at the international level than at the national level

(Yoffe 2001). However, these trends are also different from basin to basin. Current national-level transboundary water use is dictated generally by the hydro-geographic location and economic development stage of the nation. Countries having large quantities of water that surpass requirements are more likely to implement ambitious national water projects and cooperate with neighboring countries. For example, water quantity requirement in the Amazon Basin is not an issue of conflict among the riparian countries. A news analysis from 1978 to 2007 shows 15 events were about hydropower, pollution, and infrastructure while only one was about water quantity (irrigation) regarding the Amazon (TFDD 2009b). This may not be true for arid regions.

Basins with scarce water availability such as in South Asia (Indus, Makahali, and Ganga) and the Middle East (Tigris-Euphrates) show different trends than those basins with water abundance. Iyer (2003) assessed conflict resolution issues in the Indus (between India and Pakistan), Mahakali (between India and Nepal), and Ganga (between India and Bangladesh) treaties, and suggested the following three aspects regarding why the Indus is regarded as a successful treaty relative to the Ganga. First, the Indus River was allocated by giving the western tributaries to Pakistan and the eastern to India. The simplicity in the allocation method was crucial to conflict resolution; the treaty does not allocate quantity or benefits within the same river. Second, the Indus River commission is working well because it was developed as part of the treaty to resolve the dispute (Iyer 2003). Third, the Ganga treaty takes into consideration all rivers shared between the two countries, making the process a complex issue. The Mahakali treaty although formally in operation, has become bogged down due to technical and political differences. Unlike the basins covered by these three treaties, there are other basins with no clear treaty arrangement, such as the Tigris-Euphrates.

The Euphrates and Tigris rivers begin their journies in the Anatolian Plateau in Turkey, which has annual precipitation levels of approximately 1000 millimeters

(mm) per year (MacQuarrie 2004). Turkey is the primary upstream riparian, where 88 percent of the water originates (Hakki 2006). Turkey is promoting the South-East Anatiolian Development Project or Guneydogu Anadolu Projesi (GAP) to achieve three goals: 1) to develop irrigation capacity, 2) to produce hydropower energy, and 3) to increase the economy of the areas inhabited by the Kurdish ethnic group in order to dissipate separatism (Hakki 2006). Water development in upstream countries, especially in Turkey, is responsible for increasing the vulnerability of downstream countries. The hydro development in Turkey may reduce Syrian water on the Euphrates by over 40% and Iraqi water by over 80% (MacQuarrie 2004).

Across international basins, the number of cooperation incidents generally far outnumbers conflictive events where water was a primary driver. A study conducted by Oregon State University showed that out of 1831 cases, only 37 were conflicting ones (Wolf 2007; Yoffe 2001). This suggests that cooperation may predominate in transboundary basins. However, world leaders have suggested otherwise. Boutrous Boutros-Gali commented in 1991 that the next war will be fought over water; Kofi Annan said in 2001 that intense competition for freshwater, rather than political disputes, will likely become a source of conflict and wars in the future; and Ban Ki Moon's article showing the tie between water and the Darfur conflict illustrates the concerns regarding the potential for conflict over water (Zeitoun and Mirumachi 2008; Moon 2007; Jarvis 2010). Research also indicates that nations with poor relations and weak treaties, such as Turkey, Syria, and Iraq, are more prone to conflict (Wolf 2007). A plan to continue the cooperation trend or the betterment of current conditions requires an understanding and prioritization of future challenges and opportunities.

2.4.2 Potential conflict and cooperation

This chapter recommends that interested stakeholders, policymakers, and researchers be proactive and anticipate potential conflicts and/or cooperation in regards to shared rivers. An important requirement for such a recommendation is to first identify, and

then prioritize potential threats and opportunities. In this section, we have identified the following five as potential priorities that affect the management of transboundary basins: 1) climate change, 2) globalization of the economy, 3) geopolitical and cultural values, 4) trend shift from water quantity allocation to sharing benefits, and 5) trend shift from treaties to cooperation.

The effect of climate change on transboundary water security varies thematically, spatially, and temporally. Thematically, climate change affects specific factors such as rain and irrigation water availability, flood hazards, and water quality, among other things. These factors also have considerable spatial and temporal variation. Policy decision makers and other influential entities need to be aware of these threats and have some management options. It is important to evaluate scenarios to mitigate the impacts of climate change on water rights and conservation.

Climate change is expected to affect transboundary water resources negatively in most regions of the world, especially Africa. The negative impacts can be classified into two categories: 1) too much water, resulting in flooding; and 2) too little water, leading to drought. For example, during the month of August 2002 alone, Germany had rainfall equivalent to the average for a full year, resulting in the death of 108 humans, the evacuation of 450,000, and economic damages estimated at 18.5 billion USD (Wolf et al. 2005). On the other hand, the Nile, Tigris-Euphrates, and Jordan basins are expected to face increased water scarcity, and western South Africa may face a 10 percent decrease in runoff (Mukheibir and Sparks 2005). These scarcities will result in less water for some stakeholders.

In addition, future and ongoing projects to meet population and economic growth demands will be negatively affected. For example, the New Valley Project in Egypt and micro dam projects in Ethiopia will not be accomplished as expected. The competition for Nile water may or may not lead to conflict and/or cooperation scenarios. There might be conflict if countries pursue unilateral actions that disregard

the principles of the 1997 UN Convention or, as the current trend is showing, they might find cooperative win-win situations through the NBI organization.

On the positive side, some areas may benefit more from climate change effects. For example, in the Columbia Basin, the more northern areas are more likely to benefit from temperature increases and are anticipated to have longer irrigation-driven growing periods. In the short term, the rate of snowmelt is more likely to increase the water level, thus decreasing the conflict between farmers and Native Americans who fish, as there will be enough water for both stakeholders. In the long term, the level of snowmelt contribution to the basin will decrease and the conflict level might increase or decrease.

With climate change, there will be losers and winners involved. The winners are generally strong and richer governments who can benefit because they are able to subsidize and have the technological and management capacity to adjust to changes and turn the misfortunes into advantages. The losers will be poor areas, such as Sahelian regions in Africa, which are facing drought due to decreases in precipitation attributed to the effects of global warming. The “no significant harm” and “reasonable and equitable utilization” principles of the UN Convention would be violated if these cases occur. Thus, a successful management strategy is required to avoid such a calamity.

Recent reports indicate that the effect of globalization on transboundary resources is expected to increase at a faster rate than previously thought (Rieu-Clarke 2001; Bird 2001; Sigman and Chang 2010; Kempkey et al. 2009). Globalization will affect transboundary rivers due to water privatization and the increased demand for water for irrigation and other industries. Water privatization is a growing trend whereby governments allow private companies to manage water utilities. The increase in water exports is also a trend that one would expect in the future. Two case studies indicating this trend were reported: 1) a study being conducted by a Japanese company to export

water to Australia, and 2) an Ontario-based firm which was allowed in 1999 to ship 158 million gallons of water to Asia (Gramling 2008). At one point, Turkey planned to export 50 million cubic meters of water to Israel (Gruen 2004; BBC August 28th 2002), although those plans fell through. The globalization trend is expected to present opportunities by increasing wealth and knowledge through interconnectedness among economies of nations. It is also likely to create more demand for the resource, leading to competition and disputes over shared river resources. It remains to a successful management strategy to shift the globalization force in a positive direction.

Geopolitical and cultural values are expected to introduce more complexity in the future of transboundary conflict and/or cooperation. Geopolitically, water is not separable from other policies, especially politics. One example is the Jordan Basin. This basin is in dispute not only over tangible direct values, such as irrigation and domestic purposes, but also due to intangible values, geopolitical and cultural issues. Geopolitically, the basin tributaries are regarded as a border dispute. Culturally, it is sacred to many people around the world who revere it. A good example of this is bottled water originating from the Jordan River. The river is regarded as holy and bottled water is sold at a higher cost than other water because of the religious values associated with it (Wolf 2009; Jerusalem-Gifts 2010). This is not unique to the Jordan. In Canadian hydropolitics, the diversion of rivers to dry parts of the United States, in its quantitative nature, is not wholly accepted by the public; thus only the benefits (for example hydropower and flood control) associated with water such as hydropower are allowed out of the country (Bakker 2007a; Pentland, Hurley, and Bakker 2007). These intangible values are expected to affect allocations or benefit sharing processes of water.

The two other current trends, the movement towards benefit sharing and cooperation rather than quantity and treaty, respectively, are likely to be potential opportunities rather than challenges. Benefit-sharing principles are applicable in very few basins. There are two cases mentioned in literature, the Columbia River Treaty (CRT) (where the United States and Canada share the hydropower and flood control benefits) and the

Ganges where Nepal aspires to emulate the CRT (Rahaman 2005). The trend towards agreement or cooperation without compliance to binding treaties is also a new trend that we postulate to increase. For example in the Nile Basin, there are projects being implemented or planned without signing binding treaties. The NBI is considering several projects through its Eastern Subsidiary Nile program (ENSAP). One such concrete example is an NBI plan to conduct a diagnosis study on 747,600 ha in Sudan and on 43,370 ha in Ethiopia and then follow up with a feasibility study on the best 7,500 ha in each country (NBI 2007b). Encouraging and aiding these trends is likely to fulfill the 1997 UN Convention principles and be regarded as a successful management strategy.

The five opportunities and challenges discussed above affect water quantity and quality as well as its distribution. These effects, especially at the international scale, could potentially affect resources that nations depend upon either negatively or positively. Identifying and analyzing these aspects is important because they affect transboundary water security and institutions that implement water resources policy. Identifying conditions where institutions are vulnerable or resilient to stresses associated with biophysical, socioeconomic, and geopolitical stresses is important in creating sound transboundary security.

2.5 Transboundary water security

The terms "water" and "security" have recently been joined together in the transboundary water debate. The Merriam-Webster web dictionary defines security in terms of safety and protection (Merriam-Webster Accessed November 27 2009). In this section the term security is defined as both "freedom from fear or anxiety" (Merriam-Webster Accessed November 27 2009) regarding safety and as "measures to take guard against" (Merriam-Webster Accessed November 27 2009) regarding protection. The term "security" can be understood by what happens in its absence, or by threats to security. Linking the threats to the environment (climate change, environmental degradation, etc.) to the impacts on humans (poverty, sickness, social unrest) gives the term "water security" new meaning. The threats to water security can be placed into two broad categories: the environmental threats facing human and national security; and the lack of societal ability to manage the environment amongst a wide array of complex transboundary political geographies (Frédérick 1999).

Many books and journal articles have been written on the subject of the environment and conflict – particularly in the context of rapid climate changes – such as "State of the World 2009: Into a Warming World" (The World Watch Institute 2009) by the World Watch Institute and "Implications of Climate Change for Armed Conflict" (Buhaug, Gleditsch, and Theisen 2009), a report to the World Bank. Both of these publications state that climate change is a concern for security. However, positioning the environment within the modern security debate has been difficult, and many states and governments resist addressing environmental concerns alongside military ones. Therefore, most efforts have been spent on understanding the ability for society to respond to threats to the environment. Clearly understanding the root causes of these threats are important, but fashioning cooperative institutional responses to mitigate them must be as or more important.

Sustainable institutions are necessary for inducing cooperation, as well as maintaining a functioning and positive atmosphere among the stakeholders involved. The World Bank defines institutions as rules, enforcement mechanisms, and organizations (Kemal 2003). Sustaining an institution that can survive the immediate future while not compromising long-term benefits is a challenge that needs to be addressed. The sustainability discourse traditionally only applied to biophysical systems; however, over the last decade it has widened to now include human systems. The term "hydropolitics" is fairly new and relates to ability of geopolitical institutions to manage shared water resources in a politically sustainable – i.e., cooperative – manner (Wolf 2007). In order for institutions to be resilient and induce positive change, they must be able to withstand various stresses caused by biophysical, geopolitical, and socioeconomic factors.

2.5.1 Biophysical

In this section, biophysical security is defined as the threat to ecosystems and life forms, including human beings, by water quantity, quality and timing changes (Delli Priscoli and Wolf 2009). Biophysical threats to water security are significant and expected to increase for many reasons, including climate change and higher population and economic demands. For example, the decrease in water quantity due to dry weather and dam impoundment in 1974-75 almost caused a violent conflict among the three basin countries, Turkey, Syria, and Iraq, until a neutral mediator, Saudi Arabia, calmed the situation (Kibaroglu 2000; Zawahri 2006). Later, the drought from 1999 to 2001 resulted in Turkey not meeting its water release quota, creating conflict. Turkey did not adjust its behavior to comply with the protocol (Zawahri 2006). Thus, the trilateral agreement (Joint Technical Committee (JTC) representing the three riparian countries of Turkey, Iraq, and Syria) was not able to adapt to changes in biophysical water use, rendering the institutions or governments in the basin unsustainable.

Water quality can also lead to water basin vulnerability. Transboundary basin lakes are also facing water quality stresses that have endangered their security. A tributary of the Aral Sea, the Amu Dar'ya, is one such example. The Amu Dar'ya River receives approximately 10 cubic kilometers of polluted drainage water with high salt content (Kamalov 2003). The result is a loss of livelihood for people who depend on the basin resources, as well as the loss of many fish species, making the basin an ecological disaster. Similarly, Arizona return flow into the Colorado was the issue over which Mexico sought to sue the USA in the 1960s through the International Court of Justice, and it is currently a point of contention on the lower Jordan between Israel, Jordanians, and West Bank Palestinians (Wolf et al. 2005).

In addition to water quantity and quality concerns, ecological water requirements are becoming more of a security issue on river basins. The continual failure of appreciable salmon runs on the Columbia River combined with population growth and the threat of climate change are forcing the U.S. and Canada to change the way the basin is managed – reducing yields for hydropower production and limiting irrigation development and land uses in critical habitat areas of the basin (Lackey 1999). While salmon has unique significance in the Pacific Northwest, ecological water needs are becoming critically important in other rivers basins. The Colorado, Ganges, Indus, Yellow, and Amu Dar'ya and Syr Dar'ya all no longer reach their terminus for large portions of the year, severely depleting their capacity to support fisheries, and rivers such as the Rhine and Missouri have been irreparably damaged due to channelization, separating them from their native floodplains (Postel and Richter 2003).

Successful or resilient institutional arrangements that take into account biophysical factors need to include provisions for a shortage or abundance of water, water quality targets, and increasingly important, the environmental health of the watershed. And, as is illustrated by the rapidly changing environment due to climate change, arrangements also need to account for uncertainty in order to yield multigenerational sustainable results.

2.5.2 Socioeconomic

Socioeconomic threats by far are the most prominent priority for policy decision makers. Socioeconomic water securities are defined as those benefits derived from transboundary rivers that are needed for human sustenance and economic growth. These needs are evolving due to population and economic growth pressures coupled with the force of globalization. These include but are not limited to irrigation, hydropower, domestic drinking water, and industrial water requirements. Examples from the Tigris-Euphrates, Nile, and Mekong will be discussed below to illustrate the level of socioeconomic security issues.

In the Tigris-Euphrates river basin, achieving socioeconomic improvements, especially for the Kurdish population, is a priority in order to maintain regional security along its southern border. GAP started out as a purely hydroelectric and irrigation scheme but transformed into an enormous multi-sectoral, socioeconomic, regional development program that included dam building and large irrigation projects. However, weak international support leading to the lack of funding for GAP has severely hampered the Turkish agenda for developing southern Anatolia (MacQuarrie 2004). If GAP is implemented in full, Turkey argues that stress caused by economic poverty would be alleviated, leading to more congenial relations between the Kurds and the Turkish government. Similarly, in the Nile Basin, achieving food security is of importance to the countries involved. The Aswan dam has been instrumental in creating food security (in terms of availability of irrigation water) to Egypt. By doing so, Egypt has avoided famine, unlike Ethiopia. The famine in Ethiopia was one of the factors that toppled two regimes led by Emperor Haileselassie and Mengistu Hailemariam. In Southeast Asia, countries sharing the Mekong Basin, particularly Laos and more rapidly developing Vietnam, are pinning their hopes in harnessing hydropower capacity after dam development on the upper basin by China. Development of the Mekong resources is a major national security issue for every country in the basin because proposed projects would increase the socioeconomic security of the country, providing electricity, development, and jobs. Countries that

relatively economically stable are more likely to be successful at achieving their national security goals. Moreover, increased cooperation and interdependence among riparians in harnessing the resources of the Mekong could decrease current or future geopolitical tension between countries – strengthening the institutional arrangements in the basin and potentially encouraging China and Myanmar to eventually join the Mekong Agreement (Goh 2004).

2.5.3 Geopolitical

Geopolitical securities linked to water can lead to potential disasters or benefits. Geopolitical water security can be defined as the threat to national or regional security due to water usage or availability. These threats include, but are not limited to, food security that can lead to uprising by the populace against the government; powerful entities such as hydropower and irrigation interests that lobby governments to pursue policies that suit their needs; and, ultimately, the lack of water for human sustenance, which can lead to anarchy and threaten personal and political security. This section will address geopolitical threats from two aspects: 1) threats to water withdrawals by upstream nations that decrease water availability in downstream areas, and 2) pressure on downstream countries to allow upstream countries to use shared river resources. Two examples, the Tigris-Euphrates and Nile basins, will be discussed because there is so much focus on these regions relating to hydropolitical tensions.

In order to reach an agreement, countries within the Tigris-Euphrates Basin should avoid the pitfalls of other transboundary treaties. For example, the allocation of Nile water in 1929 and 1959 by quantity and at the bilateral level between Egypt and Sudan has been a thorny issue with the other regional riparian nations, especially Ethiopia. Allocation of water solely by quantity is a relatively restrictive policy and is less adaptable to changes in biophysical, socioeconomic, and political conditions. Moreover, bilateral agreements seem to collapse as the excluded riparian nations take measures to be included. For example, Ethiopia’s statements about building major

dams on the Blue Nile prompted President Sadat of Egypt to assert that Egypt would wage war if Ethiopia made plans to build a dam on Lake Tana (Dinar and Wolf 1994a). The Tigris-Euphrates basin countries need not look further for examples as they themselves narrowly avoided military conflict between Syria and Iraq in the mid 1970s (Kibaroglu 2000; Zawahri 2006). The rise in Kurdish militant attacks might also be used by weaker riparians against stronger ones, in this case Syria and Turkey, respectively. On June 8, 2007, the BBC reported that Kurdish rebels had attacked Turkey border patrols in southeastern Turkey the day before (BBC June 8th 2007). In the past, Syria used its support of the Kurdish insurgency as a bargaining chip with Turkey over water on the Euphrates – demonstrating the importance of non-water linkages in hydropolitics (MacQuarrie 2004).

Stable institutions are one way to countering these negotiation tactics; however, in countries where relations are strained, decisions often are made outside of established institutions. Therefore, proactive management strategies at all levels that involve dialogue and cooperation are needed to surmount geophysical stressors. Sustainable management strategies aided by an institution that is capable of adjusting to geophysical, biophysical, and socioeconomic stressors is critical in achieving the interests of the countries sharing a river.

2.6 Managing transboundary basins: challenges and opportunities

Managing transboundary rivers to solve challenging disputes and create cooperative opportunities, as discussed in the previous sections on potential conflict and/or cooperation and transboundary security issues, is a priority. Managing these challenges and opportunities in a sustainable way addresses the two UN 1997 Convention principles of preventing significant harm and having access to reasonable and equitable utilization of resources. Ideally, this would meet stakeholder interests and provide a cooperative platform for all involved parties. Two major aspects are needed to achieve this: 1) a management strategy and 2) an institution capable of implementing the strategy. The focus of this section will be limited to providing a simplistic general management strategy (planning, organizing, directing, and monitoring aspects), and discussion will be limited to the five factors identified as priority challenges and opportunities in the previous sections: 1) climate change, 2) globalization of the economy, 3) geopolitical and cultural values 4) trend shift from water quantity allocation to sharing benefits and 5) the increase in trend from abiding by or signing treaties to cooperation (see Table 2.2 below). The institutional portion will be addressed in the next section. It is beyond the scope of this section to assess detailed implementation and management strategies.

Table 2.2: Management examples versus potential challenges and opportunities facing transboundary water resources.

Challenges and Opportunities	**Few examples of management aspects**		
	Plan	**Organize**	**Direct and Monitor**
Climate Change	Kyoto Protocol (UNFCC framework), crops resistant to drought, flood prevention	Climate data per basin; crop type patterns; flood area identification, modeling	Carbon credit trades; farm drought resistant crops; build dykes or relocate population; form or maintain regulatory institutions
Globalization	Water privatization, larger irrigation plans, Build large dams, Environmental protection	Funding, farmers, non farming (industrial, tourism etc) resources, microcredit	Timely assessment of regulation; create farmers association, create jobs for farmers in urban industrial settings; form or maintain regulatory institutions
Geopolitical, Cultural aspects	Decrease geopolitical tension, and increase cultural values that promote cooperation	Identify geopolitical tension and cultural values; cooperation trends, postulate clear and flexible agreements	Create political will, promote education and or eco-tourism on cultural value sharing; form or maintain regulatory institutions; fund local cultural institutions related to transboundary rivers
From Water Allocation to Sharing Benefits	Agricultural, hydropower, cultural, geopolitical value sharing;	Identify benefits to be shared; assess net benefit win-win scenarios; stakeholder participation; acquire funding	Create businesses that purse water benefit sharing; promote cooperation; learn from models such as NBI; form or maintain regulatory institutions
From Treaties to Cooperation	Cooperation on common or non overlapping use of shared rivers	Identify treaties and cooperations, analyze trends, postulate scenarios	Promote cooperation; form or maintain regulatory institutions

2.6.1 Climate change

A multi-scaled plan is needed to address spatial and temporal effects of climate change on transboundary water resources (Table 2.2). This section will limit the discussion of climate change from the perspective of either too much or too little water; as it is beyond its scope to assess the myriad of factors and complex interactions associated with climate change that affect transboundary rivers. The challenge is to have a management strategy that creates equilibrium between too much or too little water distribution over time and space (Figure 2.3). Regions with limited water need a plan to accommodate not only their current needs, but also future needs. An Intergovernmental Panel on Climate Change (IPCC) report shows the northern and southern parts of Africa facing a decrease of almost 20% in precipitation, whereas higher latitude regions will be facing greater water quantity levels, ranging from a 5% to 20% increase in precipitation (Draper and Kundell 2007). Recommendations for planning in water-scarce areas include, but are not limited to, the creation of water reservoirs, conservation of water resources, water recycling, shift to drought resistant crops, evapo-transpiration and seepage control, desalinization, and education. On the other hand, some recommendations for regions that are expected to face increases in water levels include building dykes, switching to hydrophilic crops, and harnessing more hydropower energy. Some innovative international organizations, nation-states, industries, and individuals are dedicated to mitigating the current and potential threats of climate change. These leading authorities and trendsetters in the arena of climate change causes, effects, and solutions are the pioneers who will both instruct and assist the world in its response to the rising temperatures on Earth.

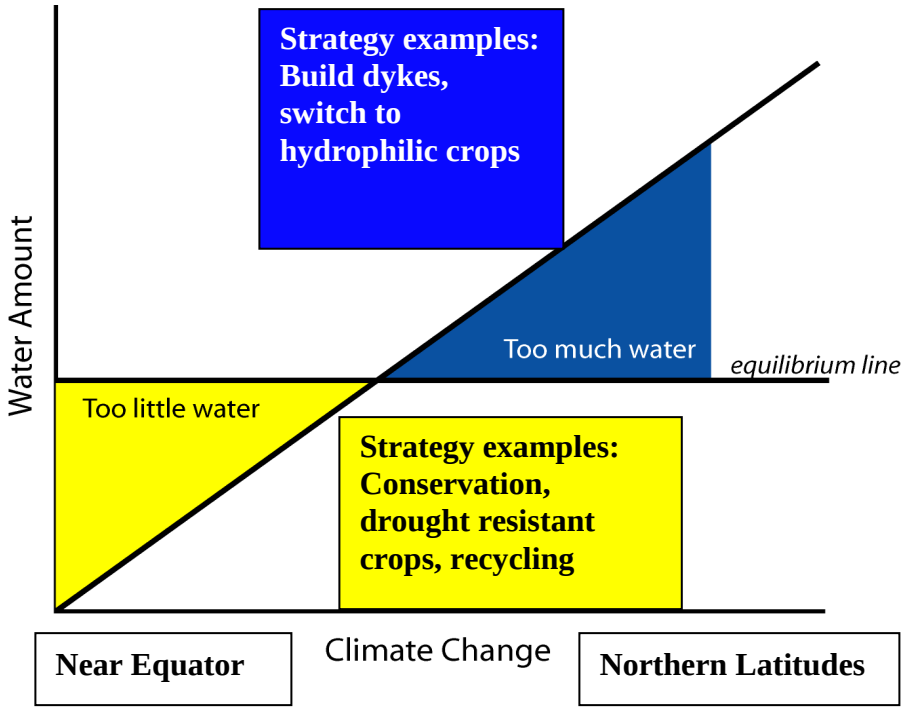


Figure 2.3: General climate change effect, water amount and equilibrium achieving strategy examples.

The United Nations Framework Convention on Climate Change (UNFCCC) and the New Partnership for Africa's Development (NEPAD) are two international organizations that are making significant progress in assessing and preparing for the negative effects of climate change through their collaborative initiatives (Mukheibir and Sparks 2005). The UNFCCC is considered the most universal and proactive authority addressing the issue of climate change. The 189 countries that participate in the Convention recognize that the atmosphere and its climate can be thought of as a shared resource whose stability is affected by all emissions of greenhouse gases (UNFCCC 2009). In cooperation with the UNFCCC Convention, participating governments need to work together in addressing worldwide impacts and reduction of greenhouse gas emissions, ensure involvement and preparedness of developing countries, and coordinate plans for adaptation to the impacts of climate change. The most widely recognized product of the Convention is the Kyoto Protocol, an amendment to the international treaty on climate change that assigns mandatory targets for the reduction of greenhouse gas emissions to participating nations (UNFCCC 2009). The UNFCCC has worked in conjunction with NEPAD to promote strategies by African countries to prepare and adapt to the effects of climate change. Even though Africa has not significantly contributed to the amount of greenhouse gases in the world and its forests have actually helped minimize the carbon emissions of industrialized countries, Africa will most likely suffer the most from the adverse effects of climate change, as its underdeveloped economic infrastructure is highly at risk to climatic hazards. The principal strategies of UNFCCC and the NEPAD Environmental Initiative to combat the negative effects of climate change include:

- integrating climate change considerations into the social, economic and environmental policies and programs in Africa;
- keeping the levels of their emissions under check by periodically or as required providing national inventories of anthropogenic emissions and removal by sinks;
- promoting education, training, and public awareness;

- promoting the sustainable management of sinks and reservoirs of greenhouse gases; and
- promoting and conducting relevant research and cooperating in the exchange of information.

Several projects incorporating these strategies have been designed and are currently underway throughout the African continent (NEPAD 2006). The continued partnership of the UNFCCC with Africa and other countries throughout the world is essential in preparing for and combating the negative effects of climate change on developed and developing countries alike.

On the national and regional scale, Singapore and the state of California have developed innovative planning and adaptations in response to the potential threats of climate change. The scarcity of natural freshwater resources in Singapore has inspired adaptive, creative, and aggressive water conservation practices. Singapore is currently in the process of building facilities to recycle water, desalination plants, and additional catchment areas in order to reduce reliance on foreign water supply, diversify its water sources, and prepare for possible water shortages associated with climate change (Anderson 2003). Similarly, Orange County in California is in the process of commissioning a large water-recycling plant that will treat municipal wastewater before it is used to recharge natural groundwater (Leslie 2004). California has also shown initiative in its recent campaign to lower its greenhouse gas emissions. In 2005, Governor Schwarzenegger initiated a plan for environmental, governmental, and private organizations in California to significantly reduce greenhouse gas emissions over the next fifty years (CECCCA 2009). The aggressive and pioneering approaches to prepare for the effects of climate change exhibited by Singapore and California provide good examples for the rest of the nations and states of the world to follow. Adopting some of these strategies is recommended to nations sharing rivers, especially those located in arid areas.

The farming industry has responded to the potentially devastating consequences of global warming by modifying their practices and products accordingly. William Niebur, Vice-president of the DuPont Crop Genetics Research and Development Group, acknowledges the need for his industry to adapt to climate change and has said that DuPont believes climate change is real and that a holistic approach should be undertaken to prepare the planet for the stressed environment (Lorentzen 2006). Crop-research companies like the DuPont Group have responded to climate change by developing pest-resistant and drought-tolerant crops. This emerging technology is also aiding crop production by allowing for good crop yields under conditions that would have been damaging before such technology was available (Lorentzen 2006). Others in the crop-research industry are using improved soil management methods to reduce greenhouse gases. Methods such as no-till farming (where farmers plant crops without using machines to plow or turn over the soil) cut down on energy use, trap organic material that breaks down to fertilize the soil, and keep carbon in the ground instead of releasing it to build up in the atmosphere as CO_2 (Kruger 2004). Central plains farmers in the U.S. are proactively preparing for global warming by planting crops that require less fertilizer and herbicide applications, using alternative fuels such as ethanol and bio-diesel, capturing methane gas released from livestock operations for energy production, and harnessing wind power. Many are also beginning to sort out water supply problems as warm, dry areas expand, by examining their water rights before shortages happen; assessing decreasing mountain snow-packs; and contemplating water storage facilities (Leslie 2004). The proactive practices exhibited by these individuals and industries will not only help protect their livelihoods from the negative effects of climate change, but will make them increasingly economically competitive. Poor nations located in transboundary water basins could strive to emulate the above models, although it might not be financially and technologically possible for them to succeed. Thus, major international organizations, NGOs, and other capable interested parties should work together with these nations in order to proactively surmount challenges caused due to climate change.

2.6.2 Globalization of the economy

It is important to assess challenges and harness opportunities caused by the ever-growing globalization force in managing transboundary basins. Globalization is defined as "the increasing interconnectedness of people and places through converging processes of economic, political, and cultural change" (Rowntree et al. 2006). As discussed in the section titled "Potential conflict and cooperation," globalization may have negative consequences. Some of these are: 1) big agribusinesses outcompeting small landowners, 2) inequitable wealth distribution between local and global stakeholders, 3) unsustainable outcomes such as the current financial crisis, and 4) significantly harmful impacts on the local ecology and biodiversity. Globalization also creates many opportunities through many ways, including but not limited to: 1) investment as an impetus for economic growth, 2) creation of jobs, and 3) a means to address global environmental issues, such as climate change through the Kyoto protocol. There are several plans to manage these challenges and opportunities in order to achieve the principles of the 1997 UN Convention. For the purposes of this section, we will limit our discussion to the following trends associated with globalization forces: 1) water privatization, 2) larger irrigation plans, and 3) building large dams.

Water privatization is a growing trend that is expected to create challenges and opportunities. From 1990 to 2002, the number of people receiving water from private institutions increased from 51 to 300 million (Palaniappan et al. 2004), and it is just a matter of time before this increase will be significant issue at the transboundary level. In a BBC report on June 2, 2003, Michael Klein, the Vice President for the Private Sector Development in the World Bank, argued that privatizing the water sector might result in saving water (which would help in circumventing the impending decrease of water due to global warming) and at the same time makes it affordable to the public (Klein 2003). In another BBC report, anti-privatization proponents, such as Trevor Ngwan, stated that private companies would work for profit and that there were several cases such as in South Africa where access to water was cut off (BBC, 2004).

Privatization could be useful in that it can bring much-needed investment to poor countries, decrease government corruption, and discourage water wastage, among other things. Privatization, if correctly applied, has the potential to ensure that some social factors are met while managing water as an economic good. The Pacific Institute Principles (Palaniappan et al. 2009) portray the management of water privatization that are also applicable at transboundary scale level. The principles suggest managing water both as a social and economic good (see Table 2.3). Implementing management strategies guided by these principles is expected to result in a more equitable distribution of transboundary resources. It is recommended that policy makers learn from or adapt the methods of successful organizations that have achieved such a purpose (Table 2.3).

Table 2.3: Pacific institute principle: water privatization strategies (source: (Palaniappan et al. 2004)).

Specific Strategies	**Model Case Studies to emulate in Transboundary Scale strategy**
Human sustenance	Public-Private Partnership (PPP) model in Durban, South Africa
Ecosystem sustenance	Good relations between the Department of Environmental Protection(DEP) and watershed communities in New York City, USA
Help fund poor people; Price regulation to achieve fairness; Price increase should relate to increase in provision by private utilities	Tegucicalpa model (concerted effort including: UNICEF, the National Autonomous Water and Sewage Authorities (SANAA), Executive Unit for Settlement in development (EUBD), Non-governmental Organizations (NGOs), Cooperative Housing Foundation (CHF)), Honduras
Make sure that funding help makes financial sense	1. Use of blockrate method in La Paz/El Alto, Bolivia 2. Use of water stumps for the poor in Santiago, Chile
The provision evidence that new projects are less expensive than maintaining or improving existing ones	Singapore Public Utilities Board (PUB), Singapore
Officials should retain ownership of water	Edwards Aquifer Authority, Texas, USA
Regulation should be conducted by government	The Office of Water Services (OFWAT) in UK
Constant checking agreed agendas versus implemented ones	Société de distribution d'eau de la Côte d'Ivoire (SODECI)
Prior to saying yes to privatize water, arrangement regarding conflict resolution methods should be made; non-biased actors should be used to assess progress and abiding of agreed purposes	Bureau of Government Research (a local independent research group), New Orleans, USA.
All interested and water users should be able to participate in decision making	1. Orangi Pilot Project, Karachi, Pakistan 2. Public Limited Company Model, Netherlands

Secondly, expanding irrigated farmlands, associated with Green Revolution technology, is a predominant trend in the globalizing world. Although increased irrigation creates more economic growth, the increase itself should not go unnoticed. Increased irrigation generally means a larger land area under irrigation and thus more transboundary water usage. The increase in water usage might lead to competition over water as a resource. Thus, increased irrigation may produce many disenfranchised small farm communities and create threats to national food security. For example, in Brazil, the decline in coffee prices that resulted from increased irrigation has hurt small landowners because they are less likely to be able to compete with large-scale producers (Watson and Achinelli 2008). Farmers in the Andhra Pradesh, India, have also been negatively affected by rapid, unregulated growth in the private sector (Aggarwal 2005). These local-scale farmers are increasingly finding it hard to compete against those who have bigger irrigation lands. The increase in food crisis due partly to globalization has also led some countries to take measures to ensure food price security. India imposed restrictions on exporting non-basmati rice to stabilize inflation (BBC April 1st 2008). The disenfranchisement of small landowners may be viewed as an inequitable situation. Recommendations for improving these conditions include providing stakeholder options and subsidies to create farming communities, encouraging micro-loans similar to Grameen Bank, and the creation of jobs other than farming.

Third, national policies, especially in developing countries, tend to favor the building of big dams to satisfy various needs including domestic, hydropower, irrigation, navigation and fishery purposes, rather than small dams, which have fewer returns. Although bigger dams create these opportunities, they also incur threats. Decades ago, costs of big dams were underestimated because factors such as ecological impacts were not considered (Gleick 2000). Currently, institutions that fund big dams, such as the World Bank, and rich nations require stringent consideration regarding ecological impacts. The World Bank would no longer provide funding toward the building of the Three Gorges dam in China after the negative ecological impacts (e.g., the endangered

Yangtze dolphin) were realized (Rowntree et al. 2006). For environmental reasons as well as maintenance costs, there are many case studies that are amenable to policies that favor dam removal (Gleick 2000). The number of dams being commissioned increased from 913 in the 1940s to 5,418 in the 1970s, and then decreased to 2,069 in the 1990s (Gleick et al. 2009a). Environmental problems are not the only issue. Some local populations have also been negatively affected due to the building of big dams. In India, the Sardar Sarovar Project on the Narmada River caused local populations such as the Adivasis to relocate because their traditional lands were inundated (Whitehead 2007; Armstrong 2002). During the building of the Aswan dam in the Nile Basin, the potential that the local Sudanese Nubians would drown if they did not move from their ancestral land was viewed negatively by the Sudanese (Collins 2002). Similarly, the Turkish Ilisu dam was not built due to concerns over potential impacts on Kurds (MacQuarrie 2004). A report by the World Commission on Dams (WCD) also criticized dams and influenced many funding organizations against funding the construction of large dams (World Commissionon Dams 2000). Future and ongoing dam construction needs to involve all stakeholders and also consider costs associated with ecology and cultural values in order to achieve socioeconomic and biophysical securities.

2.6.3 Geopolitical and cultural values

Including the influence of intangible aspects of water to the challenges and opportunities in the future is essential in achieving a more effective and efficient outcome. In addition to economic benefits (such as hydropower) and water quantity (such as domestic use), intangible aspects are of growing importance to stakeholders. Intangible aspects in transboundary rivers include geopolitical and cultural values.

In the previous section, Transboundary Security, the capacity of basins to withstand geopolitical pressures specifically due to water was discussed. In this section, geopolitical aspects that are not specific to water but still influence the management of

water will be discussed. Geopolitical interests non-specific to water affect transboundary water management in several ways. For example, geopolitical cooperation between Egypt and Sudan was instrumental in creating agreeable terms during the 1959 Nile Treaty. It was not until a government amicable to Egypt came into power in 1958 that the two countries cooperated on the Nile (Collins 2002). Similarly, a geopolitical interest of the three Tigris-Euphrates Basin countries (Turkey, Iraq, and Syria), is their resistance to Kurdish separatism. During the Saddam era, the Turkish government was induced to cooperate regarding the flow of shared rivers with Iraq, and during the Assad Senior era with Syria, it was allowed to confront Kurdish rebels within Iraqi territories (MacQuarrie 2004). The strategy is not viewed as successful by all stakeholders; the former Iraqi government might have regarded it as a successful strategy, while some Kurdish populations might have regarded it as a disastrous one. A strategy that will meet the interest of all these stakeholders, for example, through poverty alleviation, might be more acceptable.

Cultural and related values associated with water are a growing trend. This is especially true in the management of transboundary basins, as international organizations are moving towards integrated river basin management. The outcomes from analyzing and identifying cultural factors that affect water management can be used in implementing equitable, efficient and effective results. For example, the commoditization of water has found resistance in Islamic countries, although water trading is allowed to recover provision costs (Faruqui 2001). In the Columbia River basin, cultural values such as endangered species, Native American rights, and environmental quality were not addressed well in the CRT of 1964. At present, however, due to changes in these values (because of a postindustrial economy in USA and Canada that place more importance on the environment relative to 1964), there might be a change in the treaty by 2014 (Muckleston 2003). These cultural values are very numerous and vary spatially and temporally; thus, stakeholder involvement is important because the more the information about their interests is available, the higher the cooperation potential. Formation and maintenance of economic sectors that

make use of cultural values such as eco-tourism might satisfy stakeholders, especially those at the local scale. The creation or maintenance of civic societies such as in the Nile and Mekong basins could achieve successful geopolitical and cultural strategies and improve equitable socioeconomic conditions at local and national scales.

To achieve such an objective, several factors need to be organized. The organization or creation of platforms for stakeholders, political will, promoting education and/or eco-tourism on cultural value-sharing, as well as the formation of regulatory institutions are some, but not all of the necessary factors. Similar to climate change and globalization aspects, monitoring geopolitical and cultural values is complex and an ever-changing process. Cooperation in these values, particularly geopolitics, is better left in the hands of national political leaders. Cooperation can be tricky, since it might work contrary to national politics. For example, cooperating in sharing geopolitical values between Kurdish people living on the borders of Turkey, Iraq, Syria, and Iran might not be viewed in good light by the governments of the four countries involved. In addition, geopolitical ambition by Turkey to join the EU might influence it to sign the 1997 UN Convention (so far it has not). A clear procedure for monitoring these situations in order to decrease the tensions mentioned above seems complex and unlikely to be worked out. Perhaps regulation maintained by a constant national security apparatus among stakeholder countries is more desirable.

2.6.4 From water allocation to benefit sharing

A plan that assesses the water benefit sharing process seems to be gaining prominence among experts in the study of transboundary cooperation. (Sadoff and Grey 2002), argue four points where perceived benefit cooperation could result in increased returns: 1) cooperation leads to better river management; 2) due to 1, there would be higher income from the river; 3) reduction in the management costs of rivers due to reduction in dispute; and 4) benefits from 3 give way to cooperation in other sectors not related to water. Nations sharing rivers can either find non-overlapping resources

or share overlapping benefits, which can result in greater total benefits among or between the stakeholders. Some of the benefits that can be shared include: hydropower energy, eco-tourism, flood control, geopolitical, and irrigation. Hydropower energy sharing is generally a non-overlapping resource that can be shared between countries (Muckleston 2003). Flood-control benefits not only create economic benefits but also geopolitical and ecological benefits. Constant flooding of the Kosi River, shared by India and Nepal, has displaced millions of people and resulted in fatalities in August 2008 (BBC August 8th 2008). Through cooperation among the two riparian states, the river seemed to have been successfully diverted on January 27, 2009 (BBC January 27th 2009). The Columbia Basin, where the USA and Canada share hydropower and flood-control benefits equally is perhaps the best example of benefit sharing (Muckleston 2003). Another basin where the benefit (irrigation) sharing principle has been implemented is the Senegal River Basin (Delli Priscoli and Wolf 2009). The countries sharing the Nile Basin are endeavoring to implement the benefit sharing principle.

Several factors including but not limited to information on benefits to be shared, investment, stakeholder input, and a regulatory institution need to be organized (Table 2.3). Researchers are needed, especially economists, who can gather information, analyze the data and produce scenarios that can create a win-win situation or better alternatives. Benefit sharing mingled with cooperation that does not compromise treaties might achieve the 1997 UN Convention principle of reasonable and equitable utilization of transboundary resources.

2.6.5 From treaties to cooperation

In this chapter, treaties are defined as official agreements between or among nations on how to share transboundary resources. Although treaties have been instrumental in bringing rivals to cooperate, they have sometimes been blamed by stakeholders involved as too binding, non-flexible, outdated, and in need of revision. In the Nile

Basin, for example, some of the stakeholder countries, such Ethiopia, have voiced opposition to the 1929 and 1959 Nile treaties between Egypt and Great Britain and Egypt and Sudan, respectively. Revisions might not be found agreeable by all the stakeholders involved who prefer to uphold the status quo, especially Egypt. A recent phenomenon, therefore, has been an increase in cooperation with no requirement to sign binding treaties. The increased trend in information sharing, such as among the Nile countries, can be argued to have achieved some of the four perceived returns stated by Sadoff and Grey (2002). Measuring the successes and failures of cooperation in which no treaty was signed is a study area that we recommend to be pursued. The advantage of cooperation is that it is relatively non-binding and if the projects being envisaged tend to be unfavorable in practice, then aggrieved stakeholders can annul the cooperation. The disadvantage is that it is hard to enforce non-binding (non-treaty) provisions based on cooperation alone.

Organization of several factors including but not limited to information regarding type, number, successes, failures and location of treaties and cooperation; data analysis on trends, various applicable scenarios, political will, clearly stated guidelines or treaties, and a regulatory institution is needed for a successful management strategy to be realized (Table 2.3). Expert mediators and lawyers are also needed to stir cooperation processes to create an equitable use of transboundary resources and avoid the pitfalls associated with enforcement of cooperation frameworks rather than those based on treaties.

2.7 Institutional capacity to face the challenges ahead

Ideally, institutions should fulfill the desires of various stakeholders and should be capable enough to withstand the socioeconomic, biophysical, and geopolitical stressors. They should also be able to implement and monitor management strategies successfully while achieving the UN 1997 Convention goals: 1) to not significantly harm fellow stakeholders and 2) to utilize shared river resources equitably. Identifying the factors that make institutions weak or strong is crucial in order to have good governance. In this section, the vulnerabilities and resilience of these institutions, especially RBOs, will be assessed in order to propose improvements in their capacity.

2.7.1 Institutional vulnerability and resilience

Institutions have both vulnerabilities and resiliencies. The concept of vulnerabilities and resilience in relation to water and politics is described by the term "hydropolitics" (Wolf 2007). Hydropolitical vulnerabilities are those aspects that make a basin susceptible to politically riskier disputes, while the capacity of a basin to adapt and successfully withstand geopolitical, biophysical, and socioeconomic stresses is described as hydropolitical resilience (Wolf 2007). Assessing vulnerabilities and resiliencies is important, as the outcomes can be used to strengthen weaknesses in transboundary institutions and enable proactive adaptations in RBOs.

The following factors can contribute to hydropolitical vulnerability: rapid environmental change, rapid population growth, unbalanced economic growth, major unilateral development projects, the lack of institutional capacity, and generally hostile relations (Wolf 2007). An example that refers to some of these vulnerabilities is the Tigris-Euphrates basin. The politicization of the basin to high-level politics involving heads of states undermined the institutional capacity of the Joint Technical Committee (JTC) representing the three riparian countries of Turkey, Iraq, and Syria; and all communication between JTC members has been conducted using diplomatic channels

(Zawahri 2006). The JTC failed and had its last meeting in 1993 due to mismanagement, disagreements on water rights, insufficient funding, and lack of institutional support leading to geopolitical stress (MacQuarrie 2004). The Turkish position is that it has absolute territorial sovereignty, while Iraq and Syria are holding on to their historic use. This has resulted in major disagreements resulting in institutional failure.

Factors that contribute to hydropolitical resiliency include international agreements and institutions such as river basin organizations, a history of collaborative projects, generally positive political relations, and higher levels of economic development (Wolf 2007). A very good example of hydropolitical resiliency is the Columbia River Basin treaty. The two countries sharing the basin, Canada and the United States, signed an international agreement in 1964. The countries have had a harmonious historical relationship with no significant geopolitical tensions. Both nations also enjoy higher economic levels of growth. The resilience factors discussed above should be strongly considered in the creation or maintenance of capable institutions.

2.7.2 Institutional capacity

The success of a treaty or agreement is based on its implementation. The implementation of an agreement is based on the resiliency and capacity of the governing institution or management body. Institutional capacity was the key in resolving disputes of transboundary rivers located in arid areas (Wolf et al. 2005). There is no set model that fits all the needs of shared river institutions (Eaux Partagées 2002; Draper 2007). In this section we will discuss the following critical components of an institution to manage shared river resources, as developed by Wolf et al. (Wolf 2007): 1) adaptable management structure, 2) clear and flexible criteria for water allocations and water quality management, 3) equitable distribution of benefits, 4) concrete mechanisms to enforce treaty provisions, and 5) detailed conflict resolution mechanisms. In assessing these five factors, we will state examples primarily from the

Tigris-Euphrates Basin as a case study, as it is one of the few remaining basins that does not have a clearly defined treaty or institutional framework.

1. An adaptable management structure that is resilient to geopolitical, biophysical, and socioeconomic stressors is crucial to a sustainable institution. For example, the Mekong Committee survived the cold war (a geopolitical stressor) after it was interrupted for some period (Browder 2000). On the other hand, due to geopolitical stress, the JTC failed in the Tigris-Euphrates Basin because all communication channels were done through diplomatic channels (Zawahri 2006). Other important aspects that are related to the adaptability of an institution also include its mandate, who should be included or excluded, and where it should be based (Wolf 2007). The new institution for the Tigris-Euphrates basin should have members from the different riparian countries: Iraq, Syria, Turkey, and Iran. Human resources and technical training skills should be offered to the members (Wolf et al. 2005). It should have a mandate to meet outside diplomatic channels and pursue official lines when the representatives of the new institution cannot reach an agreement. There also should be a more cooperative framework among the different individual members representing their countries if they have amicable personalities. If a new institution is being formed, the location should be rotated through the different countries.

2. Clear and flexible criteria for water allocation and water quality management and concrete mechanisms to enforce treaty provisions (Wolf 2007) are necessary for sustaining an institution. There should be a viable monitoring procedure mechanism that checks on whether the various stakeholders are meeting their responsibilities. For example, the Iraqi claim that Syria should allow 60 percent of the Euphrates to flow to Iraq should be monitored (Wolf 2001). Water quality is also a main issue in the region, especially for Turkey, since it is trying to join the EU, which has a high water quality standard due to

the European Union Water Framework Directive. In addition, the quality of the marshland in Iraq should be monitored because it is an indicator of good environmental management; this might help in procuring funding from various international donors. The 1971 Ramsar convention regarding the conservation of wetlands is a very good example (Ramsar Secretariat 2010). For those pursuing the cooperation framework rather than treaty, ingenious enforcement mechanisms need to be developed.

3. The equitable distribution of benefits principle, as well as the equitable distribution of costs, is crucial in increasing cooperation among the stakeholders. Inequitable distribution of costs, such as those borne by the Native Americans in the Columbia basin, should be avoided because this leads to conflict. Similarly, inequitable distribution of benefits may result in conflict, too. The Southeast Anatolia Development Project has been criticized by Kurds for providing more benefits to Turks rather than to the Kurdish population – a minority in Turkey but making up more than half of the population in Anatolia (MacQuarrie 2004).

4. Concrete mechanisms to enforce treaty provisions or agreed cooperation factors strengthens the institutional capacity of RBOs. The Indus water treaty between India and Pakistan is often cited as a success as it has relatively clear mechanisms (eastern tributaries of the Indus basin to Pakistan and the western to India) with the World Bank being the guarantor (Iyer 2003; Zawahri 2009). Whether countries opt to have a treaty or a non-binding agreement, clear mechanisms are needed to enforce and achieve the purposes of cooperation.

5. Detailed conflict resolution strategies are needed in order to make sure that the institution runs smoothly without any hurdles. Conflict resolution mechanisms such as those found in relatively successful models can be used. Skilled negotiators used the “best alternative to a negotiated agreement” (BATNA)

and “zone of possible agreements” (ZOPA) approaches in the reputedly successful treaty, the Mekong Agreement (Browder 2000). A plan that includes a neutral mediator (similar to the role played by the World Bank in the Indus Treaty) is also recommended (Zawahri 2006).

2.8 Conclusion

Transboundary river basin resources are being utilized at an increasing rate. The increase in use is mostly associated with growing population and economic development factors. This chapter discussed insights regarding 1) stakeholder interests, 2) current and potential conflict and/or cooperation trends, 3) transboundary security, 4) management strategies and 5) institutional capacity in shared rivers.

Although more data on the current status of transboundary water management has yet to be compiled to substantiate our preliminary findings of significant increases in the trends towards cooperation rather than conflict, we are hopeful that our current international-scale data indicate a significant decrease in conflict. Event data collected so far show that cooperative incidents far outnumber disagreements. In addition, conflicting event numbers or incidents seem to be very low in water-abundant regions. Regions that have conflict seem to lack institutions or have weak ones. In addition, conflict seems to occur in basins where some or all of the stakeholder nations are or are planning to pursue unilateral action in utilizing transboundary water resources. In the future, the following factors are identified as priorities that are expected to affect the management of conflict and/or cooperation trends: climate change; globalization of the world economy; geopolitical and cultural values; the increasing trend to share benefits rather than quantity; and the increase in cooperation without signing binding treaties.

Continued assessment of the changing needs and interests of stakeholders in transboundary rivers remains an important challenge as it helps define effective strategies. There are similarities and differences in the needs of local, provincial, national, regional, and international stakeholders. All stakeholders have overlapping similar uses or interests regarding the use of transboundary rivers. These uses can range from domestic purposes to irrigation to hydropower. Differences in these stakeholder interests in addressing transboundary river policies seem to be more related to priority rather than to the type of use. For example, in the past and present, irrigation is a priority in the Nile countries, while the future trends show an increase in priority for hydropower utilization in upstream. These uses show non-overlapping utilization of the Nile, which usually decreases conflict. The insights obtained from assessing the stakeholder interests are as follows: 1) at the local scale, stakeholder participation is identified as a key component; 2) at the provincial scale, there is a preference for larger projects and a bias toward urban populations in economically developed nations; 3) at the national scale, shared rivers are just one component of a myriad of factors to be considered in geopolitical decisions; and 4) international stakeholders have tremendous influence in transboundary water usage, especially in developing nations.

Safeguarding transboundary water security is of paramount importance to riparian nations. Transboundary basins have the highest degree of water security when the stakeholders are resilient to biophysical, socioeconomic, and geopolitical stresses. Biophysical stressors, which include water quantity, quality, and environmental factors, are important because they affect water scarcity or abundance or the health of the environment. Socioeconomic stressors are those that affect the social and economic well being of a society. A societal crisis related to transboundary river use could potentially lead to negative consequences resulting in social instability, poverty, or political change. Geopolitical stressors cause vulnerability in a basin due to relations among neighboring countries, position in the basin, or international standing. Often political pressures over water are lessened through linkages to issues other than

water, such as oil or trade. Institutions are key elements to absorb biophysical, socioeconomic and geopolitical changes, thereby enabling sustainable cooperation over water rather than conflict.

Several management strategies were discussed through five subsections in response to the five potential threats and opportunities discussed in the section titled potential conflict and/or cooperation trends. Findings include the following: 1) Climate change will result in either too much water or too little water for shared water stakeholders. Regions facing water scarcity should be proactive by using various water conservation measures, as well as switching to drought-resistant crops. 2) Due to globalization, several opportunities and challenges are expected to affect transboundary basins. Some of these are: water privatization, larger irrigation areas and the building of dams. Regarding water privatization, this chapter discussed that water should be treated both as a social and an economic good. As for the increase in irrigation sizes, in order to create equitable distribution of benefits between small landowners and large ones, several strategies, such as associations of farmers and subsidies, were suggested. Dam building, as a strategy, brings both benefits (for example increase in irrigation thus leading to higher benefits) and costs (disruption of downstream habitat and displacement of populations). Thus, stringent methods to assess these costs before building were also recommended. 3) Intangible factors such as geopolitical and cultural factors were also discussed. The discussion suggested that geopolitical values are complex and changeable due to the political landscape; as such, no clear assessments could be put forth. The promotion of economic sectors that encourage the use of cultural values as well as the creation of civic societies that represent and encourage stakeholders at all geographic levels are recommended. 4) The increase in the phenomena of sharing benefits rather than quantity is an opportunity that could be harnessed positively. Studies indicate that by cooperating and sharing the benefits, stakeholders are increasing the benefits to and from the river, thereby decreasing management costs as well as improving relations among or between riparians in other sectors besides water. 5) Another phenomenon that goes hand in hand with benefit-

sharing is the trend towards cooperation without complying to or signing a binding treaty. Although this trend needs more assessment, there are indications of projects in planning stages or already implemented through cooperation, which seem to be producing positive results.

Finally, this chapter assessed the role of institutions in managing transboundary basins. It is important to have an institution capable of implementing management strategies regarding transboundary rivers. Identifying the weaknesses (vulnerabilities) and strengths (resiliency) of an institution is key to its creation or maintenance. Resilient institutions tend to be associated with richer countries with no or very low geopolitical tensions among them, as well as the existence of a governing body or institution. The following key factors were suggested in the formation or upkeep of institutions to increase their capacities: 1) adaptable management structure, 2) clear and flexible criteria for water allocations and water quality management, 3) equitable distribution of benefits, 4) concrete mechanisms to enforce treaty provisions, 5) detailed conflict-resolution mechanisms.

3 ALIGNING THE PRINCIPLE OF EQUITABLE DISTRIBUTION OF BENEFIT WITH THE 1997 UNITED NATIONS CONVENTION ON THE LAW OF THE NON-NAVIGATIONAL USES OF INTERNATIONAL WATERCOURSES

Biniam Iyob

The previous chapter addresses general challenges and opportunities in managing transboundary basins. Following its discussion regarding the shift from water allocation to benefit sharing, this chapter discusses the alignment of the benefit sharing concept with existing rules, specifically the 1997 UN convention.

3.1 Abstract

This chapter examines the potential for the principle of "equitable distribution of benefits" as a mechanism for cooperation among several stakeholders competing for benefits accrued from freshwater transboundary rivers. The EDB principle, as promoted by most development agencies, highlights the value of shared benefits rather than the allocation of water resources to specific claimants. The objective of this research is to disentangle the tangible and intangible barriers that stand in the way of ratifying and implementing conventions and treaties that seek to facilitate cooperation among stakeholders over how finite water resources are utilized. This chapter seeks to provide conceptual arguments that align the objectives of the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses in order to meet development aspirations, poverty alleviation, sustainable management, and conflict resolution goals. The basins of the Nile, Jordan, Mekong, Indus, Columbia, and Danube rivers were used as case studies because they represent different economic and hydrologic geographic locations. This chapter argues that a shift from the redistribution of existing benefits to a wider scope that highlights specific potential net benefits accruing from the resources provides a conceptual bridge between conflicts over competing "historic rights," and that national rights to "security". The shift to net benefits accruing from shared basins provides a window for realigning the debate between upstream and downstream countries with emergent norms of equity embedded in contemporary international conventions. The chapter also suggests the following four-stage process as steps to enhance implementation of benefit sharing projects: 1) the identification of benefits to be shared, 2) the benefit costs analysis, 3) the involvement of stakeholders regarding the distribution of costs and benefits in an equitable manner, and 4) management of projects that include: planning, organizing, executing, and evaluation stages.

Keywords: 1997 UN Convention, Benefit Sharing, Equitable Distribution of Benefits, Transboundary Rivers

3.2 Introduction

The utilization of transboundary basin resources is increasingly been seen as important in achieving the goals of those stakeholders who share them. Transboundary basins are defined as rivers, groundwater, or watersheds that cross national or intra-national boundaries (federal or autonomous entities). The general objective of this dissertation and this chapter is to discuss concepts that promote sharing benefits derived from shared basins in order to achieve the following four anticipated stakeholder goals: development aspirations, poverty alleviation, sustainable water management, and conflict resolution. The need to share resources gives rise to complex relations among several stakeholders exercising different degrees of control over the shared resources. International treaties, agreements, and principles are some of the major mechanisms used to minimize detrimental effects and maximize resource use and cooperation among stakeholders. The most influential of these international agreements is the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses. The following three statements summarize the objectives of the convention: 1) the avoidance of significant harm, 2) the reasonable and equitable utilization of transboundary basins, and 3) the obligation to consult fellow riparians regarding the utilization of transboundary basins (Salman 2007; Delli Priscoli and Wolf 2009). In this chapter, the focus will be on the first two. The 1997 Convention, although accepted by more than 100 countries, is still not ratified. As of 2007, only fifteen nations have ratified it (Salman 2007). Although not ratified yet, the 1997 Convention has been instrumental in bringing cooperation among countries sharing a basin. Due to its ability to bring cooperation, this chapter proposes that new principles should align or be consistent with the 1997 Convention, thereby enhancing the cooperation already gained and making inroads towards successful implementation of international agreements.

An emergent principle with a high potential for fostering a network of cooperative relationships among competing stakeholders is what has come to be known as

equitable distribution of benefits (EDB). The objective of this chapter is to align the EDB principle with the 1997 Convention and suggest recommendations for successful implementation. EDB focuses on identifying the potential of shared benefits that can be accrued by consensus-based utilization of resources, instead of redistribution of water quantity allocation. The shift from water quantity allocation to sharing benefits is occurring due to the inability of past and existing treaties to meet present and future demands. For example, in the Nile Basin, Egypt and Sudan allocated water quantity between the two countries based on population size needs (Delli Priscoli and Wolf 2009). Currently, the 1929 and 1959 treaties are being criticized as being unfair to the remaining eight countries, which also share the basin. The concept of EDB is firmly grounded in political, economic, and common-pool natural resource theories (Delli Priscoli and Wolf 2009). EDB is an ideal construct with prospects for facilitating win-win solutions to replace the zero-sum game that has characterized relations between upstream and downstream countries. The proposed win-win is allowed by the EDB as the benefit basket or pie of benefits is increased due to four factors (Sadoff and Grey 2002). First, it would lead to an increase in benefit to the river, such as water quality improvement, leading to increased benefits from the river. Second, benefits from the river would be enhanced due to cooperative management of the shared basin. Third, due to reduction of costs, which would be shared as well as reduced due to decreased conflict, the benefit pie would be increased. Fourth, the benefits discussed in the above three would spill over to other benefits, such as geopolitical cooperation and trading in other economic sectors besides those directly from the shared basin resources. Aside from the maximization of benefits, a major concept of the EDB principle is “equity,” which requires a redefining of what “sharing” of potential as well as actual “benefits” accrued from a freshwater resource with multiple national claimants entails. All actors, including those claiming acknowledged historic rights, as well those demanding recognition of their hitherto unacknowledged ownership, generally endorse the principle of shared- benefits and more or less agree in finding commonality in defining benefits, but they rarely agree on how “equity” is defined and how sharing is measured in terms of resource use.

Finding commonality in defining benefits, type, priorities, and geographic distribution of benefits are critical issues that need consideration. Commonalities in these three issues are necessary factors in achieving standardized communication and therefore cooperation among the stakeholders involved. Defining benefits, although difficult, pales in comparison when seeking a shared conceptualization of equity, which will be discussed later. In this chapter, benefits are defined as those resource management strategy returns that "promote the well being" (Merriam-Webster 2010) of the stakeholders that share a transboundary basin. Aside from defining benefits, another issue that needs to be considered is the type or category of benefits. The benefits of water include, among others, tangible ones such as agricultural, hydropower, drinking, navigation, ecological, tourism, and industrial, as well as intangible ones, such as cooperation and biodiversity values. In implementing benefit-sharing projects, priorities may be given to some types of benefits versus others. For example, irrigation and hydropower benefits were given more priorities than were biodiversity and indigenous rights during the ratification of the Columbia River Treaty in 1964 between the United States and Canada. The two nations share these two benefits equally (Muckleston 2003). The geographic distribution of these benefits and how to equitably share them is another issue that needs more research. Distribution of costs and benefits geographically is a very controversial topic due to who gets to decide the sharing method and who gains and who loses. The controversy is further aggravated when the geographic scale becomes more localized. A treaty signed by riparian representatives of the countries may be defined as being equitable on a national scale, but this may not be true on a more localized level. Moreover, the principle of EDB has ambiguity in addressing the distribution of benefits, as there is no distinction between gross and net benefits. International organizations such as the World Bank, which funds water development projects (and is a major promoter in researching the EDB principle), are increasingly demanding the inclusion of stakeholders from local populations, as well as from other non-representative stakeholders, such as the environment. The distribution or sharing of benefits among the stakeholders involved is an equity issue, which is discussed in the following paragraph.

Equity is a vague concept as its definition remains contextual and therefore is a source of ambiguity. Equity definitions or theories are discussed in many disciplines but especially in welfare economics. The discipline of economics focuses on measuring preferences and thereby devising methods on how to satisfy them (Jaeger 2005). Equity concepts, however, are not only economic, but also morality issues (Jaeger 2005). Equity issues are closely related to fairness and justice concepts and consequences (Jaeger 2005; Pascuala et al. 2009). Morality issue can further be defined through their focus on individual concepts (deontological) or according to their effects after implementing the concepts (Jaeger 2005). In this chapter, it is inherently assumed that the concept of equity relates to the distribution of socioeconomic factors in a society according to an agreed set of principles (Corbera, Brown, and Adger 2007). This dissertation inherently defines equity as the "ideal" situation where all involved stakeholders sharing a river basin find consensus regarding the processing and distribution of net benefits in space and time. In practice, while the consensus on equitable sharing of the benefits accruing from finite resources presents new opportunities for cooperation among competing actors, the focus on reaching agreement on how equity is defined produces conflicting interpretations. The absence of clearly defined parameters of equity is not necessarily negative, since ambiguity allows for expanding or contracting definitions in ways that enable inclusion of factors hitherto excluded. Thus, the opportunities that arise from new agreements necessitate a redress of past inequities and the prevention of future detrimental effects in order to implement existing conventions and treaties that will produce concrete benefits to be shared among all. Since the definition and implementation of equity concepts in transboundary basins differ among geographic regions, this chapter assesses examples from six basins: the Nile, Jordan, Mekong, Indus, Danube and Columbia. The expected lessons from these six basins are assumed to reflect and are thus more likely to be transferred to the remaining 270 transboundary basins. These basins, discussed in the following paragraphs, are chosen because they represent different hydrologic, location, economic development, and quantity of stakeholders factors.

Political considerations emerge as very important factors in defining equity when linked to competing claims of "historic rights" and "reasonable and equitable utilization" in the Nile Basin. The passage of time and the ending of colonial empires and rule by hegemonic groups associated with or opposed to Cold War politics are factors that were absent when some treaties were ratified in the 20th century. Recognition by Great Britain of the rights of Egypt provided a precedent for bilateral agreements of water-sharing between Egypt and Sudan, while excluding the upstream countries. The 1929/1959 treaties and agreements were, therefore, based on affirmations by Western powers of "historic" rights leading to negation of comparable "historic" rights of other countries such as Uganda, Rwanda, or Eritrea. Whereas economic considerations led to the analysis of the amount of water usage per population, past historical encounters with international powers (i.e., Anglo-Egyptian Condominium, Belgian rule in the Great Lakes Region, British and Italian colonial rule in East Africa) have left legacies of inequitable use between upstream and downstream countries of the Nile Basin. In the case of Ethiopia, which avoided colonial rule and engaged in treaty-making with European powers, we find that Ethiopian claims to "equitable utilization rights" were considered a threat to the survival of the downstream countries.

The Jordan Basin, a much smaller geographic area, presents a network of cooperative behavior emanating from a varied calculus for water allocation which has resulted in relatively successful scenario for the stakeholders. The exception to this cooperative scenario is the plight of the Palestinians, whose lack of representation in the international state system has left them bereft of a clear voice in the negotiation process and any sort of plan for equitable sharing of much-needed water resources. Surprisingly, the countries of the Jordan Basin whose members have been engaged in political and armed conflicts as well as resource conflict rhetoric, have developed cooperative behavior linked to a common survival and shared benefits. Despite the yet-to-be ratified 1953-1955 plan, member countries have adhered to both fixed allocations and shared benefits, thus, pointing to the potential for the success of the

EDB principle. This chapter highlights the importance of re-examining the issue of "equity" versus "equal" in terms of allocations of cubic meters of freshwater, especially in political hot spots such as the Middle East, where cooperation over resources (with the exception of the complex Palestinian equation) has become the norm since the latter half of the 20th century.

In the Mekong Basin, member countries appear to be endowed with relatively equal quantities of water resources, which minimizes conflicts. Despite the existence of major political and ideological differences between the economic Chinese giant and the less developed countries such as Burma, Laos, and Vietnam, and the more industrial Thailand, conflicts over additional benefits, i.e., hydropower, have yet to emerge. The UN Convention of 1997 (See articles 5 and 6 of the Convention in the Methodology section) addresses the equitable utilization of water benefits mostly through the "no significant harm to other stakeholders" and "reasonable and equitable utilization" statements. The combined utility of the EDB principle and the framework provided by the 1997 UN Convention can be demonstrated in the absence of conflict and the ratifications of the 1957/1995 agreements, which have ensured stability and shared benefits.

The Indus Basin also reflects a long-lasting relationship of cooperation between two contending countries – India and Pakistan – despite their political and ideological conflicts that influence their relationship in the international state-system. The history of the fractured sub-continent in 1947 has produced numerous conflicts – inter-communal, religious, as well as military face-offs. Yet, notwithstanding all these factors, the Indus Water Treaty of 1960 has withstood the test of time and ideological fervor. Geographic factors, much like in the Mekong, with both claimants having access to relatively equal allocations, have minimized resource conflicts. Again, this begs the question of re-defining "equity" and expanding the notion of benefits to include intangible as well as tangible benefits. The ambiguities inherent in the UN 1997 Convention, as well as the need to re-define frameworks of shared use, come

together in ways that do not lead to zero-sum games where victory for one means the defeat of the aspirations for equity of others.

The Danube Basin, in the European heartland, is shared by 18 countries, 13 of which were formerly known as part of "Eastern Europe" and operated beyond the Iron Curtain dividing Western Europe, while Ukraine was part of the former Union of Soviet Socialist Republics. The remaining four countries – Austria, Germany, Italy, and Switzerland – are highly industrialized; their main concerns prior to 1989 were hydropower energy production and navigational accessibility. Realigning equitable resource allocation with shared benefits is relatively easier for the member countries of the European Union, which share a Pan-European constitution. Yet, this does not necessarily mean that having a shared legal framework frees the basin from conflicts over health standards for water quality and environmental concerns. The countries of the Danube Basin are at varying degrees of industrial development, with some being more agrarian and others postindustrial. This leads to a re-definition of equity based on need, utilization, and what can be called "historic" rights of developed countries, where environmental security constitutes a part of citizenship rights.

The Columbia Basin in North America, which has members who are relatively equal in geographic size and resource endowment, provides an example where EDB appears to have been ratified and implemented. The Columbia Basin presents an interesting dilemma where differences in domestic – provincial and state – regulations produce different interpretations of the intangible benefits accorded to indigenous / native populations. The benefits go beyond the usage of hydropower energy, and include conceptualizing the restoration of salmon habitats to redress environmental abuses of the past and a re-valuation of traditional plants and cultural rights of indigenous populations. Like countries in the Danube Basin, Canada and the United States of America operate within similar (but not identical) political and economic systems, which tends to minimize conflicts. Yet, as in the other cases, the ambiguities inherent

in the EDB principle provide opportunities for exploring more areas for cooperation, while minimizing outright conflicts over environmental management concerns.

This chapter suggests, as its specific objective, that utilizing geographic concepts (for example, analyzing differences and commonalities among international basins), along with an awareness of the impact of history in identifying intangible benefits, helps to identify areas conducive to the implementation of the EDB principle by making it consistent with the 1997 Convention. A holistic policymaking framework that links geo-economic, geo-cultural, and geo-political factors would facilitate the implementation of appropriately revised principles of the equitable distribution of benefits among nations in order to achieve the development aspirations of stakeholders, the alleviation of poverty pressures, sustainable management of basin resources, and conflict resolution objectives.

3.4 Methods

There are 276 international river basins (TFDD 2009b). Out of these, six basins, the Nile, Jordan, Mekong, Indus, Columbia, and Danube, were used as case studies (see Figure 3.1). These basins were chosen because they represent a broad spectrum of differing hydrologic, location, and economic development stages. Thus, lessons developed from these different basins are likely to be transferable to the remaining basins, thereby aiding in the alignment of the EDB principle with the 1997 Convention and enhancing implementation capacities. Implemented projects, based on the EDB principle, are expected to increase the basket of benefits to be shared among stakeholders. Stakeholders can utilize these benefits in order to meet the big four general objectives as outlined in the introduction: development aspirations, efficient water management, poverty alleviation, and conflict resolution goals. To this end, specifically, the seven statements of Article 6.1 of the 1997 Convention were assessed in each of the six basin case studies. The box below provides further detail regarding

Article 6.1. Other details of the convention including, but not limited to, the details in Articles 5 (Equitable and reasonable utilization and participation), 6.2, 6.3, 7 (Obligation not to cause significant harm), and 8 (General obligation to cooperate) are discussed inherently or under assumption, although not specifically addressed as 6.1. Details on how each of the seven factors in article 6.1 were addressed are as follows:

1. Article 6.1 (a): Climate classification, water stress, and runoff data were obtained from the Transboundary Freshwater Dispute Database, and, along with literature reviews regarding ecological and environmental concerns, analyses for the EDB principle were made.

2. Article 6.1 (b): National data regarding GDP PPP (Gross Domestic Product, Purchasing Power Parity), percentages of economic sectors were obtained from the CIA World Factbook (CIA 2009). These data were used to analyze social and economic needs, along with major national concerns regarding basin utilization.

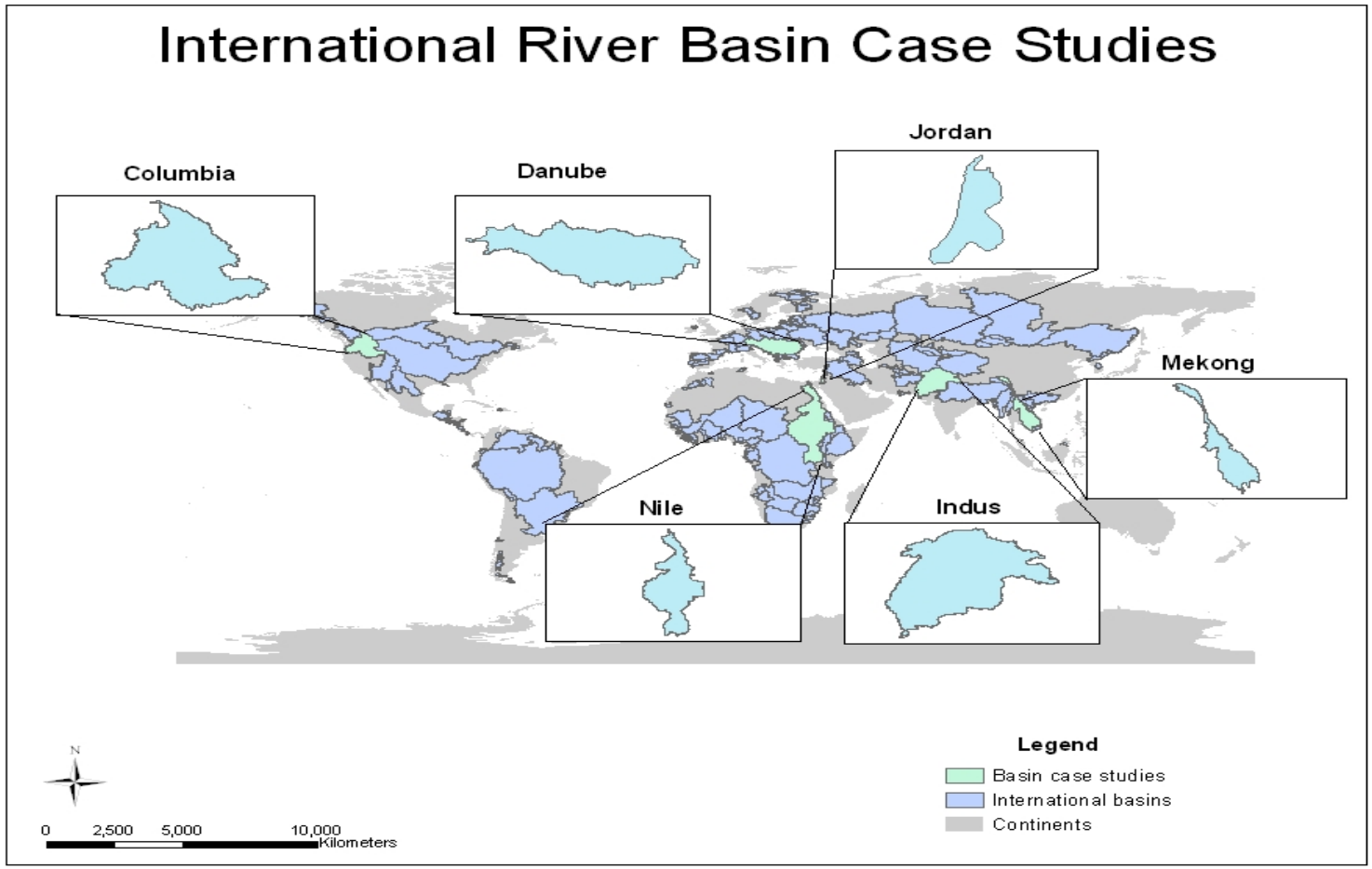


Figure 3.1: International River Basin Case Studies (Concept: Author, Cartographer: Kendra Hatcher, GIS layers obtained from TFDD)

Article 6
Factors relevant to equitable and reasonable utilization

1. Utilization of an international watercourse in an equitable and reasonable manner within the meaning of article 5 requires taking into account all relevant factors and circumstances, including:

(a) Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character;
(b) The social and economic needs of the watercourse States concerned;
(c) The population dependent on the watercourse in each watercourse State;
(d) The effects of the use or uses of the watercourses in one watercourse State on other watercourse States;
(e) Existing and potential uses of the watercourse;
(f) Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect;
(g) The availability of alternatives, of comparable value, to a particular planned or existing use.

2. In the application of article 5 or paragraph 1 of this article, watercourse States concerned shall, when the need arises, enter into consultations in a spirit of cooperation.

3. The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is a reasonable and equitable use, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.

(Source: United Nations, 1997)

3. Article 6.1 (c): National population size per basin was obtained from the Oak Ridge National Laboratory (ORNL 2008). Percentages of labor sectors were obtained from the CIA World FactBook (CIA 2009). These data were used to analyze the needs of the population dependent on the basin.

4. Articles 6.1 (d) to 6.1 (g): Data were obtained using literature review to provide examples of the concerns regarding these factors.

5. In the previous chapter, literature reviews on stakeholder participation, economics, and management disciplines were used to conceptually assess involvement of stakeholders, benefit cost analysis, and the four management of transboundary river resources stages: planning, organizing, executing, and directing, and to suggest broad conceptual phases to aid in implementation of projects.

3.5 Introduction to the six basins: Nile, Jordan, Mekong, Indus, Danube and Columbia

The Nile Basin comprises two separate sub-basins: the White and Blue Nile Basins. Countries through which the White Nile flows include, in order of downstream flow, Rwanda, Burundi, Uganda, Democratic Republic of the Congo (DRC), Kenya, Tanzania, Sudan, and Egypt. Countries through which the Blue Nile flows include, in order of downstream flow, Ethiopia, Eritrea, Sudan, and Egypt. Irrigation (mainly in downstream areas of Egypt and Sudan), and hydropower (mainly in downstream areas, but, more recently, in upstream areas as well) are the major uses affecting transboundary relations. The main issue of concern in this area is that the downstream areas, which are hydrologically dry because of their location (especially in Egypt), are very dependent on the basin and do not have alternative water sources. Existing treaties and the status quo favor the downstream countries, as there is limited water withdrawal by upstream riparians. The 1929/1959 Nile treaty between Egypt and Sudan divided the Nile water quantity, with 66% allocated to Egypt , 22% allocated to Sudan, and the remainder allocated to evaporation and other losses (Collins 2002). However, the current status quo is being challenged by upstream countries such as Ethiopia, which face increasing population and development pressures that push them to consider using the Nile resources. Rainfall and water quantity distribution vary within the basin.

The Jordan basin is a very small area geographically. The basin is shared by Israel, Lebanon, Syria, Jordan, and the Palestinian entity, with Egypt included in the negotiation as an influential party (Delli Priscoli and Wolf 2009). The basin is used for various purposes, including domestic, irrigation, and industrial usage. The hydropolitical and treaty history in the Jordan Basin are important factors in understanding its current reality. Despite historic and current geopolitical tensions in the region, there have been several relatively successful agreements regarding the sharing of the Jordan basin among the stakeholder countries. The Johnson Plan (Unified Plan), 1953-1955, allocated water from the basin (not including the Litani

River and groundwater) as follows: 400 million cubic meters (MCM) per year to Israel, 720 MCM per year to Jordan, 132 MCM to Syria, and 35 MCM per year to Lebanon (Delli Priscoli and Wolf 2009). Although the agreement was never officially ratified, all countries have generally followed the allotments even though unilateral development has continued (Delli Priscoli and Wolf 2009). Current challenges facing the agreements include ratification of the treaty, charges that the Palestinians do not have a fair share, groundwater uncertainties, and trust among the riparians.

The Mekong River is located in Southeast Asia and its basin encompasses six countries: China, Burma, Laos, Thailand, Cambodia, and Vietnam. The basin is divided into the upper (comprising China and Burma) and lower (comprising Laos, Thailand, Cambodia, and Vietnam) basin areas (Gajaseni, Heal, and Edwards-Jones 2006). The basin resources are utilized for irrigation (especially in downstream deltaic areas) and for fishery and navigation. There have not been serious conflicts over water in this basin, due to the following two factors: 1) the absence of a relatively water rich or poor riparian that is dependent on the river, and 2) a lack of upstream development that would otherwise have detrimental downstream effects (Delli Priscoli and Wolf 2009). In anticipation of future problems, the riparian countries, along with the United Nations, have pushed for the creation of a river basin organization (RBO) or similar institution to govern the shared river together. The Mekong River Commission, created in 1957 and re-ratified in 1995, has been instrumental in achieving cooperation in the basin. Current challenges include assessing the effects on downstream areas due to upstream aspirations to develop hydropower dams in China, Burma, and potentially Laos.

The Indus River is shared between India and Pakistan, with India located upstream. The Indus River has various uses including, but not limited to, irrigation and hydropower, and holds a significant amount of cultural value. The basin contributes to the biodiversity of the region, farm agriculture, livestock rearing, and fishery resources, making it important to meeting socioeconomic needs. For example, people

in the Indus Delta have used the grass in the delta to make mats, as well as farming wheat and barley, and harvesting fish and shrimp for the Sindhs and Balochistans, among others (Memon 2005). Existing uses have been criticized as inequitably distributing the benefits among the stakeholders. These alleged inequities can be between or among states within the same nation, such as in the Punjab, Haryana, and Rajasthan (Mustafa 2007) in India, different ethnic groups, such as the Punjabi and Sindh cultural groups in Pakistan (Mustafa 2007), and/or at the international level between Pakistan and India in regards to Wuller Barrage on the Jhelum tributary (Wolf 2001). Considering the geopolitical tension between these two countries, the Indus Water Treaty, signed in 1960, is a great success. The Indus River Commission (IRC) has been instrumental in resolving conflicts over many issues, including the Salal dam and water delivery during 1965-66 (Wolf 2001). The simplicity of the river allocations, with the western rivers to India and the eastern to Pakistan, as well as the role of the World Bank as the guarantor of the treaty, have been instrumental in creating cooperation (Iyer 2003; Zawahri 2009). Some of the current challenges faced in the basin are the increasing demands for water for domestic uses and irrigation due to population and economic growth, and the effects of climate change.

The Danube Basin, located in Europe, is shared among 18 countries. The countries sharing the basin are: Romania, Hungary, Austria, Serbia, Montenegro, Germany, Slovakia, Bulgaria, Bosnia and Herzegovina, Croatia, Ukraine, Czech Republic, Slovenia, Moldova, Switzerland, Italy, Poland, and Albania (TFDD 2009b). The basin is utilized for various purposes including, but not limited to, navigation, domestic use, and hydropower generation. Initially the challenges faced in this basin were navigational (Wolf 2001), but currently water quality and environmental concerns are important challenges (Wolf 2001; Delli Priscoli and Wolf 2009). Other challenges include water quality, and the policy relationship between European Union members and non-EU members.

The Columbia Basin is located in North America and is shared between two countries, the United States of America and Canada. The basin is used for various purposes including irrigation, hydropower production, and fishing. The Columbia River Treaty (CRT), dividing hydropower and flood-control benefits equally, was reached between the two countries in 1964 (Muckleston 2003). This basin is only one of the few cases where the benefit-sharing principle was applied. Current challenges facing the basin are mainly the rehabilitation of salmon habitats (which were disrupted by dams and other diversions) and the fishing rights of indigenous populations.

3.6 Articles 5 and 6 of the 1997 United Nations Convention and the principle of benefit sharing

The 1997 UN Convention, although not ratified, is the most referenced principle used in transboundary river treaty negotiations. Thus, it is important for the EDB principle to be compatible with the convention. In this section, the EDB concept will be assessed in six selected basins using the seven factors stated in Article 6 of the 1997 UN Convention. The two statements in Article 5 will be addressed within the discussion of these seven factors. The seven factors of the UN Convention are: 1) geographic, hydrographic, hydrological, climatic, ecological and other natural factors; 2) the social and economic needs of the watercourse states concerned; 3) the population dependent on the watercourse in each watercourse state; 4) the effects of the use or uses of the watercourse in one watercourse state on other watercourse states; 5) existing and potential uses of the watercourse; 6) conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect; and 7) the availability of alternatives, of comparable value, to a particular planned or existing use.

The selected basins are the Nile, Jordan, Mekong, Indus, Danube, and Columbia. These basins were selected because they represent starkly different geographical locations, cultures, and stages of economic development. This difference helps make the analysis unbiased and universally applicable. The above-stated UN factors will be

assessed by discussing some of the main issues facing each of the six basin case studies, followed by suggestions for a cohesive EDB framework.

3.6.1 Article 6.1 (a): the geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character

An equitable utilization or EDB process should consider the factors addressed in Article 6.1 (a) (The Geographic, Hydrographic, Hydrological, Climatic, Ecological and Other Factors of a Natural Character) in order to build consistency with the 1997 UN Convention, as well as to enhance the implementation processes. The following three general factors, 1) climate classification, 2) water factors (stress, runoff and discharge), and 3) ecological issue of the basin area, were considered in this chapter as they influence the six stated factors the most (Table 3.1).

Regarding climate classification, the Nile, Jordan, and Indus have substantial areas that fit in the steppe or desert categories (Table 3.1). The Danube and Columbia have substantial continental climates. The Mekong is dominated by tropical and sub-tropical (Mediterranean) climates. Climate affects water utilization in these six basins in several ways including, but not limited to, crop type for agricultural use and irrigation water availability, fishery, and amount of hydropower generation. Some examples and recommended strategy details pertaining to climate and the other factors are in Table 3.2. This is similar to the water factors (the second column in Table 3.1) in that all the stated benefits are affected by water availability. Comparing these water factors with the "absolute scarcity" threshold capacity of water availability per capita –500 m^3 per year (Phillips and McCaffrey 2007) – would help in assessing strategies. Thus, the utilization and distribution of the benefits should maintain or enhance water availability so that levels do not fall below the threshold capacity. The third factor considered, maintaining or enhancing ecological value, will increase both the tangible and intangible benefits derived from the river. Moreover, attention to ecological considerations makes water development projects sustainable. Water projects or water utilization plans that mold their strategy to the natural character (as stated in Article

6.1) of the study area, are more likely to be efficient and cost effective, and to use existing knowledge of the area, leading to increased sustainability. It is recommended that the EDB principle encourage utilization of the river in choosing benefits that enhance the natural character of the area.

Table 3.1: Criterions for article 6.1 (a): the geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character.

Basin	Climate Classification	Rainfall	Ecological Issues
Nile	BWh (desert) and BSh (steppe) comprise 36% and 17% of the land cover area of the Basin, respectively (TFDD). The Am (tropical monsoon), located in the southern (upstream), comprises only 35% of the basin area (Leventhal, Popp, and Sawyer 1973).	- Varies within the six sub basins - The water stress, and discharge rates are between 500 and 1000 cubic meters of water per person per year (except in the Baraka and the Gash sub basins (located between Eritrea and Sudan, where it is less than 500), and between 250 to 500 cubic km per year (except in the Baraka and the Gash sub basins (located between Eritrea and Sudan) where it is less than 5), respectively Run off for Nile is 107000mm per year (TFDD 2009b).	Maintaining the wetlands of the Sudd (southern Sudan), reducing siltation in reservoirs (such as in the Aswan dam), reducing salinity (mostly in upstream regions), healthy water flow to the Mediterranean Sea, and erosion control (mostly in upstream regions such as in the Ethiopian highlands).
Jordan	Only 21% of the basin area comprises of the CS (Mediterranean) climate, otherwise BS and BW comprise 38% and 54%, respectively (TFDD 2009b).	- Less variability compared to Nile - The water stress, runoff for the Jordan and discharge rates are less than 500 cubic meters of water per person per year, 900 mm per year and between 0 to 5 cubic km per year, respectively (TFDD 2009b).	Water polluted, except for one river flowing west, which is minimally polluted (Roll et al. 2007). Although there is no conclusive evidence, the effects of introduced fish species could have negative impacts (Roll et al. 2007). Another serious issue is the declining Dead Sea water amount.
Mekong	The land cover area of the basin is comprised of Am (tropical monsoon) and Cw (humid subtropical, with dry seasons, hot summers) each comprising 49% and 31% respectively (TFDD). The Basin is found in the tropics and thus is influenced by the monsoon.	-Relatively higher water quantity available relative to the Nile, Jordan and the Indus. - The water stress, runoff for the Mekong and discharge rates are, less than 8600 cubic meters of water per person per year, 165000mm per year and 480 cubic km per year, respectively (TFDD 2009b)	There are fears of detrimental ecological issues due to development and dams being planned on upstream parts; especially by China. An estimated 0.5 to 1 million people are at risk of arsenic poisoning related to groundwater in the Mekong Delta (Berg et al. 2007).
Indus	This land cover area of the Basin is dominated by the BW (49%) and BW (19%) climate classes.	- Monsoon rains available but area is generally dry. - The water stress, runoff for the Indus and discharge rates are, less than 700 cubic meters of water per person per year, 58900mm per year and 150 cubic km per year, respectively (TFDD 2009b).	Endangered river dolphin (WWF 2009),
Danube	Climate is dominated by the C (maritime) and D (continental) Koppen climate classification system. Dry areas (BSk climates) comprise only 6 percent of the basin's area (TFDD 2009b)	- High water quantity availability relative to other basins. - The water stress, runoff for the Danube and discharge rates are less than 2700 cubic meters of water per person per year, 101000mm per year and 220 cubic km per year, respectively (TFDD 2009b)	-Excessive nutrient loads (especially nitrogen and phosphorous), high concentrations of organic substances from untreated wastewater, changes in river flow (hydromorphological alterations) and its effect on sediment transport, with hazardous substance contamination (heavy metals, oil, microbiological toxins, etc.), pollution from contaminated sites, waste disposal, degradation and loss of wetlands (ICPDR 2009).
Columbia	Climate is dominated by the D (continental; Db 34% and Dc 27%) Koppen climate classification system. Dry areas (BSk climates) comprise only 4 percent of the basin area (TFDD 2009b)	-Similar to the Danube, generally high rainfall amount relative to the other case studies. - The water stress, runoff for the Columbia and discharge rates are less than 33800 cubic meters of water per person per year, 108000mm per year and 220 cubic km per year, respectively (TFDD 2009b).	Salmon habitat restoration and flood control.

Note: Am, Aw, BWh, BSh, BSk, BWk, Csa, Csb, Cfa, Cwa, Cfb, Cfc, Dfa, Dfb, Dwa, Dwb, Dfc, Dfa, Dwc, and Dwb are Koppen Climate classifications

Table 3.2: Recommendation for: article 6.1 (a): the geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character.

Basin Case	**Recommendations based on section 3.6.1 and Table 3.1**	**Example of benefit sharing strategy for the recommendations for each of the stated recommendations**
Nile	1. Plant crops that are fit for steppe or desert areas in the northern part and grow tropical crops in the southern part. 2. Water stress level 500 to 1000m^3 level maintenance or enhancement 3. Take measures in upstream countries to reduce siltation rate in downstream areas.	1. Assess cumulative benefits, implement water projects and share the net benefits from crop production. 2. Benefit distribution should not increase water stress 3. Sediment control in upstream areas benefits downstream dams in Sudan and Egypt; access these costs and benefits and share them
Jordan	1. Plant crops fit for steppe or desert area. 2. Below the threshold capacity of water availability per capita of 500 m^3 per year. 3. Decrease water pollution as per the EU water framework vision.	1. Assess cumulative benefits, implement water projects and share the net benefits from crop production. 2. Find ways to enhance water availability (for example desalinization of Red Sea), share the costs of implementation and share the net benefits. 3. Share the cost or measures to decrease pollution, and share the intangible benefits (increased national image) derived from increased biodiversity.
Mekong	1. Plant crops fit for tropical areas. 2. Well above the threshold capacity of water availability per capita of 500 m^3 per year. 3. Decrease the effect of upstream development on water quantity a necessary step to maintaining fisheries and deltaic farming downstream.	1. Assess cumulative benefits, implement water projects and share the net benefits from crop production. 2. Assess ways to utilize the extra water availability per capita, develop water projects, assess cost and benefits and share the benefits. 3. Develop plan for short-term water saving during the filling of dams upstream. As these might disrupt biodiversity habitat and economic output.
Indus	1. Plant crops that are fit to be in steppe or desert area 2. Water stress level of 700m^3 per capita level maintenance or enhancement 3. Take measures to conserve the Indus River dolphin habitat	1. Assess cumulative benefits, implement water projects and share the net benefits from crop production. 2. As in the Nile and Jordan, implement social education regarding water conservation 3. Make the dolphin habitat a world heritage site and share the benefits among the stakeholders.
Danube	1. Climate can be cold and thus necessitate more energy usage from water. 2. About 2270 m^3 per year of water per capita 3. Decrease detrimental effect of water quality	1. Assess cumulative benefits, implement water projects and share the net benefits from crop production. 2. High hydropower capacity development due to large water availability; access cumulative net benefits and share them. 3. Share the cost or measures to decrease pollution, and share the intangible benefits (increased national image) derived from increased biodiversity.
Columbia	1. Plant crops fit for continental climate 2. High water per capita value of 33800 m^3 could be equitably utilized. 3. Increase the water quantity flow in streams	1. Plant crops such as apples and share the benefits among the stakeholders 2. Extra water per person could be used to maintain and enhance quantity flow. The resulting benefits to navigation and irrigation could be shared. 3. The increase in flow will enhance Salmon habitat benefits

3.6.2 Article 6.1(b): the social and economic needs of the watercourse states

The consideration of the existing and potential social and economic needs is crucial to sharing the resources of a basin. The social and economic needs of states are very broad and ambiguous topics. Both social and economic needs can have tangible (quantifiable) and intangible (generally assessed qualitatively) aspects. According to Abraham Maslow, social needs can be hierarchically divided into physiological needs, and the need for safety, love, affection, belonging, esteem, and self-actualization (Maslow 1943). Measures of tangible social and economic status include factors such as life expectancy and education rates. Intangible factors include issues such as indigenous rights. In this section, we will focus on two aspects that are deemed to be important: 1) economic sector contribution to the national GDP, and 2) current importance of an economic sector vulnerability regarding water needs from the basin. We will consider the changes in utilization of the basins that occur spatially and temporally.

National priorities regarding maintenance and creation of productive economic sectors affect how stakeholders would prefer to utilize the basin, and thereby influence sharing strategies. The six basin case studies have economic sectors that contribute at different magnitudes to the GDP (Table 3.3). For example, in the Nile, the agricultural and service sectors have the highest job sector values (Table 3.3). Thus, in a benefit sharing proposal, DRC (with 55% of its economy being agricultural) could propose a sharing process that benefits the 50% agricultural sector, while Kenya might push for the service sector, which comprises 59.5% of its economy). Besides the priority of the economic sector, current economic concerns specific to a basin also affect the sharing process. In the Danube Basin, it is water quality, while availability of water for irrigation and fishery dominates in the Mekong Basin (Table 3.3). For other basin details see Table 3.3. The two concerns stated above change over time and space, prompting a sharing strategy to be proactive. The fact that most countries are gradually decreasing the agricultural sector contribution to the economy is something to be considered. To build consistency with the 1997 UN Convention and increase the

likelihood of successful EDB implementation, benefit-sharing strategies should consider priorities of economic sector, address specific concerns raised by the basin case study, and anticipate the temporal and spatial changes in these categories.

Table 3.3: Criterions for article 6.1 (b): the social and economic needs of the watercourse states.

Basin Case	Country Lowest to highest GDP (purchasing power parity) in U.S. $billions	Country Lowest to highest GDP per capita (purchasing power parity) in U.S. $ billions	Percent of sector per total economy Lowest to highest			Social and Economic Need priorities of Concern in regards to basin uses
			Agriculture	Industry	Services	
Nile	443.7 to 3.1	300 to 5,400	13.2 to 55	11 to 38.7	34 to 59.5	1. Food production increase for food security in all countries. 2. Hydropower energy for economic development in upstream areas.
Jordan	201.4 to 11.95	5,000 to 28,300	2.6 to 18.5	13 to 32.4	65 to 79	1. Enhance water quantity to meet physiological needs. 2. Maintain or enhance water quantity need for irrigation 3. Meeting water consumptive use for industries.
Mekong	13.98 to 7973	1,200 to 8,400	11.3 to 40.9	19.8 to 48.6	26.5 to 43.3	1. Maintain irrigation and fishery need for interior basin and deltaic environment. 2. Meet hydropower development needs of riparian countries.
Indus	3,297 and 427.3	2,900 and 2,500	17.6 and 20.4	29 and 26.6	53.4 and 53	1. Meet irrigation water quantity need. 2. Hydropower maintenance and development 3. Cooperation on Indus key to Geopolitical security
Danube	6.9 to 14,910	2,500 to 41,800	1.5 to 20.5	19.8 to 34	58.9 to 70.9	1. Enhance water quality 2. Meet social legacy through biodiversity of basin 3. Secure water quantity for navigation 4. Harness hydropower generation
Columbia	1,300 and 14,260	39,100 and 46,900	1.2 and 2	28.4 and 19.2	69.6 and 79.6	1. Indigenous Rights 2. Social legacy related to ecology (salmon habitat)

3.6.3 Article 6. 1 (c): the population dependent on the watercourse in each watercourse state

A strategy that considers the existing and potential needs of the population dependent on the basin is more likely to achieve a relatively equitable distribution of benefits. The third criterion in Article 6, focuses on the population dependent on the watercourse. The dependent population could be spatially distributed to encompass all of the population of a riparian country or it could represent a very small portion of its population. For example, 68,261,800 Egyptians, representing 82% of the total population of Egypt, depend on the Nile, versus only 3,292 Albanians (0.09% of the total population) who depend on the Danube (ORNL 2008; CIA 2009). Due to the geographically multi-scaled nature of water utilization, water benefits from a basin can be transferred to populations outside the basin. The considerations regarding the multi-scale nature of water and its associated cascading benefits of beyond the basin area are complex and beyond the scope of this paper. Thus, this section only considered the population living within the boundaries of the six basins.

This section assesses Article 6.1 (c) using three factors: 1) job availability 2) rights of the population living in the geographic area of basin, and 3) population growth effects. The creation and maintenance of the job sector is important to the population living in the basin area. If the national average labor-sector value is seen as indicator of the specific population living in the basin area, the resultant sharing of benefit would be different than benefit sharing that considered only the labor sector specific to the basin area. For example, utilizing the national indicator, the highest job sector in the Columbia Basin is the service industry (76.8% for Canada and 79% for the United States) (Table 3.4). This tilts the benefit-sharing strategy scenario to prioritize service-sector use. Similarly, using the national indicator, the priorities in the basin area tilt to agricultural priority in the Nile (the lowest value of 32% for Egypt to the highest 93.6% for Burundi) and Mekong (the lowest value of 42.6% for Thailand to the highest 80% for Laos), and Indus (the lowest value of 43% for Pakistan to the highest 60% for India) (Table 3.4). Similarly, in the Jordan, Danube, and Columbia Basins the

preference tilts towards the service sector (Table 3.4). These prioritizations might benefit or be at the expense of local populations. Thus, a successful strategy is to find the balance between labor-sector priorities and indigenous rights. For example, in the Danube, the sharing strategy (both the benefit-sharing implementation costs and benefits) should involve sharing equitably, not equally, among the EU and non-EU riparians sharing the basin, since the non-EU countries are usually relatively poorer than their more affluent EU counterparts and cannot compete effectively in sharing costs and benefits equally with EU nations. Lastly, one of the most daunting aspects for future consideration is population growth in the basin area. The population, given current growth rate, is increasing tremendously in the Nile, Jordan, Mekong, and Indus basins (see Table 3.4 for details). The social and economic needs of an increasing population need to be anticipated and planned in assessing benefit-sharing proposals. A strategy to implement EDB principles should prioritize the most vulnerable job sectors, should balance these priorities with local rights, and should anticipate future needs of the population.

Table 3.4: Criterions for article 6.1 (c): the population dependent on the watercourse in each watercourse state.

Basin	Population living in basin area in 2007 (Source TFDD 2009)	Population projection in 2057	Percent of labor per economic sector (lowest to highest sector data per country in basin) (2008) estimate from CIA Worldfact Book)			Examples of local population rights and what it means for EDB
			Agriculture	Industry	Services	
Nile	266,947,000	909,267,000	32 to 93.6	2.3 to 25	4.1 to 51	- Priority to agricultural sector to maintain or create alternative -Local rights on displacement due to dams (such as in the Merowe Dam case in Sudan (Teodoru, Wüest, and Wehrli 2006)
Jordan	10,029,000	30,040, 000	2 to 19.2	5 to 20	66.3 to 82	- Priority on service sector - Palestinian rights to equitable water share (Postel 2006)
Mekong	55, 800,000	154,942,000	42.6 to 80	7 to 25	23 to 37.1	- Priority on Agricultural sector -Local rights regarding dams in Tonle Sap (Cambodia), Se San River (Vietnam) (Fox and Sneddon 2007; Gajaseni, Heal, and Edwards-Jones 2006).
Indus	297,623,000	729,534,000	43 and 60	12 and 20.3	28 and 36.3	- Priority on Agriculture - Urban versus Rural needs
Danube	73,838,000	77,925,000	2 to 58	15 to 46	24 to 73.2	- Priority on both Serives and Agricultural sectors -Equity among EU and non EU members
Columbia	7,882,000	12,744,000	0.6 and 2	22.6 and 19	76.8 and 79	- Priority on Service sector - Native American and First nation rights

3.6.4 Article 6. 1 (d): the effects of the use or uses of the watercourses in one watercourse state on other watercourse states

The fourth criterion requires the assessment of impacts and effects of basin utilization by one or more of the riparian countries on other stockholder countries. To enhance positive impacts and decrease negatives ones, a benefit-sharing scenario should include 1) sufficient data collection and analysis to decrease uncertainty, 2) a robust conflict resolution mechanism, 3) an institution that oversees the benefit-sharing process, and 4) effects on multiple spatial and temporal scales. The fear of negative impacts is an impediment to the implementation of water projects and thus to their potential benefit-sharing process. These uncertainties are especially evident in the Nile, Jordan, and Mekong Basins (Table 3.5). Secondly, robust conflict resolution mechanisms that help resolve arising disputes are highly important. For example, one reason for the successful treaty in the Indus River Basin is the role of the World Bank as a guarantor of the treaty, which acts as a robust conflict-resolution mechanism. Thirdly, the existence of an institution, especially a river basin organization, has been linked to a decrease in disputes among countries sharing a river basin (Wolf 2007). The Nile Basin Initiative (NBI), the Mekong River Commission, the European Union Water Framework, and the International Joint Committee (Columbia Basin) have been able to solve various disputes. For example, the NBI has been instrumental in increasing data sharing and creating a venue and framework that enhanced communication channels and gradually decreased fears regarding water development projects planned by riparian stakeholders. Lastly, the effects of planned or implemented projects should be assessed at multiple spatial scales, including an assessment of how these impacts are felt at different time scales. For example, in the Columbia Basin, the effects are felt nationally (involving geopolitical cooperation and trade relations between USA and Canada), on a state or provincial scale (including cooperation of British Columbia was critical because Canadian provinces have power over allocation of resources), and on local scales (positive impacts for irrigation users and hydropower generation; negative impacts on salmon habitats, and indigenous people). These effects also change with time as priorities change. During the 1960s,

irrigation and power generation were the norm in the Columbia Basin. Currently, dam removal, biodiversity, and local rights are gaining in priority in the Columbia. Based on the above discussed, the EDB principle should increase information sharing, continue robust conflict resolution mechanism, build capacity for the institutions that oversee cooperation, and pursue impact assessments at different spatial and temporal scales for the six basins.

Table 3.5: Examples pertaining to article 6.1 (d): the effects of the use or uses of the watercourses in one watercourse state on other watercourse states.

Basin Case Study	Examples
Nile	- General situation: fear that future withdrawals by upstream riparians will negatively affect Sudan and Egypt. - Specific issue example: Upstream countries are prevented from using the Nile water by downstream countries (especially Egypt).
Jordan	- Inequitable use of water by Israel versus Palestinian Entity in the West Bank and Sea of Galilee with Syria has been a constant concern. - Speculation and uncertainty regarding inequitable groundwater aquifer usage by Israel negatively affecting other riparians.
Mekong	- Infrastructure such as transportation systems. - Absence of China from the Mekong River Commission is concerning regarding the effect of Chinese river development on upstream areas and its anticipated effect on downstream riparians.
Indus	- Decreased water quantity and quality for irrigation to Pakistani farmers due water withdrawals by India upstream. - Pakistani farmers, lacking alternative sources of water, have used this drainage water to irrigate their crops, which has increased waterborne disease among the inhabitants of a region and decreased the soil fertility. Children living near these drains have developed skin, eye and abdominal diseases (Zawahri 2009)
Danube	- Water quality decline affects domestic biodiversity and other aspects negatively. - Declining water quality has created problems for drinking water, recreation and bathing (Phillips et al. 2006). Reduction in biodiversity and sediment transport, and self-purification capacity (Phillips et al. 2006).
Columbia	- Development of dams by both countries negatively affected Salmon habitats, Native American (USA), and First Nation (Canada) rights. - Water quality issues.

3.6.5 Article 6.1 (e): existing and potential uses of the watercourse

A focus on the potential, rather than the distribution, of existing benefits is critical for the EDB principle to succeed. Re-distribution of existing benefits often results in win-lose for the stakeholders involved. The existence of a loser in these scenarios does not build consistency with the Article 6.1 (e) statement. Thus, sharing potential benefits is a better choice, as this can result in scenarios that are improvements over the existing conditions of the stakeholders. To achieve scenarios of improvement, the EDB principle process should consider the following aspects to build consistency with the 1997 UN Convention: 1) consider as many benefit and cost factors as possible, 2) assess those that can be shared, 3) assess the costs and benefits of those that can be shared at bilateral, multilateral, and temporal scales, 4) consider extreme scenarios, 5) share those that have benefits greater than costs, and 6) reevaluate the sharing method. There are numerous benefits to be shared, especially if one considers the four benefit factors as espoused by Sadoff and Grey (2002), and additionally considers benefits from outside the geographic area of the basin. The next step is to assess which of these benefits has the potential to be shared. For example, it would be hard to share spiritual benefits of water, as these values might not be understood, shared, or accepted by the other stakeholders. Other benefits, especially hydropower, could be shared relatively easily. Third, costs and benefits at differing scales, including the spatial and temporal, should be assessed. Spatially, benefits could be shared bilaterally or multilaterally. In basins shared by only two countries, such as the Indus and Columbia basins, benefit sharing is only bilateral. But in cases where there are more than two riparian countries, either of the two sharing methods is viable. In some cases, bilateral sharing might yield higher net benefits to the whole basin than multilateral sharing, and vice versa. For example, a water-development project on the Nile, located in Sudan, is a bilateral concern of Sudan and Egypt, causing no significant harm or cost to the other riparians unless the water amount usage will limit water withdrawal or utilization of the basin in upstream countries. However, a development project in Ethiopia would be of multilateral concern to Ethiopia, Sudan, and Egypt. For other examples, see Table 3.6. Fourth, provisions should be made for extreme cases and conditions, such as drought

and flooding. For example, it has been shown that drought scenarios have led to increases in the number of disputes in the Jordan (Delli Priscoli and Wolf 2009). Fifth, the best possible cost and benefit analyses (both qualitative and quantitative methods) that yield the best net benefit scenarios and cause no significant harm should be proposed and implemented. An assessment should be done at regular intervals to assess the negative and positive impacts of implemented projects as stated from the first and fifth aspects above. A regulatory body that gathers information from stakeholders on local, national, and international scales should be formed to assess impacts and suggest solutions and adjustments for future implementation purposes. In order to build consistency with Article 6.5 of the UN Convention, the EDB principle should focus on the potential benefits, consider all factors available, analyze the costs and benefits, provide for extreme conditions, proceed with implementation, and consistently reevaluate impacts.

Table 3.6: Examples pertaining to article 6.1 (e): existing and potential uses of the watercourse.

Basin Case Study	Existing Use	Potential Use
Nile	- Domestic, irrigation and hydropower in downstream countries (Sudan and Egypt) - Limited hydropower (Aswan in Egypt and Merowe in Sudan) in upstream countries - Small check dams for irrigation in upstream areas (in Eritrea for example). - Habitat for biodiversity - Groundwater resources (for example Egypt giving aid to Kenya to drill boreholes (Ministry for Foreign Affairs 2007))	Baro-Akobo Multi-Purpose Water Resources Development, Eastern Nile Power Trade Investment Program Study, and the Joint Multi-Purpose Program for ENSAP and the theme of "Power Interconnections for Regional Integration" for the NELSAP (NBI, 2008).
Jordan	- Irrigation, especially in Israel and Jordan - Drinking and Municipality in all of the countries sharing the basin - Limited hydropower in Israel - Habitat for biodiversity	- Unified dam for hydropower in Jordan - Make the existing uses more efficient - Build dam (Unified dam) in Jordan - Desalinization
Mekong	- Delta farming - Fishery in inland areas - Hydropower development in China - Habitat for biodiversity	- More dams in China for hydropower - Dams for hydropower in Laos - Maintain habitat for biodiversity
Indus	- Irrigation (mainly in Pakistan) - Hydropower (mainly in India) - Habitat for biodiversity and endangered species (For example: river dolphin)	- Build more dams or enhance existing hydropower dams and irrigation. - Increase water quantity availability through conservation
Danube	- Navigation - Hydropower generation - Domestic (physiological)	- Maintain the dams already built and also monitor water quality in the Danube Basin - Focus on the environmental aspect might be acceptable to counties within the EU but not to the poor nations outside the union.
Columbia	- Hydropower - Irrigation - Navigation	- Removal of dams, and improving the ecology (especially salmon runs). -- Maintain the dams already built and monitor water quality in the Columbia Basin

3.6.6 Article 6.1 (f): conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect

The EDB principle needs to consider the costs associated with benefit-sharing project proposals. The Article 6.1 (f) statement "Conservation, Protection, Development and Economy of Use of the Water Resources of the Watercourse and the Costs of Measures Taken To That Effect" will be assessed in general cost effectiveness (economic efficiency) examples pertaining to the six basin studies. In all six basin studies, there are various examples that show positive net benefits, as well as those that are not cost effective (net negative benefits). Table 3.7 addresses some of those examples. The cost effectiveness of water projects or basin resource developments seems to be related to the specificity of the project and to spatial scale. Some specific projects, such as terracing, seem to have positive net benefits (see Table 3.7). On the other hand, there are projects, such as the introduction of new fish species as in the Jordan, which are feared to be net negative benefits rather than positive (see Table 3.7). However, big projects, especially big dams such as those built in the 1970s in the Indus, tend to have negative benefits (Table 3.7). For the EDB principle to build consistency with Article 6.6, this paper recommends that projects should be assessed specifically and that a precautionary principle be adopted for large-scale projects.

Table 3.7: Examples of benefit and cost (negative net benefits) issues pertaining to article 6. 1 (f): conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect.

Basin Case Study	Examples
Nile	**- Positive net benefits:** Terracing in highlands of Eritrea seem to be have positive net benefits in improving soil water availability, forestation programs and groundwater recharge. And the NBI plans to implement efficient water use for agriculture and Nile Transboundary Environment Action under its Shared Vision Program (NBI 2009c). **- Fears of negative net benefits:** The building of the Merowe dam has some anticipated negative consequences, such as: loss of more than 30% of its capacity over the next 50 years, overflow and erosion, production of anoxic conditions by algae, and lack of research on aquatic biodiversity (Teodoru, Wüest, and Wehrli 2006).
Jordan	**- Positive net benefits**: Israel has implemented very efficient water development; for example, the country uses drip irrigation to precisely control irrigation water. Jordan followed suit and, at present moment, 55% of Jordanian farmlands use drip irrigation system (Postel 2006). **- Fears of negative net benefits:** water management problems on the Palestinian side. Water withdrawal rate is greater than replenishments in the Gaza strip (Postel 2006). In the Lower Jordan River Basin, demand for water especially from urban areas exceeds supply (Venot, Molle, and Courcier 2008) and (Loehman and Becker 2006) Most of the water from the river systems is used by humans, and in most streams the remaining water is polluted. Only one of the rivers flowing west is slightly or not polluted (Roll et al. 2007).
Mekong	**- Positive net benefits:** Four riparian countries (Cambodia, Laos, Thailand and Vietnam) in the basin have signed the Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin specifically mentioning in Chapters I, III and IV conservation coupled with sustainable development (Mekong River Commission April 1995). **- Fears of negative net benefits:** The MCS communicated concerns that some dams such as the Don Sahong hydropower to sustainable development (Bird 11 April 2008). An estimated 0.5 to 1 million people are at risk of arsenic poisoning related to groundwater in the Mekong Delta (Berg et al. 2007).
Indus	**- Positive net benefits:** there have been effective conservation methods and an increase in Indus Dolphin populations (Braulik 2006) A study in Pakistan by the World Wildlife Fund (WWF) ascribed the initial dolphin population decline to many factors, including barrages and irrigation diversion which are used for water development. **- Fears of negative net benefits:** During the 1970s, the Indus Basin, very little (about 10%) of the costs used to build large and medium dams were recovered (Postel 1999)
Danube	**- Positive net benefits:** integrated management system being implemented in the Danube basin by the stakeholders, is one of the most successful especially in water quality monitoring (Wolf 2001). **- Fears of negative net benefits**: Some researchers have noted lack of funding for conservation efforts and suspicion of providing funding for former socialist countries as an impediment for future sharing (Phillips et al. 2006).
Columbia	**- Positive net benefits:** In the Columbia River Basin, the trucking of juvenile Chinook salmon from the highest to the lowest dams has considerably slowed their rate of decline. Without that specific aid, the salmon would probably have disappeared from the Snake River (Lejon, Renöfält, and Nilsson 2009). **- Fears of negative net benefits:** how the building of the Dalles dam resulted in the relocation of Native Americans and the negative implications for wild salmon runs at Celilo Falls (Barber 2005).

3.6.7 Article 6.1 (g): the availability of alternatives, of comparable value, to a particular planned or existing use

An equitable sharing of river benefits strategy should consider alternatives of comparable value to existing and planned uses from within the basin or outside the geographic sphere of the basin. Here the term *within the basin* is used to imply water resource benefits found within the boundary of the basin only, while the term *outside of basin* is used as to describe benefits that are outside the spatial scale (such as the Red Sea resource for the Nile through desalinization) and resources other than water found inside and outside of the boundary of the basin (such as oil found within the basin or out of the spatial boundary of the basin). In both spheres, the best method for sharing the benefits is to consider as many factors as possible and suggest a strategy that has the best net benefit. Regarding the "within the basin scale", the various uses will have to compete against each other (see Table 3.8 for examples). Then the uses with higher net benefits can be chosen for implementation purposes. For out of the basin sphere, comparable values to major concerns would just be seen as other opportunities to exploit as resources rather than a call to halt existing or planned uses within the basin boundary (see Table 3.8 below). This is because most of these alternatives exist outside the basin and thus do not overlap with existing or planned uses. For example, using solar energy to obtain power might be an alternative to planned dam building to derive hydropower, as in the Mekong countries. However, a switch to solar energy would still leave the Mekong River resources open for exploitation, since solar energy might be seen as unlikely to meet all the energy needs of the growing population, as well as the associated increase in cultural and economic needs.

Important steps for the success of the EDB principle that build consistency with Article 6.1 (g)) are: 1) constant assessment of the various benefits, resulting in the implementation of the highest net benefit; 2) conceptualization of the basin without political boundaries first, in order to chose the best net benefits result before considering political boundaries (Delli Priscoli and Wolf 2009); and 3) the

consideration of out-of-basin resources in order to increase the number of factors brought to the table, thereby increasing the contribution of stakeholders, especially those with few negotiation factors (if only within basin resources are considered).

Table 3.8: Examples of benefit sharing scenarios pertaining to article 6.1(g): the availability of alternatives, of comparable value, to a particular planned or existing use.

Basin Case Study	Examples	
	Within the Basin Sphere	**Outside the Basin Sphere**
Nile	- Irrigation in upstream areas versus downstream would help decrease evapo-transpiration rates and increase water for irrigation (Whittington, Wu, and Sadoff 2005). - Developing hydropower upstream (best use of topography) versus irrigation downstream (to prevent evapotranspiration) (Whittington, Wu, and Sadoff 2005).	- Desalinization of water from the Red Sea. - develop other water resources such as the Awash in Ethiopia together (Nile countries) and share the costs and benefits. - Improve productivity in rainfed settings (Molden 2007)
Jordan	- Compromise between irrigation in Israel and Jordan versus industrial use. As industrial use is non-consumptive, that might create more water for physiological needs for the growing population as seen in Article 6.3. On the other hand, irrigation is associated with food security and export benefits.	- Enhance existing desalinization of Red Sea and Mediterranean as replacement for that from the Jordan.
Mekong	- A compromise between irrigation in the delta versus hydropower development (which might affect irrigation water quantity in the short term versus quality and other factors) for benefit sharing. - Eco-tourism versus irrigation (these two might or might not be overlapping issues)	- Develop rain water harvesting as alternative source for benefit sharing. - Use of biofuel as source of energy rather than hydropower and share the benefits.
Indus	- Irrigation in the Indus versus conservation measures for the survival of the Indus river dolphin. The intangible benefits of survival of the dolphin could be shared by India and Pakistan as legacy values.	- Use solar power in the deserts of India or Pakistan and share the benefits.
Danube	- Industry versus irrigation uses - Use of water as waste disposal versus enhancing biodiversity of the basin.	- Increase the biodiversity of other areas outside the basin (example northern Germany) and use the Danube as a cooperative framework for other basins
Columbia	- Preservation and rehabilitation of Salmon habitats versus irrigation needs for farmers	- The use of wave energy as an energy source versus the hydropower generated from dams in the Columbia.

3.6.8 Summary and main concerns in the six basin studies

All the factors discussed in Articles 6.1 (e) to (g) should be assessed together, with consideration of the main concerns faced by basins, in order to formulate a better implementation scenario. The UN 1997 Convention clearly states in Article 6.3 that in assessing benefit-sharing project proposals, all relevant factors are to be considered together and a conclusion reached on the situation as a whole. Below are fourteen points that put the discussed Articles 6.1 (e) to (g) together. All of these fourteen points are centered on point ten, focus on specific potential net benefits. Figure 3.2 below shows this centrality of issues. Table 3.9 also summarizes a representative set of the general main concerns faced by the basins. Although these concerns are addressed by various stakeholders (national, local and international), the institutions that deal mainly with transboundary rivers are RBOs. One of the main challenges faced by the RBOs is how to implement water projects that consider the issues addressed by the UN Convention, the EDB principle and the main concerns or pressures felt by stakeholders in transboundary basins. In the next section, we will suggest some processes that contribute to implementing benefit sharing proposals.

1. Utilize the basin in such a way that it makes the best use of the natural character of the basin area.
2. Prioritize the economic sectors that contribute the most to the national GDP.
3. Address specific concerns of basins; such local rights and biodiversity protection.
4. Be proactive; anticipate future challenges such as population growth rate needs.
5. Protect vulnerable job sectors or find ways to enhance or create jobs in other sectors.
6. Increase information sharing among riparians.
7. Have conflict resolution mechanisms available.
8. Create institutions, especially RBOs.
9. Assess impacts at different spatial and temporal scales.
10. Focus on specific potential net benefit sharing and not on the redistribution of existing benefits.
11. Consider all possible factors/resources that can be shared: water, non-water, within basin and out-of-basin resources.
12. Provide for extreme conditions, such as drought and flooding.
13. Use the precautionary principle, especially regarding large benefit sharing projects, such as big dams.
14. Availability of funding to create RBOs, support research and implement projects.

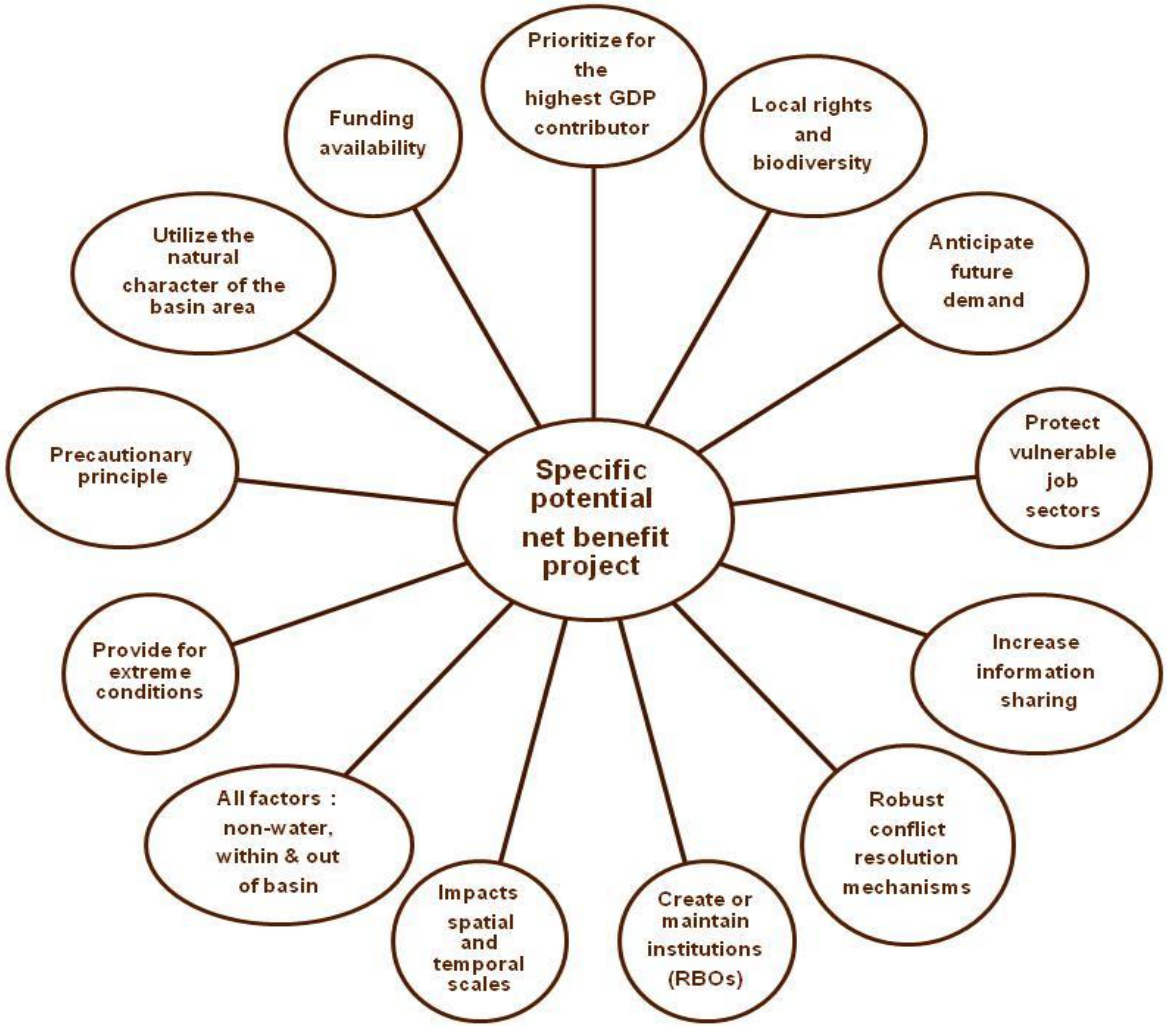


Figure 3.2: Issues map: a centered focus on specific potential benefit project that fulfills thirteen requirements.

Table 3.9: Main concerns per basin and the 1997 UN article 6 convention.

Article 6	Main concerns in the basin to be considered for EDB framework					
	Nile	**Jordan**	**Mekong**	**Indus**	**Danube**	**Columbia**
6.1 (a)	-Dry areas in the north dependent on river as sole resource -Decline in water quality	All riparians have similar dry climate patterns	- Deltas for rice production - fishery ecology	-Irrigation need for dry areas - Increase in domestic water needs in urban areas	Priority for the ecological (water quality) significance of the basin as the kidney of Europe.	Flood control and salmon ecology
6.1 (b)	- Irrigation needs to increase food production	- Irrigation - Domestic - Industrial	-Fishery - Biodiversity - Delta rice farming - Industrial	- Irrigation - Hydropower	- Social legacy - Navigation - Hydropower	-Indigenous rights - Social legacy related to ecology
6.1 (c)	- Indigenous rights (creation of civil societies)	- Total population focus rather than local - Palestinian rights	- Local population rights (creation of Mekong Civil Societies (MCS)) - total population focus rather than local by governments	- Urban versus rural needs	- Population within the EU and non- EU areas. - Population includes western and former socialist EU members	- Nexus between the needs of farmers, indigenous rights and politically powerful urban dwellers
6.1 (d)	-Alleviate geopolitical mistrust. -Willingness to share data and enforce regulation through the NBI	-Alleviate geopolitical mistrust. -Groundwater and surface water data to decrease mistrust of secret water withdrawals	- MCS effectives to protect local rights -Balance between needs of Upstream versus Downstream nations and provinces -Decrease negative effects on fishery resource	-Alleviate geopolitical mistrust. -Willingness to share data and enforce regulation through the World Bank.	-EU laws - Alleviate geopolitical mistrust between western and former socialist EU members	- Decrease intra-national negative effects, increase indigenous, provincial (BC) rights.
6.1 (e)	-Maintaining irrigation benefits for downstream countries -Potential sharing on hydropower benefits	-Maintaining irrigation benefits for downstream countries -Maintaining and creation of jobs for Palestinians	-Study needed to assess negative and positive implication on planned dams	-Potential dam benefits versus agricultural needs for drier southern portion of the basin	-Water quality monitoring of the basin -Hydropower generation	-Maintain farmer food production capacity -Revive salmon population
6.1 (f)	- Build small dams -Terrace hillsides -Improve water quality	-Conserve water amount -Share water conservation technology and management	-Policy balance needed between hydropower, delta farmers and fishery -Maintain biodiversity	-Enforcement of water quality -Maintain biodiversity	-Alleviate geopolitical mistrust in allocating funds	-Revive salmon population -Maintain ecology -Maintain irrigation benefits
6.1 (g)	-Alternative plans such as small dams versus planned big dams -Cultural and social values	-Alternative plans for basin wide water amount conservation versus desalinization plans	-Planned hydropower versus ecotourism -Cultural and social values	-Alternative plans such as small dams versus planned big dams -Cultural and social values	-Planned dam maintenance and water quality monitoring versus plans to remove dams and increase ecological/social values	-Planned dam removal and salmon ecology restoration versus irrigation and salmon barging plans

3.7 Planning, organizing, directing and regulating equitable benefit sharing projects

The implementation process of benefit-sharing scenarios in transboundary basins is a challenge faced by RBOs, researchers, and other interested parties, such as international organizations. Many schools of management suggest two initial assessment steps to implementing policy or projects, including identifying the objectives and performing benefit and cost analysis of objectives. After these two steps are achieved, the typical management model would involve planning, organizing resources, executing (directing or leading), and regulation (controlling or evaluation) stages (Griffin and Moorhead 2010). In this section, these same methods were implemented, using four phases in order to help RBOs implement benefit-sharing scenarios and build consistency with the 1997 UN Convention (Figure 3.3). Phase one identifies benefits to be shared. Phase two uses benefit and cost analysis to discard benefits that cannot be shared and/or that have net costs, in order to create net positive benefits that can be shared. Phase three involves stakeholders to address equity in distributing the cost and benefits. Phase four assesses the implementation of specific stakeholder-agreed projects with the last stage, evaluation, leading back again to Phase one to reassess the benefit-sharing process.

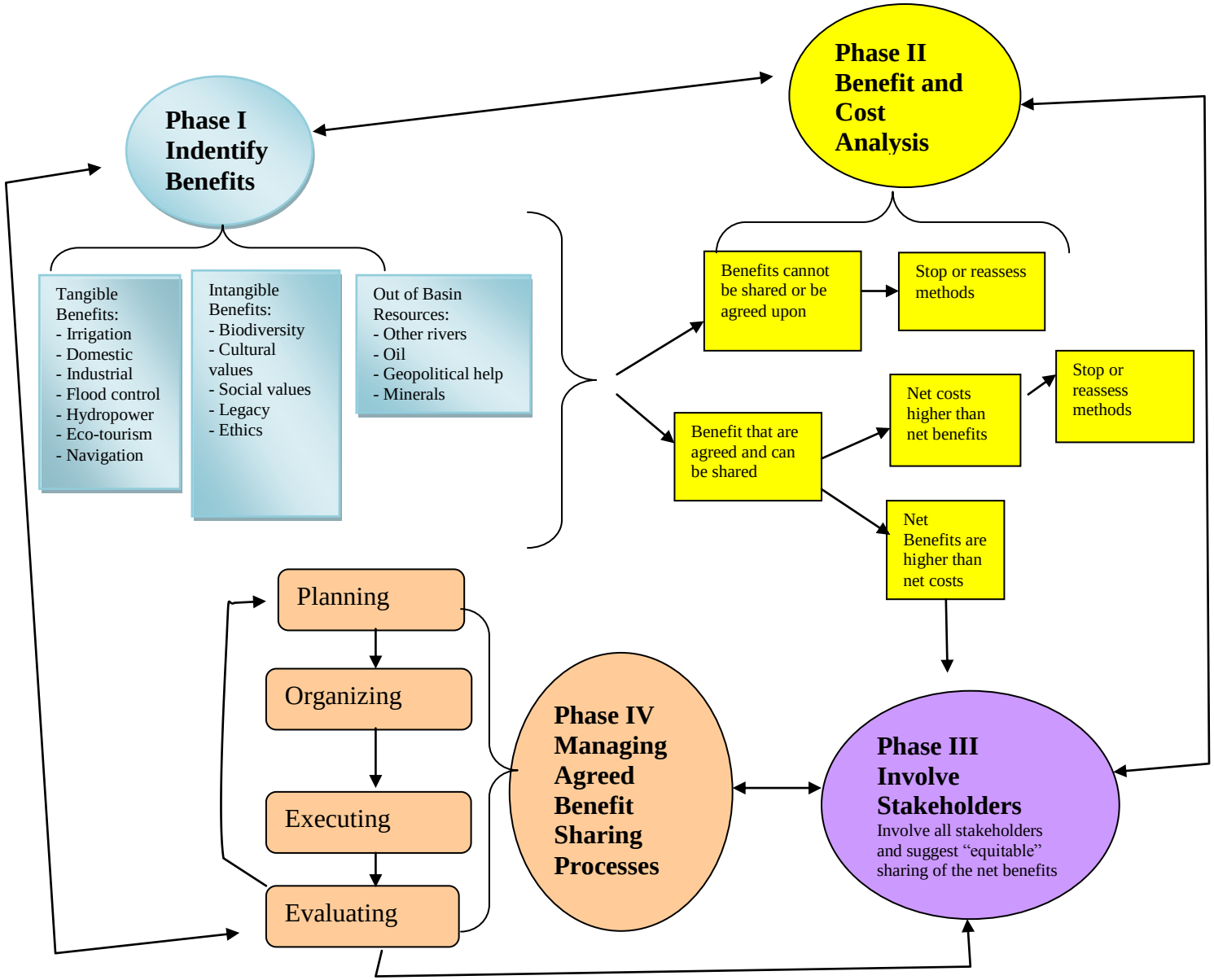


Figure 3.3: Implementation phases of the equitable distribution principle.

3.7.1 Phase I: identify benefits

Identification of benefits is a critical initial factor needed in the process of equitably distributing shared river resources. These benefits can include tangible benefits, intangible benefits, and benefits from outside of the geographic area of the basin. Most of the past and current benefit-sharing models concentrate on three tangible aspects: hydropower (for example, in the Columbia River Treaty), flood control (for example in the Ganges between Nepal and India and the Columbia), and, most recently, irrigation (for example in the Senegal River Basin) (Delli Priscoli and Wolf 2009). Aside from these three tangible benefits, there are many tangible and intangible benefits that deserve consideration (Figure 3.3). Other potential tangible benefits include monetary benefits from basin eco-tourism, industrial uses, and fishery. Intangible benefits from river basins include cooperation, geopolitical peace, biodiversity, and social legacy, among others. Another crucial factor rarely mentioned in academic research on transboundary benefit sharing is the exclusion of out-of-basin water resources and non-water related benefits such as oil, education, and security returns. Some stakeholder countries in shared river basins do not have many tangible factors to contribute to the basket of benefits. In addition, some stakeholders might need some other resources more than those derived from water. For example, Ethiopia might forgo utilizing the Nile water if the same benefits could be reaped from other rivers, such as the Awash. In the Mekong, Vietnam might accept hydropower from upstream development to compensate for anticipated losses of irrigation and fishery benefits in the downstream delta. Some examples of out-of-basin resources are addressed in Table 3.8 (Article 6.1 (g)). The identification of the benefits (tangible, intangible and out-of-basin resources) will give way to the next step of assessing which benefits can be shared. This is assessed in Phase II below.

3.7.2 Phase II: benefit-cost analysis

Three of the foremost challenges facing benefit-sharing processes are: 1) tools for pilot studies to distinguish the benefits that can be shared from those that cannot; 2) valuation methods, especially for intangible benefits; and 3) assessment of net benefit or costs. Tools for pilot studies identifying which benefits can and cannot be shared are lacking. Pilot studies are useful because they eliminate later research costs. Some quick considerations for pilot studies include space (extent or distance), available technology, and geopolitical security. Some potential benefits would not be economically efficient to share, due to the large distance separating (spaces) stakeholders. For example, sharing hydropower benefits between DRC and Egypt in the Nile would result in the implementation of huge infrastructure costs (roads, utility poles, etc). Moreover, some of the regions that would be traveled by the necessary hydropower energy lines are fraught with high geopolitical tensions. The unavailability of an economical technology to store hydropower in batteries is another impediment to the implementation of hydropower benefit sharing between DRC and Egypt. Second, valuation methods regarding benefits are not standardized among all the stakeholders. This is especially true regarding intangible benefits, such as social legacy, biodiversity, and the cultural value of water. Stakeholders value these benefits differently. In addition, the valuation of intangible benefits is often met with resistance, which hampers the implementation process. Third, once a benefit-cost analysis is done, the challenge becomes addressing distribution of the net benefits, as well as costs in the implementation of potential projects. The costs should not be born most heavily by the most vulnerable stakeholders, usually human populations living in the basin area, as well as the flora and fauna in the area. Questions arise as to how, where, when, and by whom these assessments should be made. The next section, Phase III, addresses these questions.

3.7.3 Phase III: stakeholder involvement

Stakeholder involvement is a necessary and critical process in the implementation of the EDB principle. In Phase II, the net benefits to be shared are discussed. The next phase is to decide how to distribute these benefits. Ideally, local, national and international stakeholders should participate in the decision process. The distribution of the cost needed to implement the project and the net benefits should be discussed among the stakeholders involved. At least three scenarios are possible. First, stakeholders, found at either of the scales, might come to the conclusion that the net benefits methods are flawed or non-distributable. Thus, the process goes back to Phase II again (see the arrows in Figure 3.2) for reassessment. The second scenario is that stakeholders might agree regarding the distribution of costs and benefits. The process thus enters the project management process, which is explained in Phase IV below. The third scenario might occur if at the management phase (phase four), it was decided that more inputs are needed from the stakeholders. Thus, the decision reverts back to Phase three.

3.7.4 Phase IV: management

Project management involves four stages: planning, organizing, executing, and evaluation. The planning stage includes the clarification of the objectives of the benefit-sharing project. The planning phase outlines the strategy to attain the objectives over the course of a given time (attaining the net benefit distribution as outlined by Phases I and II), while following the guidelines as outlined by the 1997 UN Convention and the benefits-sharing principles (Figure 3.2). The next step is to organize the resources needed to achieve the objective. These resources include, but are not limited to, staff, equipment, office space, and the establishment of communication channels with involved stakeholders. The third step is to execute or direct and control operations. The last stage is the evaluation or regulation stage. This process holds the management personnel accountable to whether or not the 1997 UN Convention and EDB principle are observed and upheld. The evaluation stage might uncover problems. Problems uncovered during the evaluation stage need

to be fixed, ideally at the management level, and if that is not possible, at the stakeholder phase.

3.8 Discussion and limitations

This chapter assessed the alignment of the EDB principle with the 1997 UN Convention, and suggested phases that enhance implementation likelihoods. The following subsections discuss whether the EDB principle meets development goals of the stakeholders, sustainable management strategies, poverty alleviation, and conflict resolution objectives.

3.8.1 Recommendations

In this chapter fourteen recommendations are presented that focus on specific potential net benefits concept in order to make the EDB principle consistent with the 1997 UN Convention and also to enhance its implementation possibilities. This section discusses the connection of these fourteen points to meeting the four dissertation objectives for the Nile region: 1) basin development aspirations, 2) poverty alleviation, 3) sustainable management of basin resources and 4) conflict resolution.

Development aspirations and poverty alleviation objectives are met through the utilization of the natural character of the geographic area (point one from section 3.6.8), the prioritization of economic sectors (point two), increase in information sharing (point six), focus on specific potential net benefit (point ten), consideration of all possible factors (point eleven), and the availability of funding (point fourteen) statements. The first suggested point is that stakeholders sharing a river basin utilize the natural character of the geographic area. For example, if the location of a basin area is very rugged, then the best utilization of the natural character of the area might be for hydropower generation or for tourism. Another argument for the utilization of

the natural character of the area is that it reduces costs, thereby increasing the basket of benefits to be shared, in order to meet development aspirations, such as building schools and attracting investments.

Second, benefit-sharing strategies that are geared (prioritized) towards economic sectors that contribute the most to the GDP of the states of the stakeholders are likely to meet development goals, at least in the short term. For example, regarding the Nile, the main economic contributor of Ethiopia is the agricultural sector, at 44 percent of the GDP (CIA 2009); thus, a Nile benefit-sharing scenario focusing on water availability for irrigation either directly from the Nile or through other conservation methods is likely to alleviate the poverty being felt by its inhabitants.

Third, the increase in information sharing regarding shared basins is more likely to spill over to other resources besides the basin, thereby increasing the basket of benefits and creating the integration of economies through enhanced trade. Fourth, the consideration of all factors besides those specific to the basin, leaves room for more negotiation, such as geopolitical peace, thus creating cooperation, a necessary cornerstone in the achievement of development goals. Fifth, the inclusion of other resources besides those derived from the basin, results in increasing the pie or basket of benefits that promote development, as well as alleviate poverty pressures. Last, the availability of funding is critical in the implementation of the EDB principle. Funds are necessary in paying for actual projects and also in providing critical resources for research and maintenance of institutions that promote the benefit-sharing principle. For example, the World Bank is a major donor for the maintenance of the Nile Basin Initiative, a river basin organization that is researching how to implement projects based on the EDB principle.

The objective of managing basin resources sustainably is met especially through addressing local rights and biodiversity concerns (point three), the need to be proactive (point four), the protection of vulnerable job sectors (point five), the

assessment of impacts at different spatial and temporal scales (point nine), the provision for extreme conditions (point twelve), and the use of the precautionary principle (point thirteen) statements. First, the consideration of biodiversity and local rights ensures sustainability (that measures are being taken to ensure inequitable costs are not borne by vulnerable groups). Second, implemented projects that cause significant job losses to vulnerable sectors are also unsustainable. For example, in the Nile Basin, a benefit-sharing project that allocates most of the basin water to Ethiopia to maximize net benefits to be shared with Egypt might cause harm to the 32 percent of the labor force (CIA 2009) that composes the agricultural sector in Egypt. A high degree of trust by Egypt and a strong commitment by Ethiopia to share the benefits would be needed to resolve such a situation. Third, both negative and positive effects of projects at differing spatial scales (local, national, and international) as well as temporal (short term and long term) should be taken into consideration. Fourth, a project implemented based on the EDB principle, that benefits stakeholders found at a particular geographic scale, but causes significant harm to stakeholders found at other geographic scale is not sustainable. Similarly, a project that causes no significant harm in the short term, but causes significant harm in the longer term, or vice versa, is not sustainable. Fifth, cooperative agreements, including those based on the EDB principle, should anticipate measures that need to be taken for extreme conditions such as drought and flooding. For example, the recent flooding of the Kosi River (a tributary of the Ganges basin) strained the relationship between India and Nepal and caused significant damage to the populace inhabiting the area. The lesson is that stakeholders need to anticipate, plan, and devise new methods for sharing net benefits or net costs during these extreme situations. Sixth, as much as possible before implementing projects, precautions should be taken to ensure that measures being taken cause no significant harm to stakeholders. This could be achieved through research, stakeholder participation, and devising strategies to ensure that implemented projects have the possibility to be corrected.

Conflict resolution objectives are especially met through the protection of vulnerable job sectors (point five), increase in information sharing (point six), creation of institutions (point eight), the availability of funding (point fourteen), and focus on specific potential net benefit (point ten) statements. First, in negotiations involving sovereign states, conflict might arise if vulnerable job sectors in the states are detrimentally affected. Thus, EDB suggested projects should not cause significant harm to sectors that are critically important to stakeholder nations. Second, an increase in information leads to a decrease in misunderstandings, as well as to reaching commonalities that maximize benefits. For example, in the Nile Basin, without increased communication between the Ugandan and Egyptian governments, the construction of Bujagali hydropower dam in Uganda would not have been possible. Egypt acquiesced to the project because water withdrawals by the dam do not reduce water flow towards Egypt (Luwa 2007). Third, institutions, especially RBOs, serve as platforms in the promotion of cooperation, information sharing, and joint management of common resources. For example, the IJC has been instrumental in the promotion of cooperation between Canada and the United States regarding the Columbia Basin. Fourth, the availability of funding is critical in supporting institutions, such as the IJC and NBI, as well as securing payments for experts that pursue conflict resolutions. For example, due to funding by the World Bank, the NBI has been able to consider the implementation of benefit sharing potentials, increase information sharing among stakeholders, and promote cooperation among the Nile countries. Finally, a focus on specific potential projects is recommended in order to decrease complexity. A focus on bringing consensus by considering various arrays of benefits under one umbrella is very complex, requires high financial as well as institutional investments, and is more likely to result in non-implementation of projects as agreements are difficult to reach. By focusing on net benefit-sharing projects, especially small ones, stakeholders or representatives of sovereign nations can potentially find solutions to conflicting conditions and overcome hurdles to maximization of net returns that enhance the basket of benefits for sharing.

The findings of this chapter center on specific potential projects as they meet both the above stated four general goals, as well as the specific objectives (aligning the EDB with the 1997 Convention and enhancing the likelihood of implementation for those projects that are based on it) of this chapter. In addition, non-sustainable or detrimental effects associated with specific projects are relatively easier to identify and overcome. The contribution towards development and poverty alleviation is also easier to identify as the resources required to achieve such an objective are relatively less time consuming relative to large overarching projects and strategies that include much more numerous factors. Similarly, the focus on potential benefits rather than re-distribution of existing benefits opens new avenues of resource exploration rather than taking away already allocated resources from some stakeholders and giving to others. For example, in the Nile Basin, a redistribution of the benefits from water (mostly concentrated between Egypt and Sudan) is likely to be opposed by Egypt and Sudan. However, a potential benefit, such as terracing systems in upstream countries such as Ethiopia, would help in recharging groundwater in Ethiopia, but also would decrease sedimentation, thereby aiding in increasing the lifespan of specific dams in downstream geographic locations.

The EDB principle has been criticized as difficult to implement by some researchers (Turton 2008; Merrey 2009) because it requires a high degree of trust, complex institutional arrangements, and a more integrated economies. The specific nature of the projects resolves these three requirements; specific projects, especially small-scale ones, do not necessarily require integrated economies or complex institutional inputs. If these specific projects are found to cause significant harm to fellow stakeholders, they could be potentially corrected, therefore not requiring high trust levels. The EDB principle as a new emergent principle in transboundary studies has high potential for creating better off scenarios for stakeholders sharing basins, relative to present conditions, through the maximization of benefits, its capability regarding consistency with existing rules (especially the 1997 Convention), and implementation possibilities.

3.8.1 Limitations

This chapter has uncertainties in regard to building consistency between the EDB principle and the 1997 UN Convention, as well as the implementation phases. One source of uncertainty is that the following factors were not considered: 1) the effects of direct and indirect benefits of water, 2) ambiguity regarding the definition of equity, 3) the effect of factors other than water in creating cooperation among stakeholders, 4) groundwater, 5) the assumption that stakeholders would be willing to share potential benefits, and 6) specific projects and valuation tools.

First, the benefits derived from water could directly benefit populations living outside the basin, as in the case of hydropower production, as well as having indirect benefits through interrelated economies. For example, hydropower generated from a basin could benefit an industry that uses the energy. Another example is a benefit-sharing scenario of monetary compensations made to farmers living in a basin, which negatively affects populations living outside the basin who were dependent on these farmers for food and other resources.

Secondly, it is inherently assumed in this chapter that equity in the distribution of shared benefits is achieved as long as net benefits outweigh costs and that the net benefit distribution is agreed upon by the stakeholders involved (Phases II and III). In real basin resource implementation, this ideal situation may not exist due to many factors. In some cases, politically powerful stakeholders wield more power than others, forcing their priorities regarding water projects. For example, Native American populations did not have much say in the Columbia River Treaty negotiations; as a result, they bore most of the cultural and legacy costs.

Thirdly, it is assumed in this chapter that as long as the net benefit and cost distribution is agreed upon, stakeholders would also agree in the implementation of projects. However, this might not be the case, as other factors can affect the process. For example, in a Nile Basin benefit-sharing project scenario between Eritrea and

Ethiopia, the geopolitical and border conflicts would be prioritized, hampering the implementation of benefit-sharing projects.

Fourth, groundwater presents another uncertainty in regards to its relationship with surface water, stakeholder participation, and its potential to be included as a benefits-sharing factor. The utilization of surface river water might affect water quality and quantity of groundwater and vice versa. Soil and water conservation methods and the construction of subsurface dams have been instrumental in enhancing replenishment of groundwater. On the other hand, diversion of surface rivers for benefit sharing projects might have the opposite effect. Groundwater boundaries are dynamic once the resource is developed and might include or affect other local, national, and international stakeholders, in addition to those already discussed. For example, if conclusive evidence is found that connects Nile surface flow with the Nubian aquifer system, Libya might get included in the Nile Basin Initiative.

Fifth, there is an inherent assumption in this chapter that stakeholders are willing to share potential benefits. This might not be true in some scenarios. In one scenario, when the politically powerful riparian A is located upstream and does not have any incentive to receive benefits from downstream riparian B (which is poor, politically weak, and has no benefit factor to contribute), riparian A might decide not share potential benefits.

Lastly, this chapter does not assess specific water projects and valuation tools. Each potential project will likely have its own unique type of benefits and costs and magnitudes. The lack of specificity results in the unavailability of an essential ingredient in making concrete decisions.

The six uncertainties discussed above were not addressed in this chapter for several reasons. First, the inclusion of all direct and indirect benefits, as well as the consideration of all decisions, would be very complex and costly. Second, finding

methods to decrease the ambiguity regarding the definition of equity generally results in more ambiguity. Methods such as standardization of equity values also face problems as these values change rapidly over time as well as space. Third, similar to equity issues, factors other than water (such as geopolitical relations) that affect the implementation of benefit-sharing projects change rapidly over time. For example, geopolitical relations between Eritrea and Sudan (both Nile riparians) have fluctuated between cooperation and tension several times. Fourth, the study of groundwater, especially at the international scale, is very complex and costly. The contamination of groundwater and transfer of hazardous wastes termed "silent trade" into Lebanon (Jurdi 2002) is a concern that can affect the benefit sharing framework, especially regarding water quality. Due to the relationship between groundwater and surface water, over withdrawal of groundwater can detrimentally affect surface water (Jarvis 2006), thus affecting benefit-sharing potential. Fifth, the assumption that stakeholders are likely to share potential benefits is based on the fact that international rules, such as human rights laws, UN Security Council conventions, and the increasing democratization of political systems around the world are more amenable to the implementation of the EDB principle. Last, this chapter did not consider specific projects in order to assess actual benefit-sharing processes. This is mainly due to two issues, including the intention of the UN 1997 Convention and thus the EDB principle to create cooperation or shared visions rather than actual implementation, and the difficulty of estimating potential project costs and benefits.

3.9 Conclusion

Although the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses is not yet ratified, it is the most influential legal rule that exists regarding cooperation in shared or transboundary rivers. The objective of this chapter was to make the EDB principle more amenable to implementation by building consistency with the 1997 UN Convention and suggesting broad phases to aid in benefit-sharing project management. The chapter argues that by focusing on specific potential benefits (rather than redistributing existing benefits), the following points are needed to built consistency with the convention: 1) utilization of the natural character of the basin area; 2) prioritization of economic sectors that contribute the most to the National GDP; 3) willingness to address specific concerns of basins, such as local rights and biodiversity protection; 4) a proactive approach that anticipates future challenges such as population growth rate needs; 5) protection of vulnerable job sectors or enhancement or creation of jobs in other sectors; 6) increased information sharing among riparians; 7) existence of conflict resolution mechanisms; 8) creation of institutions, especially RBOs; 9) assessment of impact at different spatial and temporal scales; 10) consideration of all factors that can be shared: water, non-water, within basin and out-of-basin resources; 11) provisions for extreme conditions, such as drought and flooding; 12) use of the precautionary principle, especially regarding large benefit-sharing projects, such as big dams; and 13) availability of funding to create RBOs, support research and implement projects. The chapter also suggests a broad flow chart that includes four phases of implementation processes: 1) identification of benefits, 2) benefit-cost analysis, 3) stakeholder involvement, and 4) managing agreed benefit-sharing projects.

4 FROM WATER ALLOCATION AND COST SHARING TO BENEFIT SHARING PRINCIPLE: IMPLICATIONS TO THE NILE BASIN

Biniam Iyob, Itay Fischhendler, and Mark Giordano

The previous chapter assesses the alignment of the equitable distribution of benefits to 1997 UN Convention. This chapter assesses whether the Nile Basin has the right conditions to implement projects based on the equitable distribution of benefits principle

4.1 Abstract

Countries sharing the Nile Basin resource are endeavoring to implement the principle of benefit sharing. The principle advocates the sharing of the benefits derived from transboundary rivers, rather than from water quantity. The general objectives of this chapter were to address the promises and ambiguities proposed by the principle in relation to returns and implementation possibilities. The specific objectives of this chapter were to assess the reasons behind the push towards the principle, derive lessons from three basin case studies (Columbia, Aral, and Ganges) to identify conditions required for successful implementation of the principle, assess whether the Nile has the right conditions, and recommend suggestions for its implementation. This chapter suggests that although the principle is ambiguous, its potential benefits are high, and that its implementation, although complex, is still viable at sub-optimal levels. Current and expected population and economic growth pressures were not accommodated through water allocation or cost-sharing methods, which paved the way for the way for the principle of benefit sharing to be proposed as a new solution. Challenges and successes faced by the three basin case studies yielded six conditions to be assessed in order to determine whether the conditions are right for the Nile Basin countries to implement benefit-sharing principles. These six conditions include the existence of cooperation, agreements, or treaties that are acceptable to and ratified by all parties, a high level of integrated economies, the availability of funding to implement large-scale projects, the level of geopolitical peace, and sustainable management strategies. With the exception of a high level of economic integration, the Nile countries partially fulfill the other five conditions.

Key Words: Benefit Sharing, Equitable Distribution of Benefits, Nile, Transboundary Rivers

4.2 Introduction

Transboundary river basins share tributaries or watersheds between and/or among sovereign nations and decentralized political entities, and encompass local, regional, and international activities related to the use of limited water resources. Developing nations, especially, find themselves embroiled in intra-communal and state-society conflicts over the use of precious and finite resources due to development policies intended to meet the growing demands of agrarian and urban areas. The conditions most conducive to mutually beneficial coexistence between rural and urban constituencies are, at times, complicated by multi-national agreements seeking to promote cooperation among or between countries sharing transboundary rivers. This chapter focused on an examination of the implications of the *benefit sharing principle* in one of the oldest regions in the world, where equitable utilization of a shared resource has long been contested by the disparate nations sharing the many tributaries and watersheds of the Nile.

Cost-sharing and allocation theories have recently been overtaken by the prevalence of policies centered on benefit sharing. Researchers and policy-makers appear to have found a common ground in the consensus that benefit sharing regarding transboundary basins points to a viable basis for the implementation of water projects, which, in turn, are expected to fulfill national aspirations for the development and equitable utilization of this finite source. Several experts in the field, including Claudia Sadoff (2002), David Grey (2002), Ariel Dinar (2007), and Aaron T. Wolf (2009) have suggested that benefit-sharing policies would achieve relatively better results than water quantity distribution in transboundary river negotiations and the implementation of water projects. River basin organizations (RBOs), encouraged by international organizations and researchers, are pondering the implementation of the benefit-sharing principle. The Nile Basin Initiative (NBI), an RBO established in 1999 by countries sharing the extended river basin, is actively engaged in a multi-national agenda, bringing together the countries of the North,

East, Central, and Horn of Africa regions in dialogues that seek to establish consensus on the modalities of the principle of benefit sharing. Although the theoretical premises point to a cautious optimism, there are numerous impediments to the implementation of actual policies of benefit sharing. This chapter identified the following factors as standing in the way of the effective implementation of policies based on the concept of benefit sharing:

- Absence of clear and accepted definitions of the following terms: benefit, sharing, equal, and equitable.
- Paucity of extensive literature on the geopolitical factors that led to the formation of ambiguous language in the shaping of multi-national agreements, which, in turn, led to impediments to the initiation of agreed-upon policies of equitable sharing of transboundary basin resources.
- Absence of clarity in the identification and assessment of the shared resources and net benefits that are subject to equitable distribution based on agreements.

The general objective of this chapter is to fill some of the gaps stated above. Specifically, this chapter has the following objectives regarding the Nile Basin:

- Assess the factors that promote a transition from water quantity allocation and cost sharing to benefit sharing
- Examine lessons from other transboundary basins regarding the implementation of benefit-sharing agreements that can be applied to the Nile Basin
- Determine the necessary conditions for the successful implementation of benefit-sharing agreements
- Assess whether the conditions are right for the implementation of benefit-sharing agreements for the Nile Basin
- Provide recommendations for implementing benefit sharing proposals.

4.3 Evolution towards benefit sharing

4.3.1 History of water sharing mechanisms

Stakeholders in transboundary basins have devised several methodologies used to achieve cooperation and maximize benefits of their shared river resources. These include 1) general agreements stating that no significant harm is to be caused by water development, 2) the allocation of water quantity, and 3) cost sharing of water projects. A fourth method, the benefit-sharing concept, will be discussed in the next section. All of these methods have advantages and disadvantages.

Nations have been using customary and international laws or principles to reach cooperative agreements in managing their shared rivers. The most commonly referenced international proposal is the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses. The 1997 UN Convention addresses two main issues in transboundary basins: "avoidance of significant harm" to stakeholders and "reasonable and equitable utilization of resources" (Salman 2007; Delli Priscoli and Wolf 2009). The advantage of this general agreement is that it includes the "avoidance of significant harm" statement. The inclusion of this statement means that riparians are likely to sign the agreements and cooperate because none want to be seen as significantly harming the other riparians. Additionally, the UN Convention also allows the utilization of resources because of its "reasonable and equitable utilization" terminology. The disadvantage is that it is hard to monitor whether any other agreements are being violated, since there are no specific parameters that state exactly what "significant harm" is and what "reasonable and equitable utilization" means.

A method with relatively less ambiguity than general agreements is the allocation of water quantity among stakeholders. An example of this method is seen in the Indus River Basin Treaty, signed in 1960 (Abu-Zeid and Biswas 1992; Iyer 2003), between India and Pakistan. The eastern rivers, the Sutlej, Beas, and Ravi, were allocated to

India and the western rivers, the Indus, Jhelum, and Chenab were allocated to Pakistan (Abu-Zeid and Biswas 1992). There are advantages and disadvantages to water quantity allocation. The main advantage is that management costs are lower, as monitoring is relatively easy. The disadvantages include the difficulty of including new factors that may emerge, such as drought periods, changes in environmental values, the effects of climate change and local rights. Water quantity allocation also leaves very little room for negotiations, as discussion is generally centered on water quantity. Due to high costs and low benefits, one of the methods developed is to share the costs of water related projects in the shared rivers.

An alternate method of sharing transboundary river resources involves sharing the costs of water projects comparable to the expected net benefits. Several basins have negotiated agreements that are based on cost sharing. For example, with the 1988 treaty between Brazil and Bolivia, the two governments agreed to develop hydropower generation plants and share the cost relative to the benefits they obtain (TFDD 2009b). The advantage of sharing costs among riparians is that it allows the implementation of water projects in riparians that would not otherwise be able to afford them. The main disadvantage of the cost-sharing concept is that cost-sharing assessment is a complex process that requires time and money. Furthermore, there may be additional costs to vulnerable stakeholders and poorer countries that may not be included or considered, such as loss of wildlife habitat. Meeting the costs to be shared may be beyond the capacity of some stakeholders, and there may be additional costs for enforcement or regulations. These disadvantages have led to research on new ways to manage shared rivers. One of the suggested new methods is the benefit-sharing concept.

4.3.2 The evolution to benefit sharing principle

One of the most promising trends in sharing transboundary river resources is the benefit-sharing concept. The concept suggests the sharing of benefits, rather than

distributing quantity or costs of water projects related to transboundary rivers. There are several factors that precipitated the evolution toward the benefit-sharing concept. Some of the factors that will be discussed in this chapter include: 1) the disadvantages associated with implementing treaties based on water quantity allocation principles; 2) information about the type, quantity and influence of costs that were not being considered in the past; 3) increase in cooperation and information sharing among nations sharing rivers; and 4) the dependence on funding from benefactors outside of the influence of the stakeholder nations.

Shared river treaties or agreements that were implemented, especially those based on water quantity allocation, have often resulted in net losses rather than increased benefits. Some of these losses include the loss of biodiversity, socio-cultural problems, and geopolitical tensions. In the past, water quantity allocations have focused on very few factors, mainly the irrigation of crops and water for hydropower benefits, rather than on multiple benefits, and have ignored the costs to other aspects of transboundary river basins. Examples of such costs are abundant in several transboundary basins. In the Lesotho Highlands water projects, where three out of five planned dams have been built, researchers have found negative social impacts, including the loss of arable land, inadequate compensation, earthquakes caused by water accumulation due to the dams, and increased labor for women (Tilt, Braun, and He 2008). In the Danube River Basin, which is shared by 18 countries in Europe, the focus on navigation has led to a lack of attention paid to water quality and pollution issues (Wolf 2001) in the past. Currently, under the EU water framework directive, the pollution problem, which is estimated to be 40% at risk of not meeting the 2015 goal (WISE 2009), seems to be in the process of being overcome. The identification of costs, such as the cost of pollution in the Danube, has led to the identification of water quality as an essential benefit factor, along with other new factors.

The identification or consideration of new and numerous benefits that are derived from transboundary rivers has resulted in innovative benefit-sharing processes. Among many others, water quality, hydropower, biodiversity, socioeconomics, cultural aspects, eco-tourism, and geopolitical cooperation are some of the benefits being considered. Hydropower benefits have been the easiest to implement, as they do not result in overlapping use of water resources. The use of hydropower by upstream countries generally does not result in decreased water quantity to downstream countries. Globalization and an increased focus on international cooperation, along with research that supports sustainable development, have also been instrumental in propelling the benefit-sharing concept. Stakeholders are finding that, by linking their economies, they benefit more as goods are produced at the most efficient and effective geographic locations available. In addition, international and local governments are requiring projects, including transboundary river utilization projects, to abide by sustainability rules in order to mitigate the negative impacts of globalization. Sustainability, which is generally defined as ensuring that present activities cause no significant harm to present and future stakeholders, requires the assessment, both negative and positive, of all factors that can be considered. Accounting for all the factors and benefits, especially those regarding transboundary river resources, requires cooperation among the stakeholder countries.

Cooperation or agreements among countries and the relative ease of information sharing have propelled the implementation processes of the benefit-sharing concept to higher levels. Worldwide, the intensity of conflict among or between countries (not insurgencies within nations) has been dropping. After World War II, the formation of the United Nations and the ending of the Cold War have led to relative peace in many countries. European nations integrated in the European Union formed the EU water framework in 2000 (WISE 2009) regarding water resources. The United States of America and Canada agreed to share hydropower and flood control benefits from the Columbia basin equally (Muckleston 2003). Even in potentially volatile areas, such as the Jordan River Basin, there are abundant examples of and

opportunities for the concept of benefit sharing. For example, in 1987, Jordan and Syria signed an agreement to share hydropower benefits from the Unity dam, which is still in the construction phase (Fischhendler 2008). Most of the research regarding benefit sharing has been proposed using economic models. Delli Priscoli and Wolf, assessing game theories, suggest that although the economic gains are theoretically feasible, failures may be due to "political considerations", "unbalanced allocation of the regional gains", and "not clear benefits" considerations other than those directly related to water (Dinar and Wolf 1994a; Delli Priscoli and Wolf 2009). So far, although there are agreements regarding benefit sharing, the only enduring implemented benefit sharing agreements are in the Columbia, Ganges, and most recently, the Senegal basins. In addition to cooperation, information has been flowing at a faster rate than ever before, thanks to the internet and computers. The quickened flow of information is promoting fast communication and allowing members to identify existing problems and thus come up with new ideas. The increase in information sharing is greatly aided by international organizations.

The influence wielded by international organizations in RBO activities has also been instrumental in promoting the benefit-sharing principle. International organizations, such the World Bank, International Water Management Institute (IWMI), and the UN, primarily help in fostering information sharing platforms, providing researchers, and giving financial aid for the formation and maintenance of RBOs. Prominent researchers associated with international organizations promoting the benefit-sharing principle include Claudia Sadoff, and David Grey, working for the World Bank. Sadoff and Grey are pioneers of the benefit-sharing concept in transboundary basins. The World Bank is the major financial donor, and the United Nations is also involved in the management processes of the NBI. The World Bank is the guarantor of the Indus River Treaty between India and Pakistan. The support of international organizations, as well as globalization processes, has greatly facilitated the formation of RBOs and the realization of their objectives. Several RBOs in different regions of the world have had experiences in reaching agreements and implementing the

benefit-sharing principle. The experience of these basins can serve as a lesson for the Nile Basin. In the next section, experiences from basin case studies of the Columbia, Aral, and Ganges basins will be assessed.

4.4 How cost and benefit sharing have been applied in practice.

Analyzing transboundary benefit-sharing experiences from other basins provides critical knowledge for managing the Nile Basin. Many researchers recommend the promises of benefit sharing for many reasons. Prominent among these researchers are Sadoff and Grey. Sadoff and Grey aptly summarized the promises as follows: 1) better ecosystem management, which will maintain or improve the river; 2) higher returns from the river, due to cooperation between basin nations; 3) decreased costs, due to cooperation between basin nations; and 4) creation of opportunities for cooperation in other sectors not related to the river, and increased geopolitical harmony (Sadoff and Grey 2002). Aside from the Nile, other basins with promising futures in implementing benefit-sharing principles include the Aral and Ganges basins. In the following subsections, we will discuss case studies from the Columbia (where implementation of benefit sharing has already occurred), the Aral, and Ganges basins in order to assess their experiences with benefit sharing, synthesize the lessons learned, the conditions that led to successes, the limitations they faced, and evaluate applications of these lessons to the Nile Basin.

4.4.1 Columbia River Basin

The Columbia River Basin is shared between the United States and Canada. The Columbia River Treaty (CRT) is frequently cited as a successful example of benefit sharing of transboundary rivers. The CRT was ratified in 1964 to ensure sharing of flood control and hydropower benefits equally between the two countries (Muckleston 2003). The United States paid in advance for the share of the value of the Canadian benefits from estimated 60 years worth of flood control and 30 years

worth of hydropower (Muckleston 2003). The success of the CRT can be attributed to several factors, including harmonious historical relations (Muckleston 2003), the existence of a permanent RBO, a relatively rich stage of economic development, integration of the stakeholder economies, location of both countries upstream and downstream of basins' tributaries of each other, and relatively abundant distribution of water in both countries.

Historically, United States and Canada have enjoyed peaceful geopolitical conditions. This peaceful and cordial relationship has been instrumental in creating the cooperation that led to the success of the CRT (Muckleston 2003). In addition, should conflicts arise, the International Joint Commission (IJC), a permanent RBO, will most likely resolve the disputes. The IJC, created in 1905-1909, was able to resolve about 130 cases, mostly located in the Great Lakes region and dealing primarily with water quality (Wolf 2001).

Successful and integrated economies tend to create an impetus for the implementation of the benefit-sharing principle. The higher the level of economic development, the higher the potential of an institution to be resilient or successful in addressing pressures (Wolf 2007). Both countries that share the Columbia River Basin are two of the economically richest in the world. The average Gross Domestic Production (GDP) of Canada, adjusted for Purchasing Power Parity (PPP) is $39,300, while the United States has a GDP of $47,000 (CIA 2009). These countries have the capacity, monetarily, technologically and skill-wise, to resolve problems. In addition, because both nations are members of the North American Free Trade Agreement (NAFTA), formed in 1994, the economies of the nations are highly integrated. The USA and Canada are primary export and import partners to each other. USA exports 77.75% to Canada, while Canada imports 52.4% from the USA (CIA 2009). Due to the presence of integrated economies, benefit sharing from the Columbia and other shared rivers are easily incorporated within the framework of their shared trading parameters.

Their location and the relatively high abundance of water in both countries are also an impetus for cooperation. On some of the tributaries of the basin, both countries are upstream and downstream of each other (Yu 2009). Thus, both countries are hindered from implementing policies unilaterally that might cause significant harm to the other, as both have the capability to respond with equivalent strength. Regarding abundance, Canada has renewable freshwater resources equivalent to 3300.0km^3 per year, while the U.S. has 3,069 km^3 per year (Gleick et al. 2009b). In comparison, other countries in the world have much a lower amount of renewable freshwater resources. For example, in the Nile, Egypt has 86.8, Ethiopia has 110.0, and Sudan has 154.0 (Gleick et al. 2009b). The relative abundance of water in the Columbia Basin has led to more innovative utilization of their shared river resources, other than just quantity allocation. Hydropower and flood-control benefits dominated policy-making in the past, while currently, newer factors such as water quality, Native American and First Nation rights, and salmon habitat restoration seem to be dominating policy ventures.

Some of the goals that the Nile can adopt from the Columbia River Basin success include: 1) increase geopolitical harmony; 2) give economic incentives to stakeholder countries to increase their GDP; 3) push a collaborative framework that promotes or facilitates economic integration among the Nile countries; 4) increase the abundance of water through various means, such as by decreasing existing losses and improving conservation with erosion control, decreasing evapotranspiration from standing waters (dams), desalination from the Red Sea, and drilling for groundwater resources; and 5) push for the creation of a permanent RBO. Additionally, disadvantages associated with the CRT should also be considered as learning opportunities. Some of the problems associated with the CRT that the Nile should avoid include ecological losses such as the loss of salmon habitat, and the inequitable costs borne by the Native American and First Nation peoples. Summarized lessons from the Columbia from the following two basins are stated in Table 4.1.

4.4.2 Amu and Syr Darya (Aral Sea) Basin

Benefit-sharing processes in the Aral Basin are heavily influenced by stakeholder association with the former Union of Soviet Socialist Republics (USSR) and by environmental disaster. The basin is often cited as an ecological disaster due to water shortages and water quality degradation. Water shortages result mainly from overdrawing of water from river tributaries (the Amu Darya and the Syr Darya) that drain to the Aral Sea. During the Soviet era, these withdrawals were heavily encouraged in order to produce cotton through intensive irrigation. Desiccation of the basin can be mostly seen especially in the southern portion of the Aral, where the sea was only 60% of its original size in 1987, as compared to 1960 levels (Glantz 2007). Increased salinity, drought, respiratory illnesses, and loss of the fishing industry are some of the problems faced by the Aral Basin (Glantz 2007). The northern portion has been overfilling due to increased flow from the Syr Darya, while the southern portion is still desiccated (Roll et al. 2003). Due to the recently built Kok-Aral dam, there have been reports that the northern portion is filling up (Burton 2006). Restoring the quantity and quality of the Aral Sea are critical in the Amu and Syr Darya (Aral Sea) basins. After the collapse of the Soviet Union, the basin is now shared among five countries, Kazakhstan, Uzbekistan, Tajikistan, Turkmenistan, and Kyrgyzstan (TFDD 2009a). These countries are now facing challenges in sharing the benefits of the Aral Basin.

Table 4.1: Lessons from the Columbia, Aral and Ganges Basins to the Nile.

Basins	Successes	Lessons from Successes	Challenges	Lessons to the Nile
Columbia Basin (Flood control and hydropower benefit sharing)	1. Historically harmonious geopolitical relation 2. Integrated economies 3. Relatively economically rich riparians 3. Low economic dependency on the basin being shared 4. Successful permanent RBO, i.e., International Joint Commission (IJC)	1. Create geopolitical harmony between Eritrea and Ethiopia; create peace between rebel forces and governments in DRC, Rwanda, Burundi, and Uganda 2. Integrate economies using the African Union or The Intergovernmental Authority on Development (IGAD) in Eastern Africa. 3. Create economic sectors that are less dependent on water 4. Facilitate and increase the formation of a permanent RBO	1. Ecological Values 2. Native American and First Nation rights	1. Consider ecological values such as: salinity of soils, siltation, deforestation, erosion, and lake pollution (Kagera, and Victoria) 2. Consider indigenous and local rights such as the displacement caused due to relocation of the populace due to the building of the Merowe dam in Sudan and the various potential dams and other projects
Aral Basin (Hydropower benefit sharing: between Kazakhstan, Uzbekistan, Tajikistan, Turkmenistan and Kyrgyzstan)	1. Historical economic integration under USSR 2. International cooperation in the form of aid. 3. Economic gain (oil) from some of the riparians 4. Relatively clear terms of sharing benefits	1. Integrate economies using the African Union or the IGAD 2. Involve international organizations such as the world bank. 3. Use the new oil economy of Sudan as key to benefit sharing principles 4. Create clear benefit sharing upon mutual agreement that satisfies the Egyptian Water Security clause and the equitable utilization aspiration by upstream riparians	1. Ecological Values 2. Dependency on cotton rather than on sustainable methods of use in the Aral basin 3. Implementation of agreements	1. Consider, ecological values such as: salinity of soils, siltation, deforestation, erosion, lake pollution (Kagera, and Victoria) 2. Shift from high intensive water use (agricultural) to other economic sectors 3. Create implementation mechanisms with clear deadlines for starting and finishing projects
Ganges Basin (Flood control and hydropower benefit sharing between India and Nepal)	1. Historically harmonious geopolitical relation 2. Topography (India being on the flood direction)	1. Create geopolitical harmony, including improved relations between Eritrea and Ethiopia; create peace between rebel forces and governments in DRC, Rwanda, Burundi, and Uganda 2. Create benefit sharing mechanism that makes use of the topography (Eg. hydropower in the rugged terrain of upstream and irrigation in relatively flat downstream countries)	1. Flood prevention. 2. Implementation of proposed benefit sharing agreements 3. Dependence of nations on agricultural or irrigation use of common rivers.	1. Create implementation mechanisms with clear deadlines for starting and finishing projects 2. Shift from high intensive water use (agricultural) to other economic sectors.

Before the split of the USSR, quotas were allocated for each of the countries (Wolf 2001). The quotas included both water quantity and benefit allocations. During the Soviet era, Resolution 566 allocated water from the Amu Darya to Kyrgyzstan, 0.6%, Tajikistan, 15.4%, Turkmenistan, 35.8%, and Uzbekistan, 48.2% (Roll et al. 2003). Because the USSR wanted Uzbekistan to produce cotton at a large scale, upstream riparians were compensated through "alternative fuel", "food stuffs," and "other products" (Abdullaev, Giordano, and Rasulov 2007). After the split of the USSR, the agreements regarding benefit sharing processes became untenable. The five sovereign nations sharing the basins have had to reach different agreements than they had in the past. In 1992, the riparians reached an agreement, The Agreement on Cooperation in the Management, Utilization and Protection of Interstate Water Resources, which was signed on February 18, 1992 by representatives from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan (Delli Priscoli and Wolf 2009). In general terms, the agreement calls on the riparians to coordinate efforts to "solve the Aral Sea crisis" by exchanging information, carrying out joint research, and adhering to agreed-upon regulations regarding water use and protection (Delli Priscoli and Wolf 2009). The agreement also establishes the Interstate Commission for Water Management Coordination to manage, monitor, and facilitate the agreement (Delli Priscoli and Wolf 2009). Since its inception, the commission has prepared annual plans for water allocations and use and defined water-use limits for each riparian state (Wolf 2001).

The agreement among the four out of five riparians involves the sharing of benefits other than water quantity allocation from the basin. The agreement among Kazakhstan, the Kyrgyz Republic, Uzbekistan, and Tajikistan in the Syr Darya basin and the Aral Sea involves arrangements for trading hydropower, gas, coal, and oil (Qaddumi 2008). In 1998, an agreement was signed among three Aral Basin riparians, including Kazakhstan, Kyrgyz, and Uzbekistan. In Article 2 of the agreement, an equal (1100 million kWh each) sharing of hydropower benefits between Kazakhstan and Uzbekistan was reached (The Republic of Kazakhstan, the

Kyrgyz Republic, and the Republic of Uzbekistan 1998). Article 4 also states that "The Republic of Kazakhstan, in exchange for 1.1 bn kWh of power from the Kyrgyz Republic, will provide 250 million kWh of electric power to the Talaskaya Oblas"(The Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan 1998). Tajikistan, which joined the agreement later, is also involved in sharing hydropower energy. "The Republic of Tajikistan agreed to operate the Kairakkum reservoir according to the set protocols, and the Republic of Kazakhstan and the Republic of Uzbekistan agreed to supply equal portions of electric power to the Republic of Tajikistan in the period of the reservoir water storage, the agreed equivalent electricity amount shall be subsequently supplied back during summer" (The Republic of Kazakhstan et al. 1999). The agreement further includes compensations as part of the negotiation process through decisions on water releases, production and transit of electricity, and for energy losses, on an equivalent basis (The Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan 1998). The above-discussed treaties, set up after the fall of the Soviet Union, keep essentially the same agreements in place. However, they are not enforced. Therefore, although elegantly stated, the agreements do not currently function as actual benefit sharing.

In a parallel development, the Agreement on Joint Actions for Addressing the Problems of the Aral Sea and its Coastal Area, Improving of the Environment and Ensuring the Social and Economic Development of the Aral Sea Region was signed by the same five riparians on 26 March 1993 (Wolf 2001). This agreement established a coordinating body, the Interstate Council for the Aral Sea, which was designated as having primary responsibility for developing policies and implementing programs in order to mitigate the crisis (Wolf 2001). The minister of water management of each state is a member of the council. In order to mobilize and coordinate funding for the activities of the council, the International Fund for the Aral Sea was created in 1993 (Wolf 2001). Although major efforts have been undertaken to save the Aral Sea, none of the riparians are currently considering

curtailing water withdrawals for irrigation. The riparian economy is highly dependent on irrigation activities. Because of problems associated with achieving the objectives of the International Fund for the Aral Sea (IFAS), formed in 1998, the riparians did not meet until 2002 (Delli Priscoli and Wolf 2009). In 2002, Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan formed the Central Asian Cooperation Organization (CACO) (Delli Priscoli and Wolf 2009). This collaborative organization, CACO, which addresses regional cooperation issues, including water, might be the catalyst needed to achieve a more successful and implementable benefit-sharing scenario. The solution to implementing benefit-sharing agreements on the ground still remains elusive in the basin. The lessons from the Aral could help Nile Basin riparians in achieving successful implementation of the benefit-sharing principle.

The lessons from the Aral to the Nile are as follows: 1) the reliance on irrigation at the cost of sustainability should be avoided; 2) the Nile countries should be aware that without a strong permanent institution that can direct and enforce benefit sharing, the possibility of implementing the benefit sharing principle is low; and 3) a similar (obviously not the same) integrated economy to what existed during the Soviet era might be required to implement the principle (Table 4.1).

4.4.3 Ganges Basin relations between India and Nepal

The Ganges Basin is shared by Nepal (the most upstream riparian), India, and Bangladesh (utmost downstream riparian) (Biswas and Uitto 2001) and is fraught with complexity. The complexity arises from the diversion of water to accommodate growing population demands, information availability, geopolitics, overlapping needs, and water quality and weather variability. Although there are agreements regarding benefit sharing between India and Bangladesh, actual implementation of benefit sharing happened only between India and Nepal, hence our focus on implementation in this section.

In a 1996 agreement between India and Bangladesh, a treaty was signed that establishes that both countries wish to share the international rivers that flow through the two countries and optimally utilize the water resources for flood management, irrigation, river basin development, and generation of hydropower for the mutual benefit of the two countries (The Republic of India and The People's Republic of Bangladesh 1996). Although the agreements between India and Nepal are similar to those between India and Bangladesh, some of the benefits stated have actually come to fruition. In Article 2, Section 2a of the agreement between India and Nepal, which details a method for sharing water quantity, it states that India make a supply of 28.35 m^3/s during wet season and 8.50 m^3/s during dry season to Nepal, and also hydropower energy sharing, i.e., India providing 70 million kWh to Nepal (His Majesty's Government of Nepal and The Government of India 1996). In addition, as part of the flood-control benefit-sharing process, India plants trees in Nepal to contain downstream sedimentation (Delli Priscoli and Wolf 2009). The factors influencing these agreements seem to be geopolitical power, location, and historical relations between India and Nepal. In terms of geopolitical power, India overwhelms Nepal. This power relationship hinders Nepal, as the upstream riparian, from implementing unilateral decision regarding water projects that might affect India. This is not the case regarding relations between India and Bangladesh, where politically powerful India is located upstream. In addition, for most of their mutual histories, Nepal and India, have had harmonious geopolitical relations.

Despite seemingly successful benefit-sharing implementation processes, the nations have faced some challenges. There have been complaints from Nepal that India exercised undue influence over the benefit-sharing process (Delli Priscoli and Wolf 2009). The most recent challenge facing the agreement is the flooding in the Kosi Dam. Flooding occurred in 2008, displacing 50,000 Nepalese and 2.5 million Indians from the state of Bihar (Pun January 2009). The Nepalese government has blamed the problem on the Indian Government, while the current governor of the state of Bihar, a federal state of India, has blamed the problem on the government of his

predecessor (Pun January 2009). Relief efforts are being made by India, which has sent a delegation to Nepal, suggested the building of a high dam, provision of "round the clock patrolling", and offered assurances that relief will be given (Rs 200 million for immediate relief, Rs 852 million for operating the sluice gates, and Rs 1430 million for reconstruction of embankment), as well as inviting delegates from Nepal (IANS 2009).

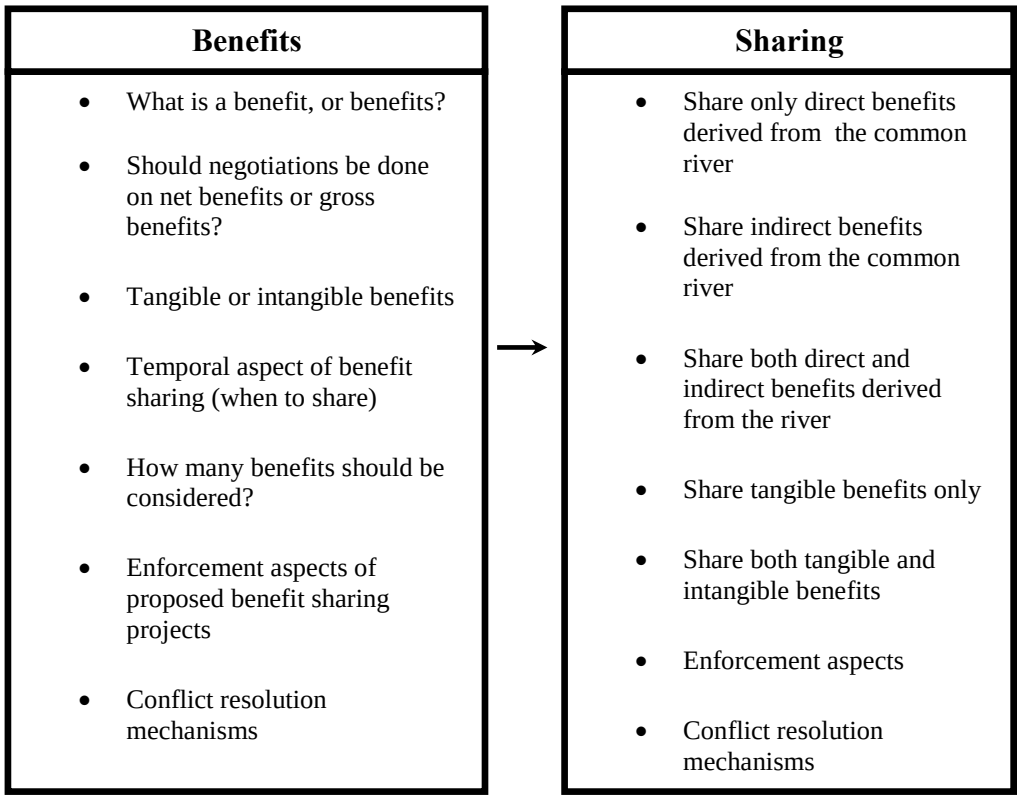
The successes and challenges faced by the Ganges Basin can serve as lessons for the Nile. The factors leading to success include 1) historically harmonious geopolitical relations; and 2) the politically powerful downstream location of India, which helps in the implementation of flood control benefits. The challenges to success include 1) flood prevention, to prevent cases such as what was seen in August 2008, in the Kosi River; 2) implementation of proposed benefit sharing agreements, as other discussed benefits including hydropower have yet to materialize; and 3) the dependence of the nation on agricultural or irrigation use of common rivers. The lessons for the Nile to be gleaned from the Ganges Basin include 1) the creation of geopolitical harmony, including between Eritrea and Ethiopia, and peace between rebel forces and governments in DRC, Rwanda, Burundi, and Uganda; 2) the creation of a benefit-sharing mechanism that will make use of the topography, for example, hydropower generation in the rugged terrain of upstream Nepal and Ethiopia; and 3) the institution of flood control in downstream areas, and irrigation in relatively flat downstream countries. The lessons that can be gleaned from the challenges to success include 1) the creation of implementation mechanisms with clear deadlines for starting and finishing projects and 2) shifting from high intensive water use (agricultural) to other economic sectors that use benefits from water rather than just water quantity (Table 4.1).

4.5 Conditions for benefit sharing

From the experiences of the three basin case studies discussed previously, as well as other basins, several insights regarding conditions for successful benefit sharing were identified. The identification of these conditions is important, as agreements regarding the sharing of benefits have only been implemented successfully in very few cases, including the Columbia, Ganges, and Senegal River basins, and the Lesotho highlands project (located on the Senqu River). In the remaining 272 out of the total 276 transboundary basins (TFDD 2009a), implementation of agreed benefit-sharing principles have not materialized. The hindrances to implementation are related to the non-fulfillment of conditions that are needed to clear the following ambiguities, which we will discuss in more detail in this section: 1) lack of clear definition of terminologies of benefits and sharing; 2) lack of clear definitions of equal versus equitable sharing; and 3) the geographic scale (physical, socioeconomic, history and environmental aspects) of benefit sharing at which optimum results can be obtained.

4.5.1 Establish clear, universal and applicable definitions of benefits and sharing in transboundary rivers

Most of the stakeholders in transboundary rivers do not have mutually agreed-upon definitions of the meaning and considerations of benefit terminology. Additionally, they demonstrate a lack of flexibility or positive ambiguities that would enhance the implementation of the benefit-sharing processes. These terminology non-agreements and inflexibilities may create misunderstandings regarding what benefits mean. Below are the some of these misunderstandings or non-commonalities regarding the meaning and considerations of the term benefits:



Aside from devising methods to create mutual definitions for the above stated issues, positive ambiguities are needed for national representatives or politicians to reach agreement. If there are no ambiguities, the conditions become relatively inflexible. Inflexibilities or non-ambiguities generally result in representatives or politicians from stakeholder countries becoming hesitant to comply. Politicians like to have "getaway clauses," including general ambiguities, which allow for more flexibility regarding agreements. Some of these ambiguities may be necessary. Fischhendler (2008) assessed ambiguities in the Jordan Basin that created positive re-enforcement. Three types of ambiguities were identified including "issues not addressed," "issues addressed ambiguously," and issues "addressed in a conflictive manner" (Fischhendler 2008). Utilizing the above three types, ambiguities were instrumental in "diffusing domestic opposition" and alleviating "future crisis without the need to

renegotiate the treaty" (Fischhendler 2008). Thus, a balance between common benefit and sharing terminologies and positive ambiguities are required as conditions for the implementation of benefit-sharing proposals in transboundary basins.

4.5.2 Defining equal and equitable benefit sharing

Sharing mechanisms are sometimes hindered by discussion of the sharing mechanism, equal versus equitable distribution of benefits, as well as prioritization of these benefits. Stakeholders interpret equal and equitable terminologies differently, thereby hindering implementation processes. Equal and equitable sharing methods could be interpreted many ways, depending on the basis for the gauges of equal and equitable terms. Below are some of these bases for equal and equitable sharing of benefits:

Examples of basis for **equal** sharing:

- Per population living in the basin area
- Per population living in the country
- Per the dependence of a nation's economy on the shared river
- Per capita income in the basin or country.

Examples of basis for **equitable** sharing:

- Fairness
- Basic or minimum human needs
- Basic or minimum ecological need
- Assessing priorities
- Altruism
- Survey (regarding how people perceive equity) of total or selected population values
- Total population agreement
- Representative agreement

Aside from the fact that the bases or terminologies for equal and equitable sharing could be interpreted differently, stakeholders might value one benefit more than another or have differing priorities. There are several examples from other transboundary basins regarding the prioritization of benefits. For example, in the case of the U.S. and Canada agreements, the main priorities, in descending order, are domestic and sanitary, navigation, and power and irrigation, while in the Indus

Waters Treaty, the priorities are domestic, non-consumptive, agriculture, and hydropower (Wolf 1999). Prioritizing Nile River utilization may lead to better treaties, and successful implementation of agreed-upon water projects. While considering priorities, caution is suggested as representatives or politicians might be hesitant to commit to binding treaties, as stated in the previous section. The fact that these bases also have differing definitions and can be assigned differing weights leads to ambiguous solutions. Thus, conditions that bring together terminologies as well as create getaways for politicians are needed to promote trust and cooperation, leading to successful implementations.

4.5.3 Geographic scale of benefit sharing

The particular geographic settings of a basin influence the implementation of the benefit-sharing principle. These processes are influenced by physical, socioeconomic, historical, and environmental aspects. Physical aspects are the primary factors that influence river utilization. For example, in the Mekong Basin, Laos is poised to utilize the river for hydropower due to its mountainous physical geography. Secondly, socioeconomic issues, such as jobs held and number of people dependent on the river are important factors that need to be considered. For example, in the Tigris-Euphrates River Basin, the river resources are used by Turkey, Syria, and Iraq for agricultural purposes, and there have also been efforts to harness hydropower to meet socioeconomic development aspirations in southeast Turkey (MacQuarrie 2004). Third, historical stakeholder usage of shared rivers is seen as heavily influencing cooperation and agreement negotiations. For example, Iraqi rights to the Tigris-Euphrates River are based on historical usage. Fourth, environmental concerns are gradually gaining influence over the implementation of water projects with regards to detrimental effects on fauna and flora. For example, in the Columbia Basin, one of the main concerns is the rehabilitation of salmon habitats which were negatively affected by dam construction. Assessing ways to implement the best possible scenarios that can meet the conditions required to maximize

benefits while considering physical, socioeconomic, historical and environmental concerns is a recommendation for the Nile Basin countries.

4.6 Are the conditions right for benefit sharing in the Nile Basin?

4.6.1 Brief history of the Nile Basin and reasons behind the push for benefit sharing principle

The Nile Basin is shared by ten countries: Egypt, Sudan, Eritrea, Ethiopia, Kenya, Uganda, DRC, Tanzania, Rwanda, and Burundi. There have been treaties and agreements among or between the Nile riparians regarding how to share the Nile water resources. Three factors are of concern regarding benefits sharing: 1) the 1925 treaties between Great Britain and Italy, 2) the 1929 and 1959 Nile treaties between Egypt and Sudan and 3) the agreements currently being negotiated through the NBI. In 1925, Great Britain made an agreement to pay 20 percent of all sales over £50,000 for utilizing the Gash River, a tributary of the Nile that flows through Sudan to Eritrea, which was a colony of Italy from 1890 to 1941 before Britain took Eritrea in 1941 (Delli Priscoli and Wolf 2009). Allocations focused on water quantity were made in the 1929 and 1959 treaties. According to the 1929 treaty between Great Britain, (representing Sudan) and Egypt, Egypt gets 48 billion cubic meters (BCM) and Sudan 4 BCM (Collins 2002; Colorado River Commission of Nevada 2008). After it was realized that the Nile River flow amount was different from that of the 1929, Egypt and Sudan signed the 1959 treaty where they each obtained 55.5 and 18.5 BCM (Collins 2002). One challenge to be surmounted is Egyptian insistence that the Nile countries recognize the 1959 treaty or find other ways to appease its water security before any new agreements can be implemented, including benefit-sharing proposals. The challenge is complex, as the 1959 treaty has been criticized by several upstream riparians. These riparians, including Ethiopia, which provides approximately 85 percent of the Nile flow to Egypt, state that they were not included in the 1929 and 1959 treaties, and that these treaties violate their right to reasonable

and equitable utilization, as stated in the 1997 UN Convention. In 1999, the Nile Basin Initiative (NBI) was formed. The NBI comprises nine permanent members and one observer, Eritrea. The NBI has been instrumental in promoting information sharing, and initiating small projects but still struggles to be a permanent river basin organization and to obtain signatories for the ratification for a new Nile Treaty as agreed by all members, and with implementation of new, large Nile Water projects. Drawing lessons from the Columbia, Aral, and Ganges basins as discussed from section 4.3, as well as the conditions of benefit sharing aspects from section 4.4, the following subsections will 1) discuss whether or not the conditions are right for the Nile Basin, and 2) recommend suggestions for the Nile Basin to implement successful benefit-sharing projects.

4.6.2 Assessing the conditions for implementation of the benefit sharing principle in the Nile

Deriving from the lessons of the three basin studies (section 4.4), as well as the suggested condition (from section 4.5), several factors determine whether the Nile Basin countries have the right conditions for the benefit-sharing principle to be implemented. The lessons, successes, and challenges were grouped as sub-conditions within six broad conditional categories. These six are, not necessarily in order, cooperation, agreements or treaties, economic integration, availability of funding, geopolitical security and sustainable management strategy (see Figure 4.1). In this chapter, the term “conditions” does not apply as a pre-requisite, but suggests factors that enhance the implementation process. Table 4.2 below shows a summary of the above discussed conditions, and their fulfillment in regards to the Nile.

Table 4.2: An assessment on whether the Nile countries have the right conditions to implement benefit sharing principle.

Conditions that enhance benefit sharing	Sub-Conditions	Does the NBI or Nile countries have the conditions?
Cooperation	Incentives to cooperate and share benefits	Yes. Problem to alleviate population growth pressures and achieve development aspirations are the primary incentives to cooperate
	Politically powerful downstream riparians	Yes. Egypt the utmost downstream country is politically very powerful
	Formation of an institution or RBO or a platform meeting framework	Partial. The NBI is not a permanent organization
Agreements or Treaties	Treaty that is ratified	No. The only existing treaty is between Egypt and Sudan and it is being criticized as being unfair by the remaining riparians.
	Clear definition of Benefits	Partially. The only factor that is being considered is hydropower (still under discussion though) rather than a basket of benefits
	Clear definition of Sharing	No. So far only trading and non-overlapping needs are considered.
	Clear definition of Equal	No. As equality is still being interpreted differently by the stakeholders
	Clear definition of Equitable	No. As equity is still being interpreted differently by the stakeholders
	Ambiguities that compliment benefit sharing	Partially. The still continuing cooperation, negotiations and information sharing through the NBI although not implemented as seen as successes.
Integrated Economies	Common currency	No.
	Highly integrated trade	Minimal. Mostly bilateral exist
	Basket of benefits	No. need integrated economies such as EU
Availability of funding	Rich economies	No. All the riparians are poor
	International help	Yes. There is help from the World Bank and other international institutions
Geopolitical Harmony	International conflict	Partial. Tensions flare between Eritrea and Ethiopia, Eritrea and Sudan, Uganda and DRC, and Rwanda and DRC.
	Internal conflict	Partial. Conflicts in Sudan (Darfur and SPLA), Uganda (Lords Resistance Army) and DRC might undermine implementation processes.
Sustainable Management Strategy	Maintain ecological habitats	Partial. Statements exist but there is no evidence to suggest basin wide regulation to maintain ecological habitat
	Respect indigenous rights	Partial. The formation of the Nile Basin Discourse may be able to achieve the rights. But, there is still no evidence that shows.
	Flood protection and drought management	Partial. Flood protection are available in some parts such as the Aswan dam but drought affects countries such as Ethiopia
	Low dependency on industries, such as agriculture, that use high water quantities	No to partial. All are highly dependent on water quantity for agriculture or domestic purposes in upstream areas

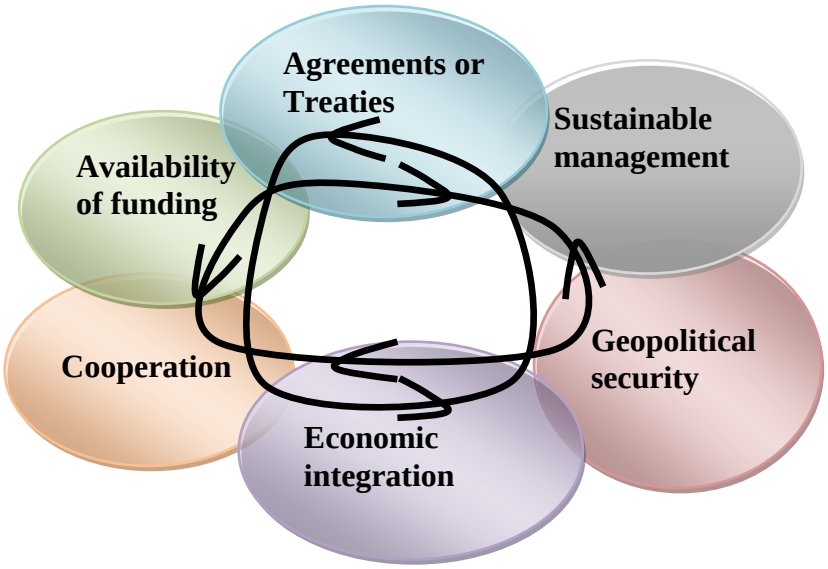


Figure 4.1: Interrelated conditions in implementing benefit haring principle. The arrows indicate interrelatedness rather than directionality among the conditions.

The cooperation condition:

Cooperation is a cornerstone upon which mutual agreements are based. Cooperation is the initial step in implementation of the benefit-sharing principle in transboundary river basins. Cooperation includes the realization by stakeholders that getting together will ameliorate or solve problems, as well as ensure information sharing. Cooperation can be accomplished through many other phases, as well as through signing agreements or/and binding treaties. Some of the factors or sub-conditions, gleaned from the lessons of the three basin case studies, and used as measures of cooperation for the assessment of the Nile Basin are incentives to cooperate, the location of politically powerful riparians, and the formation of permanent RBO or other institution that deal with shared rivers (Table 4.2). Due to increasing population and development aspirations, all the riparians are looking forward to using more of the Nile Basin water. These uses include domestic, irrigation, and hydropower benefits. The first sub-condition has been fulfilled, since the nations have stated that they would cooperate and have formed the NBI. Regarding the second sub-condition, the Nile Basin riparians realize that unilateral utilization of the river might affect fellow riparians detrimentally. This could lead to conflict rather than cooperation. Those who opt to pursue unilateral developments might do so if the nation being affected, usually located downstream, is politically weak. In the Nile, the utmost downstream nation is Egypt, a politically powerful state, relative to the region. Egypt has a relatively powerful political position that is instrumental in limiting unilateral decisions. Limited unilateral decisions can lead to the sharing of information and to the formation of an institution that resolves conflicts and promotes cooperation. Thus, the second sub-condition has been fulfilled. The NBI has not yet graduated to a permanent RBO. Thus, assessing for the third factor, the existent of a permanent RBO, the Nile partially fulfills the condition, since the NBI is not yet a permanent institution. Even though they sometimes voice complaints against each other, the Nile riparians have consistently cooperated with each other in the NBI and in official statements. In terms of conditions necessary to the implementation of benefit sharing, the incentives are very much there.

The agreement or treaties condition:

The Nile riparians, having achieved cooperation, are currently in the process of reaching agreements or treaties. Treaties or agreements that are acceptable and ratified by all the Nile stakeholders will help to fulfill essential conditions in the implementation of the benefit-sharing principle. Some of the factors or sub-conditions that aid in achieving treaties or agreements include 1) the signing and ratification of treaties in regards to benefit sharing; 2) clear and agreed-upon definitions for benefits, sharing, equal and equitable terminologies; and 3) ambiguities that complement the implementation processes. Regarding the first sub-condition, although there has been some past sharing of benefits, such as the sharing of the Gash River, a tributary of the Nile, between Great Britain and Italy (Delli Priscoli and Wolf 2009), the agreement stopped after the British occupied Eritrea in 1941. A treaty that is still in effect today is the 1929 and 1959 treaty between Egypt and Sudan. The treaty has been criticized by the other seven riparians, who want a new treaty. So far, there is no such new treaty or agreement. From conversations with the NBI in Ethiopia, as well as with those close to the Nile basin negotiations, the representatives are close to signing a new treaty, which might include the benefit-sharing principle. The Egyptian representatives are said to have expressed that almost 95% of the issues have been agreed upon, except for the issue of water security for Egypt. Egypt wants the other riparians to recognize its quota, a water security issue, as per the 1959 treaty. This claim seems to be substantiated by the recent report on the British Broadcasting Service (BBC). The report quotes the Deputy Foreign Minister Mona Omar of Egypt as stating that it is a national security issue, and there is "no way" Egypt will allow a reduction of its water quota (Knell August 7 2009). The report also states that a meeting in Alexandria, Egypt did not achieve to close the gap between the requirements of downstream Egypt and upstream countries, but that there is hope of resolving the situation in 6 months (Knell August 7 2009). Although the Nile countries have shown willingness to cooperate, a new treaty which gives the quota to Egypt, as well as providing for the

needs of the riparians, has not been created, and so the sub-condition of a treaty that is agreed upon by all stakeholders has yet to be realized (Table 4.2).

Besides the treaty condition discussed above, mutuality regarding the "benefits", "sharing", "equal", and "equitable" terminologies create the right conditions to implement the EDB principle. At a minimum, the stakeholders need to clarify direct or indirect (out-of-basin) benefits, and then create a management strategy that includes planning, organizing, directing, and regulation mechanisms (see Figure 4.2). So far, instead of a basket of benefits, the only tangible benefit factor under negotiation, but not yet implemented, is the hydropower benefit. There is negotiation regarding a yet-to-be-built multi-purpose dam in Ethiopia, and negotiation regarding the sale price of hydropower benefit (in kWh per United States Dollars (USD)) to Sudan. Thus, the conditions, in principle, seem to be right for hydropower benefits (Table 4.2). Generally, hydropower diversions do not decrease water flow to downstream areas, as the diverted water is returned back to the river after its power is harnessed. Intangible benefits such as cooperation, information sharing, and security in terms of geopolitical peace have yet to be realized, or the NBI has yet to find methods for their valuation. This gives an indication that perhaps the next phase for implementing the benefit-sharing principle should be environmental restorations, as there are qualitative methodologies already developed. These include flood control, terracing, and water quality improvements that could potentially benefit both upstream and downstream stakeholders. However, another factor that complicates the sharing of benefits is determining the basis on which these benefits should be allocated. Stakeholders could argue that the benefits should be shared equally or equitably. The issue can become more complicated, since equal sharing can be seen in many different ways, including equal division by country, by the population dependent on the basin, by development aspirations, or by ecological benefits. For example, in regards to the eastern Nile Basin, if the benefits are divided equally using the size of the population dependent solely on the Nile, Egypt would gain the largest share. On the other hand, if relative poverty rate is utilized, Ethiopia might

get the largest share. In conclusion, the Nile countries do not fulfill the second sub-condition because they have not reached mutually acceptable definitions regarding the type of benefits, sharing, equal and equitable terminologies (Table 4.2).

A partially successful factor that the NBI is pursuing is the ambiguity in its negotiation process (Table 4.2). The NBI, as an organization, has been successful at emphasizing the benefits of cooperation, information sharing, and creating a platform for negotiations. Due to these endeavors, some actual plans have been proposed. However, no clear guidelines have been formulated for implementing benefit-sharing processes. However, the NBI stances have been instrumental in creating cooperation, although they are ambiguous. In conclusion, the Nile countries have been partially successful in fulfilling the third sub-condition, positive ambiguities that promote cooperation, information sharing, and actual water project proposals.

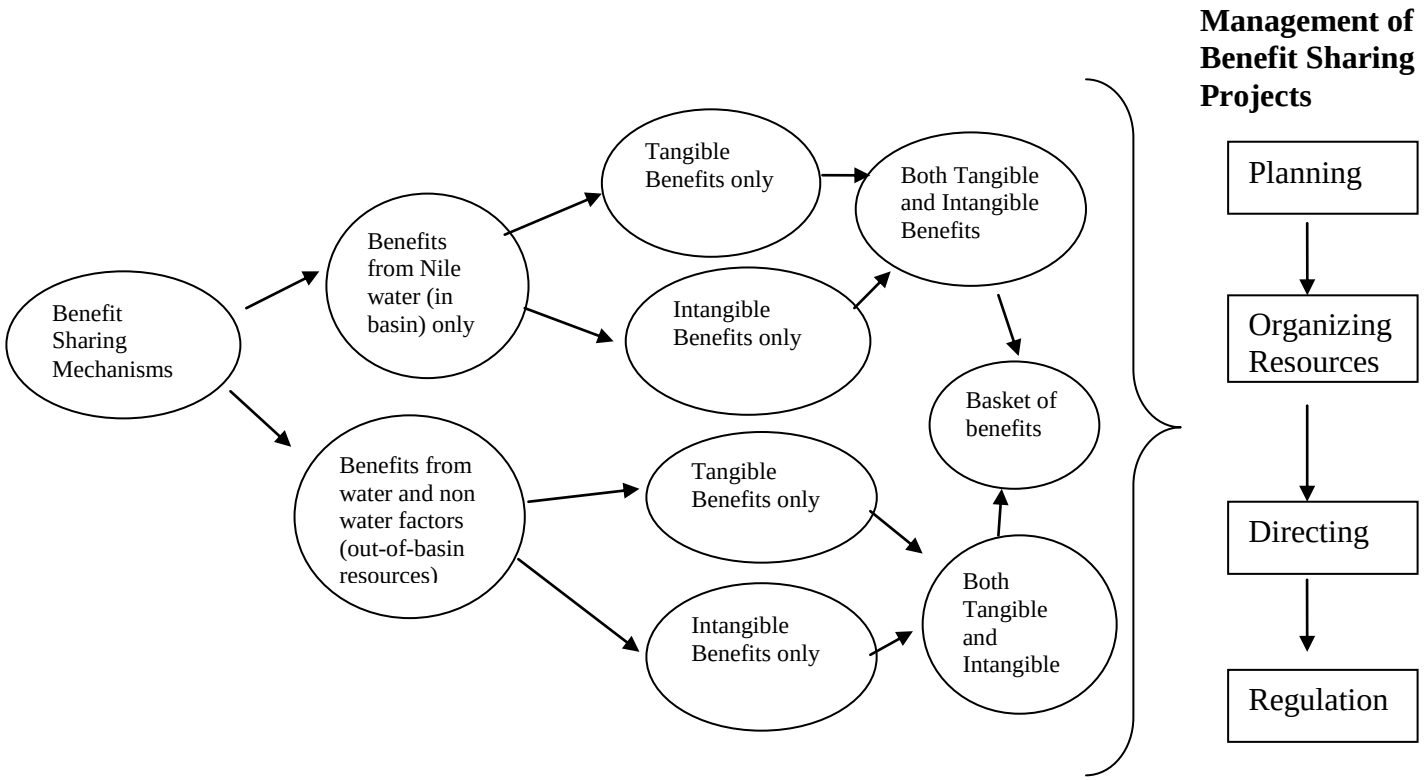


Figure 4.2: Basket of benefits requirement in a benefit sharing process and integrated economies.

The integrated economies condition:

Nations that have highly integrated economies will have an easier time implementing benefit-sharing projects. In the context of this chapter, there are different integration levels. Nations that display highly integrated economies generally fulfill the following sub-conditions: 1) a common currency, 2) well-developed infrastructures that link co-riparians to support trade of benefits, and 3) consideration of the basket of benefits principle. An example of an entity that meets all of these conditions is the European Union (EU). The effects of the common currency (the Euro) and well-developed infrastructures helped to maximize benefits through the EU water framework directive from transboundary rivers such as the Danube. An example of riparians that only have one of these requisites, well-developed infrastructures, is the Columbia River between the U.S. and Canada. Although the two countries do not have a common currency, they have well-developed roads, a high amount of trade with each other, and administrative and navigational links, which help in the implementation of the benefit-sharing principle. The fact that the stakeholders in these two basins, Danube and Columbia, are some of the richest nations also helps because they are able to afford the infrastructures needed to support water projects. In the Nile, the economies are poor and not highly integrated multilaterally. Bilaterally, the stakeholders might be well linked through shared borders. However, since a multilateral benefit-sharing process is preferred theoretically and by the NBI, the Nile countries do not fulfill the condition of having rich and integrated economies (Table 4.2). Their economies are too dependent on sectors that use water quantity. The third sub-condition, a basket of benefits, requires a holistic approach.

A holistic approach that considers the basket of benefits would achieve the purpose of the shift from water quantity to benefit sharing. The benefit sharing types can vary greatly. The benefits that need to be considered are benefits directly derived from water, benefits indirectly derived from water, tangible or intangible benefits, and even out-of-basin resources (Figure 4.2). From a research perspective and international business theories, if stakeholder countries put forth their entire resource pool or basket of benefits, including tangible and intangible, as well as out-of-basin resources to be

shared at the negotiation table, the net benefits would be maximized as each stakeholder will have a competitive edge in at least one factor. The fact that water is multi-scaled as it flows from place to place and its benefits are usually transferred out of basin adds to the promise of sharing a basket of benefits. Sharing a basket of benefits would achieve the four returns as proposed by Sadoff and Grey: 1) increased benefits to the river, 2) increased benefits from the river, 3) "decreased costs from the river," and 4) increased benefits aside from those directly from water, such as geopolitical peace and cooperation (Sadoff and Grey 2002). However, regarding the fourth return, in the case of the Nile basin, the benefits being discussed are those that are only directly derived from the Nile River basin. From conversations with the NBI offices, the Nile countries do not even want their other water resources to be included in the benefit-sharing basket, let alone including out-of-basin resources. For example, in the DRC case, the immense hydropower energy of the Congo River cannot be considered in the NBI negotiations because it is outside the Nile Basin. Thus, to achieve all the four benefits as espoused by Sadoff and Grey, it is suggested that the Nile countries consider a basket of benefits that requires ideally an integrated economy. The integrated economy does not need to have a common currency similar to the European Union or include out-of-basin benefits, but it needs to be multifaceted and include a high amount of trading, such as the case between the United States and Canada. Managing the sharing of the basket of benefits would also require very complex planning, organizing, directing, and regulating phases (Table 4.2 and Figure 4.2) that are only feasible in integrated economies, such as in the EU and the U.S. Table 4.3 describes some of these benefits and their associated management phases for the Nile Basin. Thus, regarding the third sub-condition, the Nile countries have not fulfilled the ideal basket of benefits sharing framework (Table 4.2).

Table 4.3: Management strategies in implementing benefit sharing principle for selected factors in the Nile Basin.

Selected benefit factors	Selected (not whole) Management Strategy suggestions			
	Planning	**Organizing**	**Directing and regulation**	***Remarks***
Hydropower	Explore potential hydropower locations, assess whether the net benefits outweigh the net costs, compensate losses, assess whether all the stakeholder countries agree or not	Engineers, significant funding, civil rights representing locals, environmentalists, government representatives, economists	Annual report on proposed hydropower projects, identifying benefits and costs	*High implementation possibility as no overlapping issues with water for irrigation. Initial investment, benefit sharing negotiations, and effects on local and ecology might be problematic.*
Watershed restoration	Identify watershed locations that improve water quality and other factors to fellow riparians, assess measures for benefits derived to communicate benefit sharing	Soil and water conservationists, light funding, scientists from various fields that measure benefits from water shed restoration	Annual report on proposed hydropower projects, identifying benefits and costs	*This method seems to be the most better off situation as none seems to be significantly harmed. The measurement of benefits might be problematic.*
Eco-Tourism	Identify eco-tourism locations, assess geographic scale of the basin, promote the concept to tourists	Tourism specialists, tour guide trainers, marketing (promotion), security personnel for the basin, economists, and local representatives	Annual report on proposed ecotourism projects, identifying benefits and costs	*Although the funding costs is relatively small, the geopolitical securitization of the basin to facilitate tourism travel and the distribution of benefits might be problematic.*
Technical support	Share information, identify strength and opportunities (for example irrigation concepts from Egypt)	Scientists from various disciplines including, engineers, agronomists, social scientists and others	Annual report on proposed technical support projects, identifying benefits and costs	*This has the highest benefit sharing potential as it could be done through minimal initial investment and running costs.*

The availability of funding condition:

The availability of funding is a crucial factor that affects the implementation of benefit--sharing projects. Funding availability to implement successful benefit-sharing processes requires one of two sub-conditions: 1) rich national economy or 2) international funding assistance. The Nile countries, although able to implement small water projects, are not able to implement large projects as required by their aspirations and the attention of the NBI. Small projects do not meet the population and development pressures that the Nile countries are endeavoring to resolve. Most of the major water projects that require large investments have been achieved due to help from international organizations or foreign states. For example, the Aswan dam in Egypt, built in 1970, was due to help from the USSR (Collins 2002); and later, help also came from the World Bank, and Netherlands in regards to the drainage programmes (Ali, Leeuwen, and Koopmans 2001). Similarly, the Merowe dam in Sudan, inaugurated on March 3, 2009, cost a total of 1966 millions in USD, with contributions from the Government of Sudan (575 millions in USD), Government of China (520 millions in USD), Arab Fund for Economical and Social Development (250 millions in USD), Saudi Fund for Development (200 millions in USD), Abu Dhabi Fund for Development (150 millions in USD), Kuwaiti Fund for Economical Development (150 millions in USD), Sultanate of Oman (106 millions in USD), and the State of Qatar (15 millions in USD) (DIU 2009). The NBI, as an institution, is funded by international organizations, especially by the World Bank. Although the Nile countries do not fulfill the sub-condition of having rich economies (Table 4.2), the availability of funding as a sub-condition is fulfilled. Maintaining good geopolitical relationships with investors, international organizations and foreign states will also be helpful in maintaining peaceful relations among co-riparians.

The geopolitical security condition:

Having good international relations (such as from the lessons of Columbia and Ganges) and internal geopolitical peace are two sub-conditions required for successful implementation of benefit-sharing processes in the Nile Basin. Internationally, among the Nile countries, there are numerous tensions, as well as peaceful conditions.

Geopolitical tensions between or among the sovereign nations pose problems in sharing benefits. The current tension between Eritrea and Ethiopia comes foremost to mind when considering sharing benefits from the eastern Nile Basin. If the geopolitical situation between these two nations could be resolved, the implementation process might be enhanced. On the other hand, the issue might not be that crucial, as Eritrea is just an observer, not a member of the NBI. Tensions also flare sporadically between Sudan and Eritrea, Uganda and DRC and Rwanda and DRC. Thus, the sub-condition for international geopolitical peace is only partially fulfilled. Similarly, internal conflicts may or may not be instrumental in the implementation of the benefit-sharing principle within the NBI framework. If the sovereign nations accuse each other of interfering in their internal geopolitical conflicts, then cooperation to share the Nile resources might be jeopardized. So far, although there are accusations (for example, Sudan accuses Eritrea, and DRC accuses Rwanda and Uganda) the statements have not been a hindrance to the cooperation process. Although internal conflicts in DRC, Uganda, and Sudan might not be detrimental to cooperation, they serve as impediments to the implementation process. Infrastructure to support generation of benefits cannot function without security. Conflict areas generally scare investors, and cost more to build infrastructures such as dams, irrigation canals, roads and the administrative bodies needed to support benefit-sharing processes. Even benefits that require relatively little infrastructure, such as eco-tourism, need security. Benefit sharing might not be fully realized in conflict areas, but may in relatively peaceful locations such as in Egypt, Kenya, and Tanzania. In conclusion, the Nile countries partially fulfill the two sub-conditions (Table 4.2). However, caution should be taken with these conclusions, as benefit sharing processes might result in achieving internal geopolitical harmony through alleviation of poverty and the creation of jobs and economic prosperity.

<u>The sustainable management condition:</u>

The sustainability concept suggests principles and implementation processes that do not cause significant harm to stakeholder interests currently and in the future. The Nile Basin countries, through their cooperation stances, are very concerned about

sustainability as it fulfills their claims. This is especially true when considering the claims of downstream riparians that upstream users should not utilize the Nile River in ways that significantly harm downstream countries such as Egypt. Although numerous factors could be discussed, this chapter focuses on only four sub-conditions required to implement successful benefit-sharing processes. These are the maintenance of ecological habitats, respect of indigenous or local populace, flood and drought management, and low dependency on industries, such as agriculture, that use high quantities of water (Table 4.2). At the Nile Basin organizational level, although there are studies being conducted and statements to the effect, there is little evidence that suggests regulation to implement ecological habitat maintenance. The fact that the NBI is not a permanent organization adds to the fact that the Nile countries do not have the conditions right in terms of ecological maintenance. Secondly, in terms of indigenous rights, there is an organization, the Nile Basin Discourse (NDB), which was founded to advocate those particular rights. The success is partial as there is an organization that advocates for the rights of the local populace, while there are very few facts on the ground that are evident due to intervention by the NBD. The third sub-condition, flooding and Nile river drought, are major concerns, especially for the downstream nations. Detrimental effects due to drought are prevalent in downstream countries such as Ethiopia. The third condition is partially fulfilled, since downstream countries such as Sudan and Egypt have built dams to prevent flooding and store water for drought times; upstream countries have not. The fourth sub-condition is based on the fact that low dependency on industries, such as agriculture, that use high water quantities often leads to the implementation of benefits derived from water rather than just quantity allocation. Unfortunately, all the countries are primarily agrarian societies requiring water from the Nile for irrigation. A shift to non-water quantity utilization (non-consumptive uses) by industries that utilize benefits derived from water such as hydropower and eco-tourism generally leads to less competition for water quantity utilization. This is evident in the Nile where, with help of the contractors of the People's Republic of China, the Ethiopians have built a hydropower generating plant (near the Blue Nile Falls, locally known as Tis Esat or "Smoke of the Fire") which does not decrease the amount of flow to the downstream countries. In the

Nile, the fourth sub-condition for a shift to economic sectors that use less water quantity is minimally or only partially fulfilled (Table 4.2).

4.6.3 Selected recommendations to the Nile

Following from the sections discussed above, the following points are recommended in order to successfully implement the benefit-sharing principle in the Nile Basin:

- Create incentives, especially those that can alleviate population growth and economic development aspirations of the Nile Basin countries, to enhance cooperation.
- Encourage the Nile Basin countries to transform the NBI to a permanent river basin organizational institution.
- Research and propose methods that reconcile the appeasement of water security concerns for Egypt with utilization of the Nile by upstream countries.
- Find common definitions for the “benefits”, “sharing”, “equal” and “equitable” terms.
- Increase trade and economic ties among member countries in order to move to a basin wide basket of benefits sharing scenario.
- Promote economic growth in general to fund large projects that are needed to alleviate population and development pressures.
- Decrease geopolitical tensions, internally and internationally, to enhance cooperation and attract investors.
- Encourage the Nile Basin Discourse and other environmental justice organizations in order to make sure that indigenous rights and ecological habitats are not significantly harmed due to implementation of the benefit sharing principle.
- Provide for extreme conditions, such as flooding and drought, during benefit sharing negotiations and treaty implementations.
- Steer economic sectors from consumptive use, such as agriculture and irrigation, towards other industries that are non-consumptive, such as eco-tourism and service sectors.

4.7 Conclusion

Countries sharing the Nile Basin are endeavoring to implement the principle of benefit sharing, the new norm in transboundary river studies. The push towards benefit sharing is due to the inability of past and existing international methods, especially water quantity allocation and cost sharing methods, to meet current and expected demands. Successes and challenges regarding benefit sharing from three basin case studies (Columbia, Aral, and Ganges), helped in the identification of six conditions that are required in the implementation of the benefit-sharing principle. These six are 1) the existence of cooperation, 2) agreements or treaties that are acceptable and ratified by all parties, 3) the high level of integrated economies, 4) the availability of funding to implement large-scale projects, 5) the level of geopolitical peace, and 6) sustainable management strategies. With the exception of the lack of a high level economic integration, the Nile countries partially fulfill the other five conditions. The findings of the chapter indicate that preliminary investigations support the viability of the principle of benefit sharing as a framework of consensual and cooperative interaction between the different countries that are members of the regional body of countries that share tributaries and/or watersheds of the Nile River. Yet, as the discussions in sections 4.2 to 4.5 also demonstrate, the potential for success depends a great deal on the continued willingness of member countries to 1) engage in constructing working definitions and methods of identifying resources; 2) reach consensus about procedures used to assign values to the resources shared by upstream and downstream countries; and 3) work with necessary ambiguities in the crafting of multi-national sharing agreements to promote cooperation and mitigate the rise of conflicts over resources.

5. ASSESSING INSTITUTIONAL RESILIENCY OF THE NILE BASIN INITIATIVE

Biniam Iyob

The previous chapter assesses whether the Nile countries have the conditions to implement projects based on the equitable distribution of benefits principle. This chapter assesses the resiliency of the Nile Basin Initiative (a river basin organization created to enhance cooperation regarding utilization of Nile water resources among the Nile countries) in mitigating biophysical, socioeconomic and geopolitical pressures

5.1 Abstract

Strengthening institutional resiliency of river basin organizations (RBOs) is a key factor for transboundary river relations. This paper assessed the institutional resiliency of the Nile Basin Initiative (NBI). The NBI was formed in 1999 to enhance benefits and cooperation among the ten countries sharing Nile Basin. The objective of this paper was to assess the resiliency of the NBI in mitigating pressures exerted to the biophysical, socioeconomic, and geopolitical systems of the Nile Basin. The pressures that were considered are: 1) drought and flooding (for biophysical); 2) increase in demand for irrigation, hydropower and domestic Nile water use (for socioeconomic); and 3) local, national, regional and international tensions (for the geopolitical system). For all these pressures, 55 possible measures of the institutional strength of the NBI were considered. Borrowing concepts from management theories, six progressive resiliency stages (and ranks) were utilized to communicate current institutional resiliency of the NBI. These are as follows: stage 0: no statement or vision regarding a response (no-resilience); stage 1: statement of the response (very low resilience); stage 2: research being conducted (low resilience); stage 3: proposal of projects (medium resilience); stage 4: implementation of project proposals (high resilience); and stage 5: evaluation of implemented projects (very high resilience). A no-resilience rank was given if none of these stages are considered. The findings of this paper suggest mixed resilience rank values for the 50 responses, ranging mostly from no resilience (for example, treaties regarding drought and water quality), to very high (for the assessment of existing water quality for domestic use) regarding biophysical and socioeconomic resiliencies. At local, national, regional and international scales, the findings suggest that the NBI has high to very high resiliency values regarding two (participation and responsiveness) of the six responses. It is recommended that the NBI consider increasing institutional resiliency for responses that have low resiliency and maintain the ingredients that make the ones with impressive resiliency capacity.

Key Words: Biophysical, Geopolitical, Nile, Nile Basin Initiative, NBI, Resilience, Socioeconomic, Transboundary Rivers

5.2 Introduction

Maximal institutional capacity for river basin organizations (RBOs) is necessary in the promotion of cooperation and getting increased benefits for countries sharing transboundary basins. Transboundary basins are defined as surface and groundwater resources that are shared by different sovereign countries, autonomous and semi-autonomous entities, and federal states. One of these transboundary basins is the Nile Basin, which is shared among ten countries. The Nile Basin Initiative (NBI), an RBO formed in 1999, is an agreement to coordinate cooperation of the ten countries to maximize benefits to the stakeholders involved. The focus of NBI is the implementation of benefit sharing to achieve equitable utilization of the Nile Basin resources, rather than solely water quantity allocation. Simply stated, the sharing of benefits from the basin (such as hydropower, irrigation, and geopolitical cooperation), rather than allocation of water quantity results in increased benefits for stakeholders and enhanced cooperation. In order to achieve such an objective, the NBI should ideally have robust institutional resiliencies. This chapter aims to assess the resiliency of the NBI as applied to the biophysical, socioeconomic, and geopolitical systems of the countries sharing the Nile Basin. It is based on the premise that a river basin institution that is resilient, adaptive, and transformative has higher capacity to successfully guide the implementation of projects that increase benefits, resolve conflicts, and enhance cooperation in transboundary rivers.

Resilience is generally defined as the measure of the "persistence" of organizations or networks and of their capability to recover from disturbance and return to the same pre-disturbance conditions (Holling 1973; Brand and Jax 2007). Most resilience studies originated and have focused on the study of ecological and economic systems. Recently, there have been more studies that use the resilience concept to study institutional capacities. The best definition of resilience, from literature, that fits this paper can be stated as "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change" (Adger 2000). This paper defines a metric for resilience of an institution, and assesses the ability of the NBI to achieve objectives while the basic biophysical,

socioeconomic, and geopolitical systems are being maintained despite pressures. The general and specific objectives and also their significance are described briefly as:

General objectives:

The general objective of this paper is to assess whether the NBI, a river basin organization formed in 1999, has the institutional capacity (resiliency) to achieve poverty alleviation and development aspirations, via equitable distribution of benefits of the Nile River water.

Specific objectives are to assess whether the NBI has the:

1. biophysical resilience to drought and flooding pressures.
2. socioeconomic resilience to pressures exerted due to increase in demands for a) irrigation water, b) hydropower, and c) domestic use.
3. geopolitical resilience to pressures exerted by local, national, regional and international stakeholders due to utilization of Nile water resources.

The significance of the study includes:

1. contributing to building institutional capacity of the NBI (an objective stated on the NBI website).
2. helping to provide necessary conceptual details that may help to transform the NBI into a permanent River Basin Organization (RBO).
3. helping to make progress in implementing Nile water management projects.
4. contributing to academic research by evaluating the NBI and applying a novel method for assessing institutional resiliency.

5.3 The Nile Basin Initiative

The Nile Basin Initiative (NBI) is currently a non-permanent river basin organization functioning to bring cooperation and increased benefits to the countries sharing the Nile River. The Nile basin is shared among ten countries: Egypt, Sudan, Eritrea, Ethiopia, Uganda, Kenya, Rwanda, Burundi, Tanzania, and the Democratic Republic of the Congo (DRC). The basin is generally divided into the Blue Nile (Egypt, Sudan, Eritrea, and Ethiopia) and the White Nile (Egypt, Sudan, Uganda, Kenya, Rwanda, Burundi, Tanzania, and DRC) sub-basins. Both the Blue and White Niles flow northward, with Egypt being the utmost downstream country, and finally drain to the Mediterranean. The water resources in the basin have been and still are essential in maintaining ecological systems (flora and fauna) as well as socioeconomic systems (domestic water, irrigation, hydropower, and other uses). Population and development pressures are propelling the primarily agrarian countries of the Nile to maintain or increase the utilization of the basin's resources at a higher rate than before. Most of the Nile countries have rainfall and other river or groundwater resources, except for Egypt and large parts of northern Sudan. Egypt is almost totally dependent on water from the Nile. Facing higher water needs for irrigation, hydropower and domestic needs especially, Egypt and Sudan reached agreements in 1929 and also in 1959 so as to use the Nile in such a way that the two countries reach cooperation. The 1929/1959 treaties allotted (as measured in Aswan High Dam) 55.5 billion cubic meters (BCM) of the Nile water to Egypt and 18.5 BCM to Sudan (Collins 2002). Since then the rest of the Nile countries (especially Ethiopia) have increasingly been putting claims on the Nile, citing that they were not included in the treaty and that it is inequitable. Facing poverty and development needs, countries such as Ethiopia (from whose territory Egypt obtains approximately 80 percent (Collins 2002) of its Nile water), have been very critical of the status quo agreement between Sudan and Egypt. Realizing that conflict of interests has to be changed to cooperation, the Nile countries have been working to enhance the institutional capacity of the NBI.

The history of the formation of the NBI and its key achievements are listed in detail on the NBI webpage (NBI 2010v). The major impetus for the NBI occurred in 1992 when Egypt, Rwanda, Sudan, Tanzania, and Uganda formed the Technical Co-operation Committee for the Promotion of the Development and Environmental Protection of the Nile Basin (TECCONILE). The other four riparian states participated as observers (NBI 2010v). Since 1992, through continued cooperation among the Nile countries and also support from

Canadian International Development Agency (CIDA) and later the World Bank, the Nile countries had sixteen major timeline meetings before the formation of NBI (NBI 2010v). The NBI, formed June 1, 1999, is a non-permanent RBO with nine of the Nile countries being represented and one observer (Eritrea) (NBI 2010v). The organizational structure of the NBI contains the Nile-COM, the Nile-TAC and the Nile Secretariat (Figure 5.1). Key achievement by the NBI are listed in Appendix 7.1.

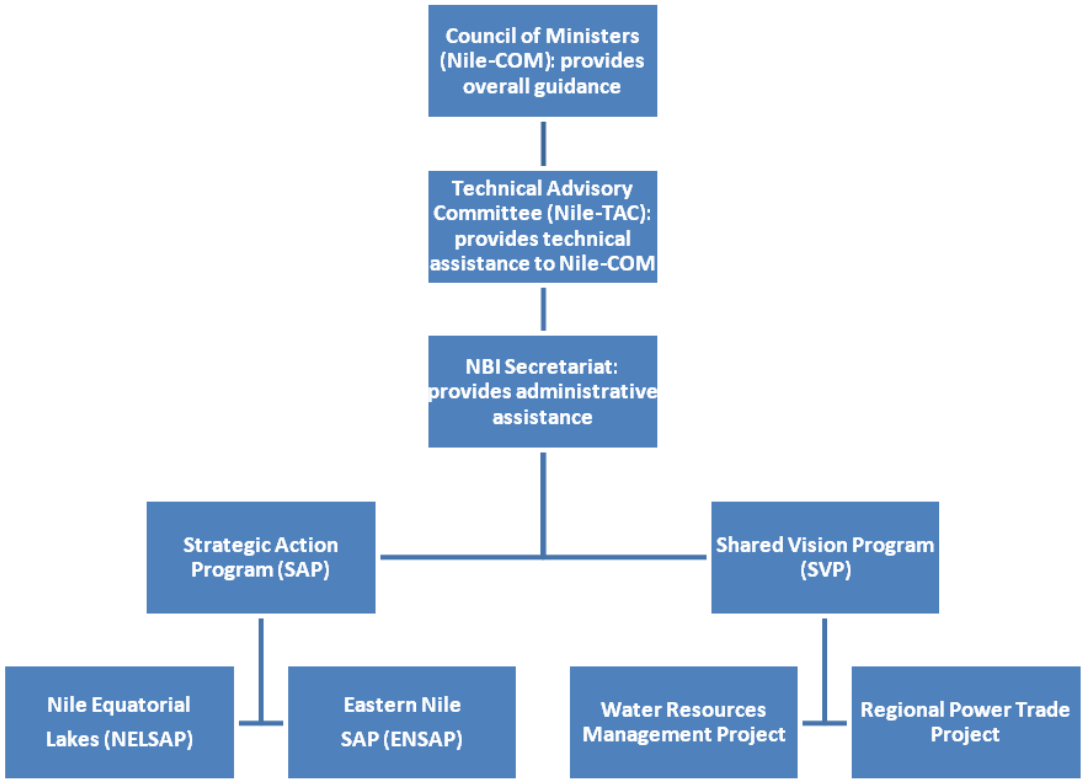


Figure 5.1 : Organizational structure of the NBI (modified from (NBI 2010v; GAES 2010)). The ENSAP coordinates the eastern countries (Egypt, Sudan and Ethiopia), while the NELSAP consists of all the eight Nile countries except Ethiopia.

5.2 Methods.

This section describes the methodology utilized to assess the resilience or capacity of the NBI in achieving two primary objectives: 1) increase benefits and 2) enhance cooperation among the Nile countries. To achieve the objectives, this section: 1) briefly discusses figures portraying aspects of the biophysical, socioeconomic, and geopolitical systems of the Nile, and the pressures that are exerted on these three systems; and 2) describes the specific methods utilized in assessing the resiliency of the NBI. The paper is based on the following two premises:

1. Biophysical, socioeconomic, and geopolitical systems of the Nile Basin are subjected to perturbations or pressures that influence the quantity, quality, and timing of water.

2. The resilience of the NBI can be evaluated by assessing its capacity to respond to these pressures.

5.2.1 Biophysical, socioeconomic and geopolitical systems and pressures

The objective of this subsection is to briefly describe and portray the biophysical, socioeconomic and geopolitical systems and pressures (Figure 5.2 to 5.5). The effect of pressures was assessed with respect to water quantity, quality and timing (Wolf 2007). In this paper, water quantity is defined as the volume of water available. Water quality is defined by the amount of dissolved solids (silt and sediments), and pollutants (salinity and sewage) and other related issues. Water timing is defined as distribution of water temporally; for example the distribution of water by government authorities to farmers (for irrigation) and urban dwellers (utilizing pipes to bring consistent uninterrupted provision of water). The biophysical system is described through a combination of the hydrological cycle and the living organisms (flora and fauna) of the Nile Basin. The hydrological cycle components utilized to describe the biophysical system are precipitation and evaporation. Other factors such as groundwater were beyond the scope of this paper. The description of the living

organisms is limited to flora and aquatic systems; fauna mobility and ecology are complex and beyond the scope of this paper. Although numerous pressures are exerted on the biophysical system, only two factors (drought and flooding) were assessed (Figure 5.2).

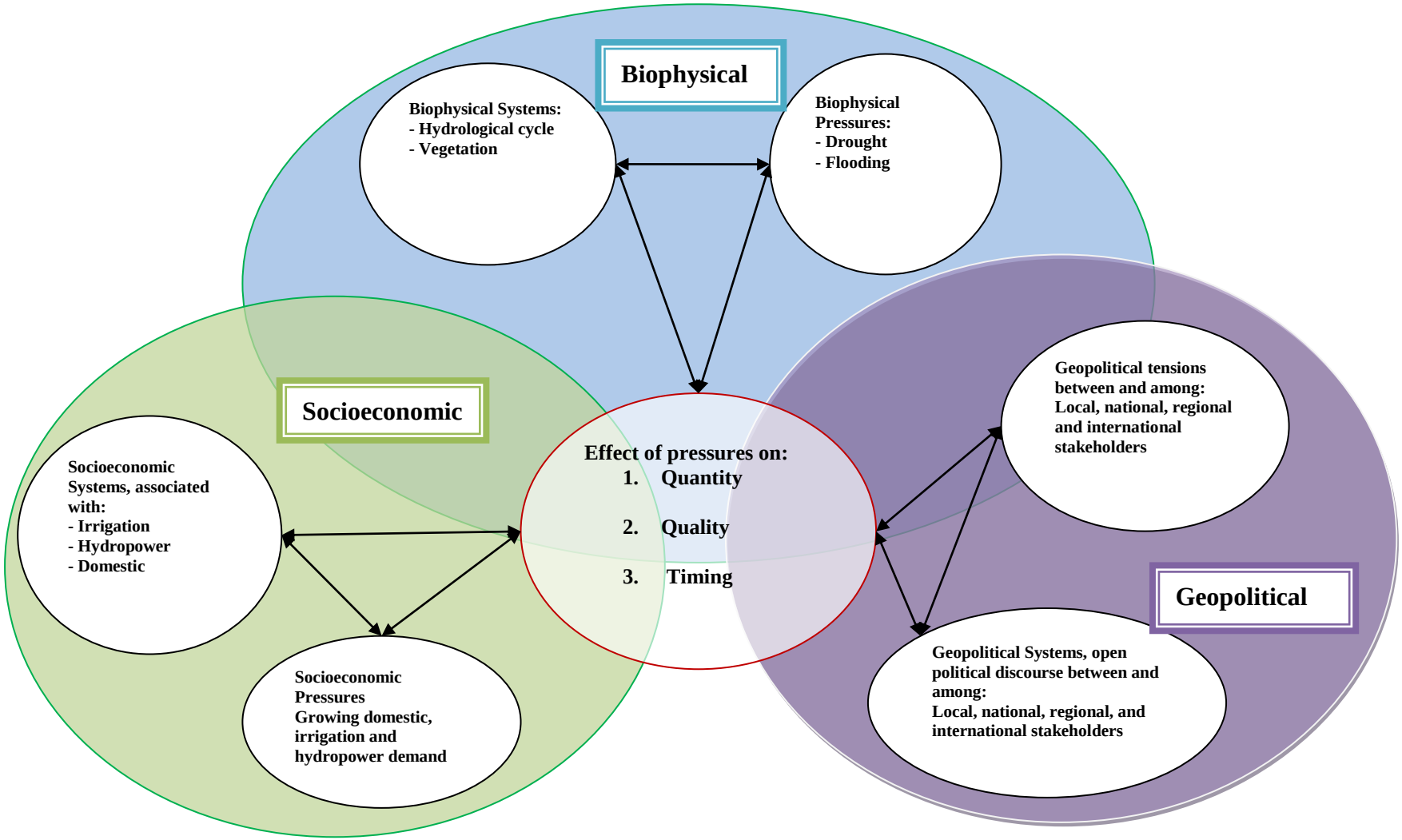


Figure 5.2: Impacts on water quantity, quality and timing by biophysical, socioeconomic and geopolitical pressures.

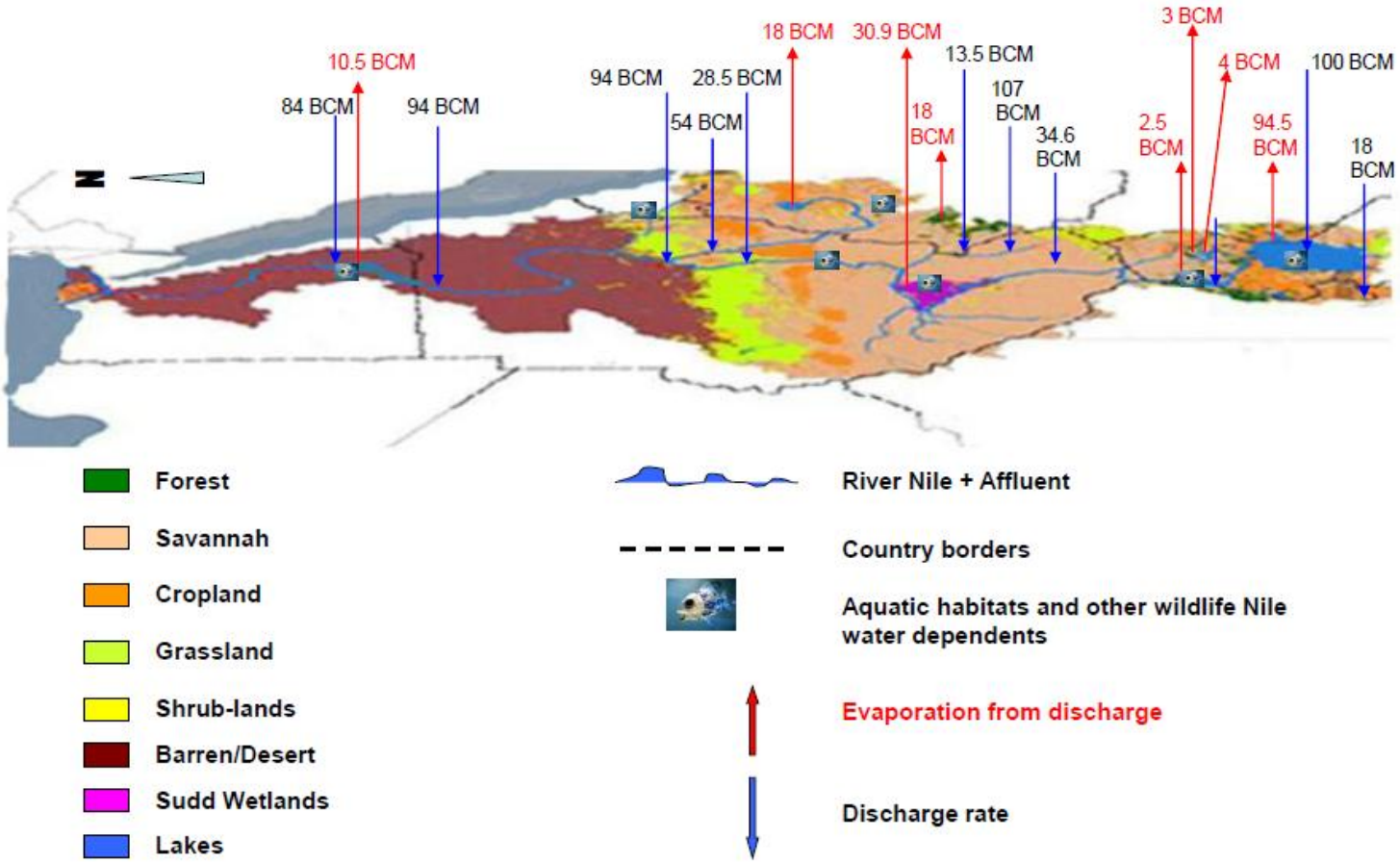


Figure 5.3: Biophysical system of the Nile (Modified from literature (WRI 2003; Blackmore and Whittington 2008; Tesemma 2009); Concept: Author, Biniam Iyob; Figure drawing: Biniam Iyob and Simon Iyob). Precipitation and discharge rates are higher south (upstream), evaporation is higher downstream. Vegetation pattern shows desert plants to the north and tropical forests on South. Aquatic fauna are located mainly in lakes but also in tributaries.

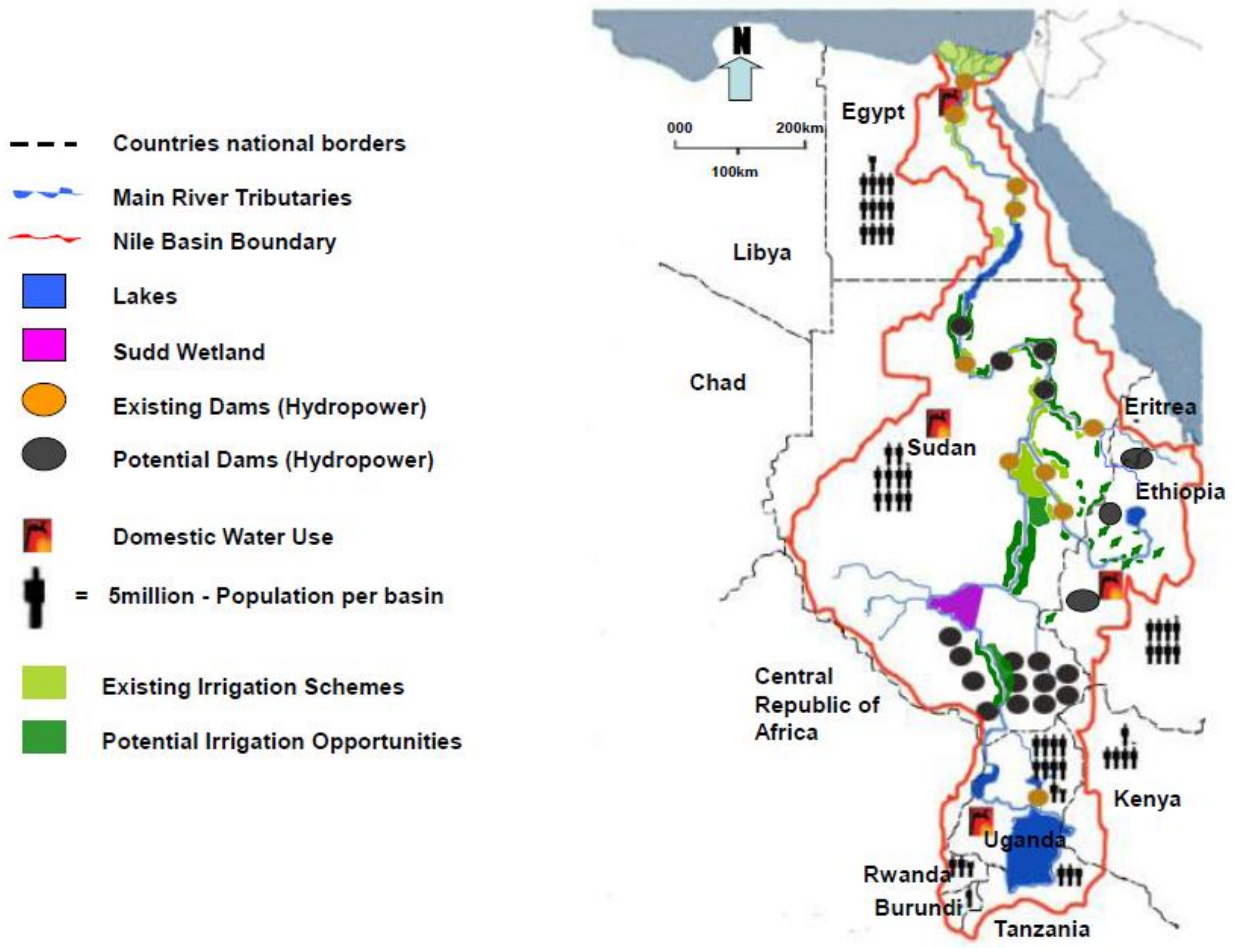


Figure 5.4: Socioeconomic system of the Nile (Modified from literature (WRI 2003; Blackmore and Whittington 2008; Tesemma 2009; GAES 2010; TFDD 2010); Concept: Author, Biniam Iyob; Figure drawing: Biniam Iyob and Simon Iyob). Domestic uses of the Nile are more in Northern locations (Egypt). Irrigation and hydropower potentials are more prevalent upstream (south).

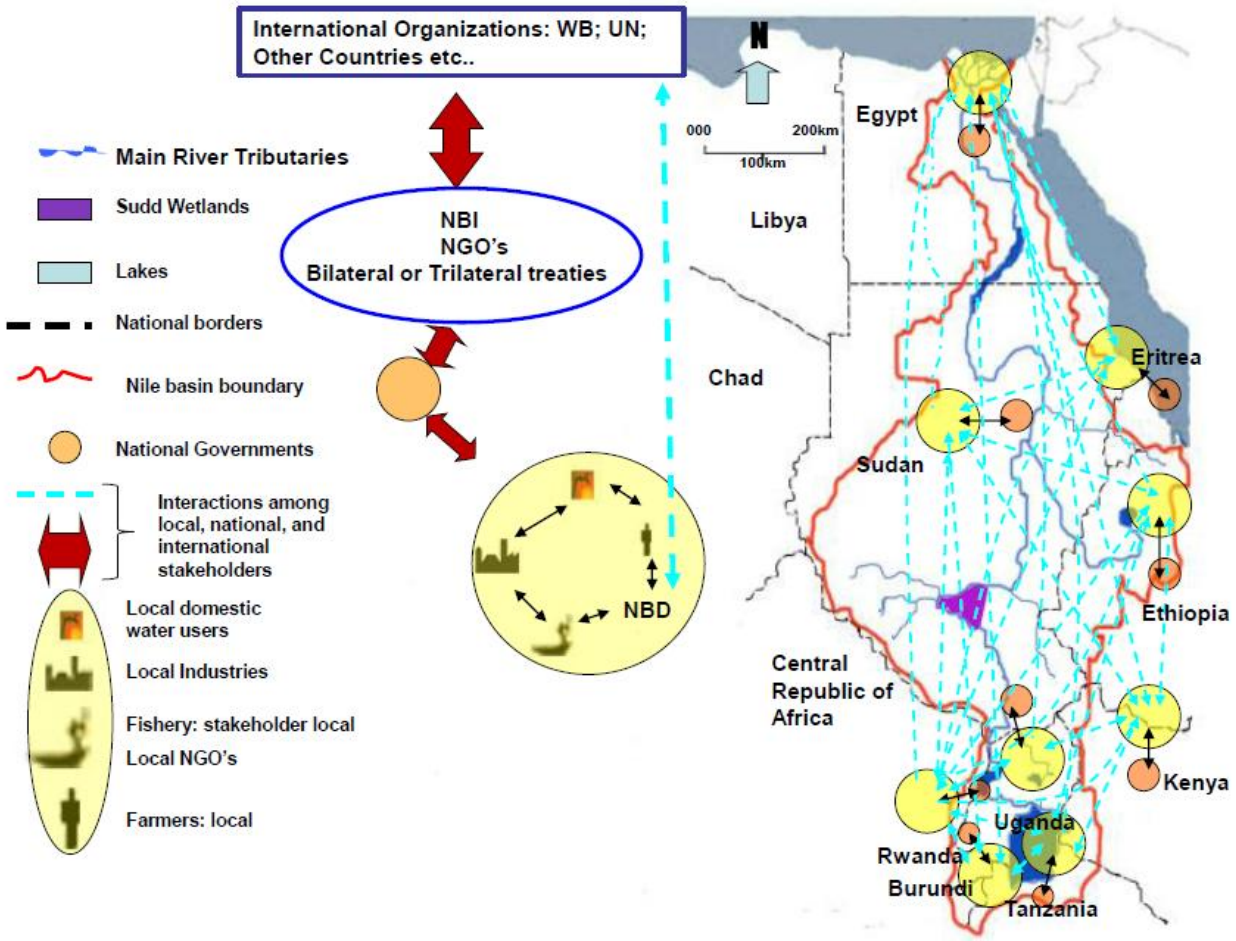


Figure 5.5: Geopolitical system of the Nile (Modified from literature (WRI 2003; Blackmore and Whittington 2008; Tesemma 2009); Concept: Author, Biniam Iyob: Figure drawing: Biniam Iyob and Simon Iyob). Although interactions exist among all the stakeholders (dashed blue lines), national (respective governments), except for the NBD, represent local interests in communicating with regional and internationals stakeholders (shown by thick red arrows).

The socioeconomic system was described through irrigation, hydropower and domestic water use factors with associated pressures occurring due to increase in demand for these three factors. Regarding the geopolitical system, local, national, regional, and international stakeholders and their requirements regarding water quantity, quality and timing were used to describe the geopolitical system. The tensions that can arise at these four geographic scales due to utilization of Nile water resources were the pressures that were considered (Figure 5.2). These pressures or tensions can range from mild disagreements to violent conflict (Wolf 2007). For example, at the regional level, a Kenyan MP was reported for making a war threat on Ethiopia because of the dam being built on the Omo River which is perceived to affect Kenya negatively (JimmaTimes 2008). This particular case did not lead to war. This paper does not assess the range and depth of biophysical, socioeconomic and geopolitical pressures that affect the systems such as disagreements and conflicts for geopolitical. Other researchers have assessed these issues extensively (Wolf 2001, 2007b; Yoffe et al. 2004). This paper instead focuses on whether the NBI has the ingredients or resiliencies to mitigate these pressures.

5.2.2 Methods utilized in assessing resiliency

This paper utilized processes from the management discipline to assess whether the NBI is resilient to the pressures exerted on the three systems (results section) and suggests recommendations for NBI (discussion section). The methodology utilized in this paper differs from previous studies as it particularly utilized (see Table 5.1 for examples) fairly simple management (Figure 5.6) procedures: initiating (vision statements), planning (implementing studies), directing (implementation of projects), and monitoring (evaluation) (Lewis 2007; UNCHS 1993).

Table 5.1: Selected resilience studies, methodologies utilized, and gap analysis.

Framework	Authors of Study	Study area or focus	Methodology utilized	Differences compared with this paper
Vulnerability or resilience of hydrophysical, political and social systems	(Hamouda, Nour El-Din, and Moursy 2009)	Eastern Nile Basin countries	Utilized 31 international indicators (water scarcity, hydropower independence etc) in radar diagrams	This paper particularly assesses institutional capacity of an RBO (NBI) rather than country based.
Management and Human Resources	(Bhagria 2010)	Nile	Utilized Strength Weakness Opportunity and Threat (SWOT)	This paper utilizes quantity, quality and timing concepts and responses rather than just assessment of the NBI.
Resilience of a river basin institution	(Schlüter and Pahl-Wostl 2007)	Amudarya River Basin	Utilized conceptual as well agent based models to describe resiliency. Used also mathematical equations to describe availability of water and fish, centralized versus decentralized systems	This paper studies the Nile Basin and also it utilizes management concepts (observation, planning, directing, executing and monitoring) as tools of resiliency measures.
Drought mitigation or management as resiliency measures	(Rockström 2003)	Southern Africa	Conceptual frameworks such as small scale managements such as minimum tillage, crop water harvesting were utilized	This focus of this paper is more than drought. And also it utilizes the methods stated in Rockstrom to assess whether NBI will utilize them.
Transboundary water institutional capacity	(Kliot, Shmueli, and Shamir 2001)	The Mekong, Indus, Ganges–Brahmaputra, the Nile, Jordan, Danube, Elbe, Rio Grande and Colorado, Rio de la Plata, Senegal and Niger	Utilized conceptual method: 1) legal regime,2) customary law,3) territorial extent, and membership, 4) functions, 5) explicit or implicit expression, 6) purposes and power of implementation 7) external impacts on institution, and 8) conflict and conflict management	This paper utilizes project implementation based approach and also biophysical, socioeconomic and geopolitical frameworks.
Social and ecological resilience	(Adger 2000)	Various study areas and a case study of mangroves in Vietnam	Utilized specific case studies and conceptual discussions. Utilized household surveys due to loss of commonly owned mangrove converted to agricultural areas as decrease of social resiliency	This paper studies a specific institution and utilizes management concepts (observation, planning, directing, executing and monitoring).
Water supply of reservoirs	(Hashimoto, Stedinger, and Loucks 1982)	No particular study area. Utilized water reservoir example	Utilized mathematical models to describe reliability, vulnerability and resilience	This paper assesses a more general but comprehensive ideal resiliencies required by the NBI.

For each of the biophysical, socioeconomic, and geopolitical systems, as well as associated pressures, several responses or factors were considered as resilience or institutional strengthening factors for the NBI (see Tables 5.2 to 5.7). These factors were selected because they were the most frequently cited in literature. The greatest challenge was the assessment regarding the specifics of how the NBI is related to the proposed resiliency factors and the involvement rate (strong or weak involvement). The NBI does a lot of research utilizing its own facilities and collaborates with several organizations (such as IWMI, World Bank, and UN) and individuals (Blackmore and Whittington 2008; Whittington, Wu, and Sadoff 2005). This paper, first and foremost, utilized the NBI website (http://www.nilebasin.org/), but additional sources as well, to explore the resilience factors (such as "soil conservation" in Table 5.2 for the first resilience factor). Only those specifically addressing the response or resiliency factors and the NBI or those closely addressed or have collaborated with the NBI (such as Blackmore and Whittington (2008) used data from the NBI) are considered in assessing for the five resilience stage ranks (see Table 5.8 for more details).

Table 5.2: Methods to assess responses to drought pressures.

Possible negative effects of drought pressures on quantity, quality and timing	**Possible proposed responses to drought pressures**	**Literature about proposed response**
*Causes a decrease in water **quantity*** resulting in loss of habitat for wildlife	*Soil and Water conservation*	(Shi and Shao 2000)
	Crop water management	(Legg et al. 1979)
	Rain-Water Harvesting	(Bruins, Evenari, and Nessler 1986; Grewal et al. 1989)
	Minimum Tillage	(Rockström et al. 2009). (Abou El Hassan et al. 2006), (Brhane et al. 2006)
	Minimum water flow for ecosystem, biodiversity/wetlands and other ecological habitats	(Delli Priscoli and Wolf 2009; Sengo et al. 2005)
	Build Reservoirs	(Whittington, Wu, and Sadoff 2005)
	Alternative water resources (groundwater and desalinization)	(Elemam 2010)
	Treaties or agreements for drought affected water quantity	(Shmueli 1999; Utton 1999)
*Results in decrease of water **quality** due to increase in total dissolved solids relative to water quantity*	*Decrease in turbidity through terracing*	(Dhameja 2001)
	Monitoring and Purification	(NBI 2005)
	Treaties or agreements for drought affected water quality	(Sigman 2002; Shmueli 1999; Utton 1999; Cooper, Stednick, and Gilbert 2005)
*Causes green drought due to disruption of **timing** of water*	*Reservoirs (dams) to distribute water at opportune times*	(Collins 2002)
	Treaties addressing drought caused timing of water disruption	(MacQuarrie 2004; Shmueli 1999)

Table 5.3: Methods to assess responses to flood pressures.

Possible negative effects of flooding pressures on quantity, quality and timing	**Possible proposed responses to flooding pressures**	**Literature about the proposed response**
*Causes an increase in water **quantity***	*Reservoirs (dams) to distribute water at opportune times*	(Collins 2002)
	Drainage of excess water	(Dawoud et al. 2006)
	Emergency evacuation and monitoring	(Rashid, Haider, and McNeil 2007)
	Treaties regarding flooding and water quantity	(Muckleston 2003)
*Affects water **quality** detrimentally due to increase in sedimentation*	*Better design for reservoirs to avoid siltation*	(Sur, Bhardwaj, and Jindal 1999)
	Terracing	(Nyssen et al. 2004)
	Treaties that consider impact of flood on water quality	(Bakker 2007b)
*Generally occurs at unpredictable **timing***	*Anticipation and monitoring of disruption of water timing*	(Billi and el Badri Ali 2010)
	Water diversions	(Martin 2002)
	Treaties that consider disruption of timing of water due to flooding	(Bakker 2007b)

Table 5.4: Methods to assess responses to irrigation pressures.

Possible negative effects of increase in irrigation demand on quantity, quality and timing	**Possible proposed irrigation responses to pressures**	**Literature about the proposed response**
*Decrease in water **quantity** for irrigation ultimately leading to food shortage*	*Water efficiency (drip irrigation)*	(Gadissa and Chemeda 2009)
	Building of reservoirs	(Whittington, Wu, and Sadoff 2005)
	Alternative resources (groundwater and desalinization)	(Elemam 2010; Attia et al. 1989)
	Irrigation quantity treaties or agreements	(Delli Priscoli and Wolf 2009)
*Water **Quality** might degrade causing decrease in agricultural production*	*Availability of irrigation water quality data and improvement*	(Radstake, Attia, and Lennaerts 1988; Elemam 2010)
	Potential irrigation developments and water quality standards	(Radstake, Attia, and Lennaerts 1988; Elemam 2010)
	Treaties regarding Irrigation water quality treaties	(Shmueli 1999; IJC 2009)
***Timing** gets disrupted causing decrease of water when needed such as for downstream countries*	*Availability of irrigation water timing data and improvement*	(Tsakiris and Kiountouzis 1984)
	Potential irrigation developments and water timing standards	(Tsakiris and Kiountouzis 1984)
	Treaties regarding timing of water in relation to irrigation	(Delli Priscoli and Wolf 2009)

Table 5.5: Methods to assess responses to hydropower pressures.

Possible negative effects of hydropower development on quantity, quality and timing	**Possible proposed responses to pressures**	**Literature about the proposed response**
*Decrease of water **quantity** downstream and flooding*	*Increase existing hydropower efficiency*	(Yüksel 2010)
	Develop better designs for potential hydropower	(Yüksel 2010)
	Alternative water resources (groundwater and desalinization) or alternative energy resources	(Elemam 2010)
	Treaties regarding relation of hydropower and water quantity	(Muckleston 2003)
*Increase in siltation and heavy metal pollution lead to less **quality** and thus less power*	*Dredging*	(Hoke et al. 1990)
	Treaties regarding relation between hydropower and water quality	(Shmueli 1999)
*Disruption of **timing** of water flow causing power outages*	*Assess and adjustment of water timing, and management*	(Muckleston 2003)
	Treaties regarding relation of hydropower and timing	(Muckleston 2003)

Table 5.6: Methods to assess responses to domestic pressures.

Possible negative effects of increase of domestic demand on quantity, quality and timing	**Possible proposed responses to pressures**	**Literature about the proposed response**
*Decrease in water **quantity** due to high demand for domestic use can created social inequality*	*Water recycling*	(Yunfeng et al. 2009; Friend and Coutts 2006)
	Education	(Friend and Coutts 2006; Delli Priscoli and Wolf 2009)
	Get alternative water (groundwater and desalinization)	(Elemam 2010)
	Treaties regarding relation between domestic water use and water quantity	(Wolf 1999)
*Decrease in **quality** due to management and infrastructure can create health problems*	*Assessment and monitoring of existing water quality*	(IJC 2009)
	Potential developments and water quality standards	(IJC 2009)
	Treaties regarding domestic water use and water quality	(Wolf 1999)
*Disrupt and change **timing** at different locations can cause local economies not to strive*	*Timely distribution of water for urban and rural areas*	(Delli Priscoli and Wolf 2009)
	Treaties regarding relation between domestic use and timely distribution of water	(Wolf 1999; MacQuarrie 2004; Delli Priscoli and Wolf 2009)

Table 5.7: Methods to assess responses to increase resilience to local, national, regional and international geopolitical pressures.

Possible negative effects of local politics on quantity, quality and timing	**Possible proposed responses to pressures utilizing the UNDP and NBI framework (UNDP 2010; NBI 2010n, 2010o)**
Quantity decrease generally results conflict among local stakeholders	*Participation*
	Rule of Law
	Transparency
	Equity
	Accountability
	Responsiveness
Quality degradation may lead to loss of local livelihood for agricultural purposes	*Participation*
	Rule of Law
	Transparency
	Equity
	Accountability
	Responsiveness
Timing of water could lead to drought (such as Ethiopia's green drought	*Participation*
	Rule of Law
	Transparency
	Equity
	Accountability
	Responsiveness

Table 5.8: Criteria for evaluating resiliency of NBI documents and projects.

Resilience criteria stages	**Explanation**	**Resilience rank (see Figure 5.5 for more details)**
0. Not mentioned or stated	The **specific factor** relating to vision statement must be **explicitly mentioned** in a document or project **undertaken by the NBI or closely supported by the NBI.** For example if a vision statement is mentioned for the Nile basin but the statement is not done by the NBI, it will not be considered.	No resilience
1. Stated or mentioned	The **specific factor** must be **explicitly mentioned** in a document or project **undertaken by the NBI or closely supported by the NBI**. For example, in managing standards utilizing soil water conservation for water quantity as affected by drought, only those specifically stated as soil and water conservation or closely resembling to it were considered	Very low resilience
2. Doing Research	The **specific factor** must be **explicitly mentioned** in a document or project **research undertaken by the NBI or closely supported by the NBI**. For example, in managing irrigation efficiency to mitigate decrease of water quantity due to higher irrigation demands, only those specifically stated as researches already undertaken or in progress or anticipated to improving irrigation water efficiency or closely resembling to it were considered	Low resilience
3. Proposed specific projects	The **specific factor** must be **explicitly mentioned** in a document or project **proposed by the NBI or closely supported by the NBI**. For example, in managing local stakeholders' political demands regarding water quantity due to higher local demands, only those specifically stated specific project proposals such as having meetings with the local populace or closely resembling to it were considered	Medium resilience
4. Helped implement projects	The **specific factor** must be **explicitly mentioned** in a document or project **implemented by the NBI or closely supported by the NBI**. For example, in managing national stakeholders' political demands regarding water quantity due to higher national demands, only those specifically implemented such as having meetings at national level to address national demands or closely resembling to it were considered	High resilience
5. Monitored or evaluated projects	The **specific factor** must be **explicitly mentioned** in a document or project **evaluated by the NBI or closely supported by the NBI**. For example, in managing standards for water timing to distribute water at appropriate timing to urban or rural areas, specifics or closely related factors that monitored or evaluated implemented projects were considered	Very high resilience

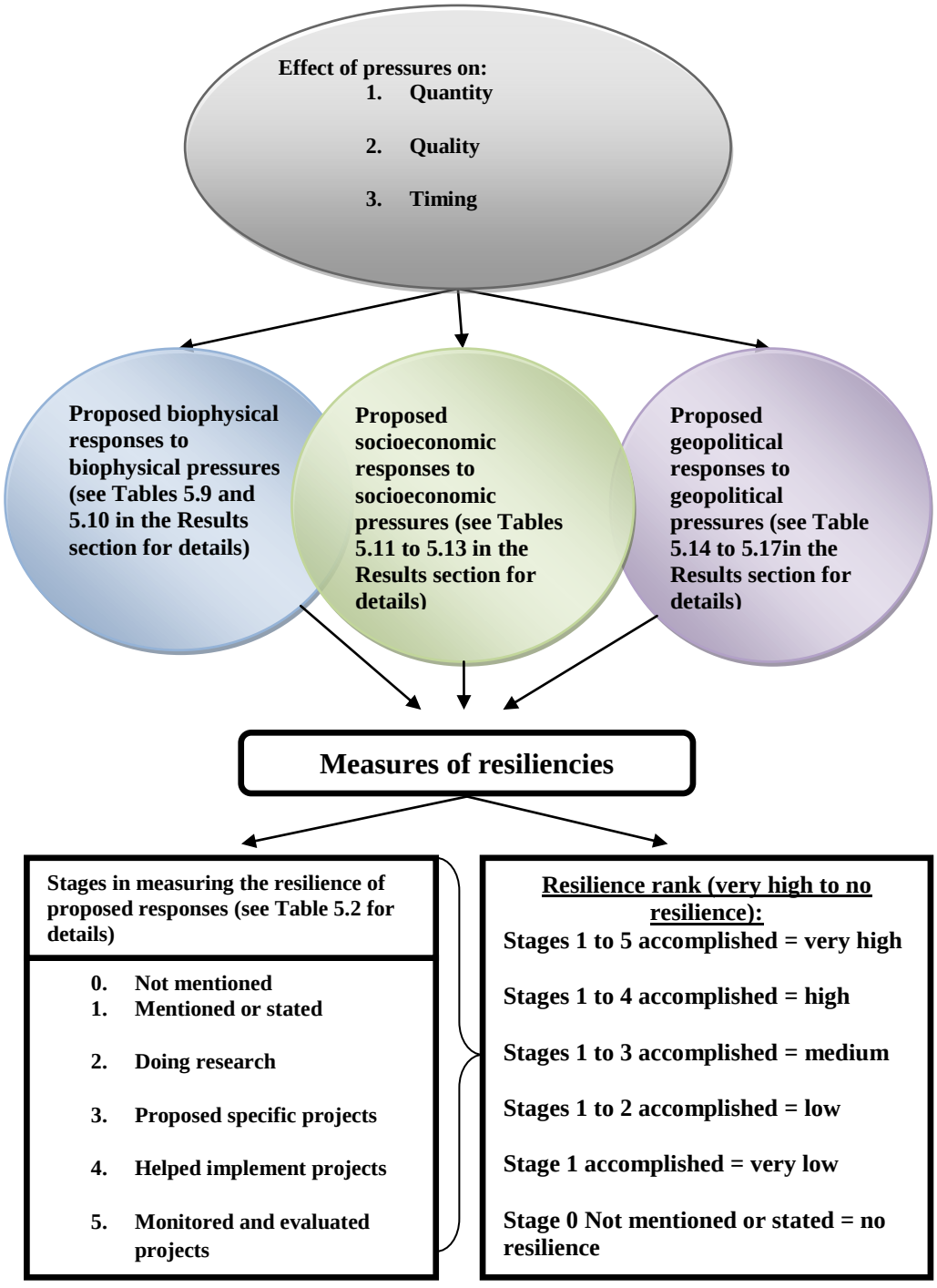


Figure 5.6: Methods in assessing resilience of proposed ideas to biophysical, socioeconomic and geopolitical pressures on quantity (decrease or increase), quality (siltation and pollution) and timing (disruption of flow) of Nile water resources.

5.3 Results

The objective of this section is to address the findings regarding possible resilience responses or factors required for the NBI to mitigate the impact of biophysical, socioeconomic, and geopolitical pressures (see Figures 5.1 and 5.5) on water quantity, quality and timing of the Nile. The resiliency assessment methods or requirements stages (see Figure 5.5) are: 1) whether the NBI has stated or mentioned the proposed responses, 2) whether the NBI has done research on the factors, 3) whether the NBI has identified specific projects regarding the proposed factors, 4) whether it has implemented the proposed research projects, and finally, 5) whether it has evaluated the successes and challenges of implemented projects (Table 5.8).

5.3.1 Biophysical resilience to drought and flooding pressures

The NBI website recognizes that due to climate change, there would be more incidents of drought and flooding. The Joint Multipurpose Project (JMP) has clearly been mentioned as dealing with the impacts of drought and flooding (NBI 2010j), while it also mentions other studies (NBI 2010za) which have tried to assess impacts of climate change. During a conference proceeding on water forum in 2006, the executive director of NBI clearly mentioned drought and flood management as opportunities that are envisaged (Kahangire 2006). Following are the findings of this paper regarding the proposed resiliency responses to mitigate drought and flooding.

Resilience to drought

Water **quantity** resilience to drought

Seven possible responses were assessed to determine water quantity resiliency of the NBI to drought. These are: 1) soil and water conservation, 2) efficient crop water management, 3) rainwater harvesting, 4) minimum tillage, 5) building of reservoirs, 6) alternative measures (such as groundwater and desalinization) to mitigate the decrease

of quantity caused due to drought, and 7) treaties or agreements that address water quantity issues due to drought.

Soil and water conservation has been mentioned generally on the NBI website, such as in the planning and development vision regarding Rwanda and Kenya (NBI 2010ze, 2010r). The Nile Transboundary Action Project (NTAP), mentions water conservation to reduce soil erosion in its vision statement (Bhagria 2010). Although not explicitly stated as quantity management, it is strongly implied. Although the Nile countries have achieved soil and water conservation measures (such as in Ethiopia, Eritrea, and Kenya utilizing terracing) independent of the NBI, there were no indications where the NBI has specifically done research, identified projects, implemented projects, or evaluated implemented projects of soil and water conservation measures to mitigate drought impacts on water quantity. Thus, this paper finds evidence that only the first resilience stage (very low resilience rank) is accomplished (Table 5.9).

Efficient crop water management can bring increased benefits due to a decrease in the irrigation water needed, thus decreasing the detrimental impacts of drought. Although not mentioned specifically, the use of efficient crop water management is addressed generally through the irrigation and drainage project under the Integrated Development of the Eastern Nile (IDEN) projects under the ENSAP (NBI 2009b). Drought-resistant crops and other methods such as the Sasakawa plans (SAA 2010) have been implemented by the Nile countries to mitigate the impacts of drought on water quantity. The author was involved in Eritrea in the 1990s in the Sasakawa global plans to plant drought resistant crops. In Eritrea, the Sasakawa method promoted genetically engineered, short-stalked crops that are drought resistant as they have shorter growing period. However, there was no indication that the NBI was closely involved or helped do research, proposed projects, implemented projects, or evaluated projects regarding crop water management. Similar to the soil and water conservation factor, this paper finds evidence for only the first resilience stage (very low resilience rank) was accomplished by the NBI (Table 5.9).

Table 5.9: Resiliency of the NBI to drought pressure.

Quantity, quality or timing	Possible proposed responses to drought pressures	Has stated in its vision statement	Doing research	Proposed specific projects	Helped implement projects	Monitoring and evaluation of implemented projects	Resilience rank
Quantity	*Soil and Water conservation*	✓	×	×	×	×	**Very low**
	Crop water management	✓	×	×	×	×	**Very low**
	Rain-Water Harvesting	✓	✓	✓	✓	×	**High**
	Minimum Tillage	×	×	×	×	×	**No resilience**
	Minimum water flow for ecosystem, biodiversity/wetlands etc	✓	×	×	×	×	**Very low**
	Build Reservoirs	✓	✓	✓	×	×	**Medium**
	Alternative water resources (groundwater and desalinization)	✓	✓	×	×	×	**Low**
	Treaties or agreements for drought affected water quantity	×	×	×	×	×	**No resilience**
Quality	*Decrease in turbidity through terracing,*	×	×	×	×	×	**No resilience**
	Monitoring and Purification	✓	✓	✓	×	×	**Medium**
	Treaties or agreements for drought affected water quantity	×	×	×	×	×	**No resilience**
Timing	*Reservoirs (Dams) to distribute water at opportune times*	✓	✓	✓	×	×	**Medium**
	Treaties addressing drought caused timing of water disruption	×	×	×	×	×	**No resilience**

Rainwater harvesting programs are underway in many of the Nile countries. The Ethiopian Rainwater Harvesting Association (ERHA) (ERHA 2009), Kenya Rainwater Association (KRA) (KRA 2009) and the Ugandan Rainwater Harvesting Association (URHA) (URWA 2009) are just some examples. Rainwater harvesting is mentioned in the planning and development plans for the Egypt profile on the NBI website (NBI 2010k). Rainwater harvesting is specifically mentioned in the NELSAP (NBI 2010zb) and the Nyagatare Rainwater Harvesting in Rwanda is an example of a small-scale project (giving 15 water tanks to schools) that shows the resiliency of the NBI in doing research, proposing a project and implementing it, but not the last resilience stage, evaluation (NBI 2010q, 2010zc). Thus, this paper finds that the first four resilience stages were accomplished (high resilience rank) by the NBI, but not the last one (Table 5.9).

Tillage practices and their effect on water saving have been examined, for example, for the paddy rice in the Nile Delta of Egypt and in northern dry areas of Ethiopia (Abou El Hassan et al. 2006; Brhane et al. 2006). Searches done for this paper as to whether the NBI mentions tillage practices to increase water saving yielded no result. This paper finds no evidence that suggests that any of the five resilience stages regarding minimum tillage were fulfilled (rank of no resilience) by the NBI (Table 5.9).

The consideration of minimum water flow to maintain ecological habitat was another resilience response factor that was considered. The NBI has considered these responses through the Nile Basin Awareness Kit (NBI 2010u). The Nile Basin Decision Support System (DSS) has data that shows low and high flow conditions (Blackmore and Whittington 2008) that are possibly being used to assess drought conditions and benefit sharing, especially regarding irrigation. During conversation on the visit to Ethiopia, the DSS seems to have considered the effect of minimum flow, as it is considering low-flow scenarios for the Nile River. There is also evidence that shows cooperation among the Nile countries to dredge and maintain healthy ecology

for aquatic habitats, for example between Egypt and Uganda regarding Lake Victoria (Elemam 2010). However, this paper finds evidence that suggests the first resilience stage is accomplished (very low resilience rank) by the NBI, but not the remaining four (Table 5.9).

The multiple benefits accrued from reservoirs can be utilized as responses not only for drought but also for other pressures including but not limited to flooding, increase in hydropower demand, and decreasing political tensions arising from lack of water and therefore less food production at national levels. Drought is explicitly mentioned (strongly implied reservoirs aid in drought mitigation) in the Joint Multipurpose Program (JMP) and the irrigation and drainage project of the ENSAP (NBI 2010i, 2010h). The JMP program has identified potential small and major dams such as in the Blue Nile/Abbay. There are many projects that are being developed to mitigate drought, such as the building of many small earthen dams and the development of irrigation projects, but these seem to happen independently of the NBI (Waterbury and Whittington 1998). There have been many feasibility studies done by the NBI or with its collaboration. One such collaboration is the assessment of the JMP programs to build dams in the the Baro–Akobo–Sobat, the Tekeze-Atbara, and the Abbay (Blue Nile) (Blackmore and Whittington 2008). Blackmore and Whittington reached the conclusion that they are more confident about the Abbay in building reservoirs in order to have more irrigation water (which by implication is also for drought) (Blackmore and Whittington 2008). During the visit to Ethiopia, a meeting with the NBI staff also revealed that low- and high-flow simulations and scenarios are being conducted by the Decision Support Tool (DST), (which is part of the NBI). Thus, regarding the utilization of reservoirs by the NBI and water quantity saving to mitigate drought, this paper finds that the NBI has met the first three stages (medium resilience rank), but not the last two, implementation and evaluation (Table 5.9).

Besides the Nile water resources, alternative measures such as groundwater and desalinization constituted the fourth resilience-strengthening response that was

assessed. The NBI, in a recent news article quoting David Molden from the IWMI, mentions groundwater as a possible alternative resource that needs consideration (NBI 2010s) and also as a water security issue that needs consideration due to climate change (NBI 2010zf). The Nile Basin DSS has also commissioned studies regarding the collection of groundwater data (Droogers and Immerzeel 2009). There are studies that have considered groundwater and the implications of its relationship with Nile surface waters (Sileet, El Fattah Metawie, and Soliman 2007; Hefny and Amer 2005; Elemam 2010). Desalinization, as an alternative resource, also merits serious consideration, especially for Egypt, although it is cost prohibitive at the moment (El-Sadek 2010). Nevertheless, brackish groundwater has the potential of being cost effective (Elemam 2010). Thus, this paper finds evidence that the NBI accomplished the first two resilience stages, (low resilience rank) regarding the utilization of alternative resources, but not the remaining three (Table 5.9).

Regarding treaty or agreement or cooperation that addresses quantity and drought relations, the 1929/59 Nile treaty water quantity sharing was actually done for a low flow rate (Blackmore and Whittington 2008). Since the inception of NBI in 1999, this paper has found no evidence that any of the resilience stages have been accomplished (rank of no resilience) regarding treaties or agreements relating to drought and water quantity (Table 5.9).

Water **quality** resilience to drought

Three possible responses were assessed to determine water quality resiliency of the NBI to drought. These are: 1) the decrease of turbidity (total dissolved solids) utilizing terracing, 2) monitoring and purification of water, and 3) treaties or agreements regarding water quality issues and drought.

The use of terracing or similar methods (such as reservoirs) has been mentioned as a possible cooperation factor, especially to decrease siltation in downstream areas (Billi and el Badri Ali 2010). Research presented in this paper shows no conclusive evidence

(no-resilience rank) that suggests the consideration of the five resilience stages as related to water quality and drought (Table 5.9).

The monitoring and purification possible response to mitigate drought-caused water quality degradation effects was the second resilience response factor that was assessed. There are water quality considerations and assessments being done by the NBI with support from national data (NBI 2005). However, this paper finds no clear evidence that suggests any of the five resilience stages were accomplished (rank of no resilience) by the NBI, with particular consideration for water quality and drought (Table 5.9).

Similar to the water quantity and drought findings, although there are references to consider water quality in treaties, the specific effect of drought and quality as it relates to treaty or agreement was not considered by the NBI. Thus, the finding of this paper suggests that the NBI has not accomplished (rank of no resilience) any of the five resilience stages (Table 5.9).

Water **timing** resilience to drought

Two possible responses were assessed to determine water timing resiliency of the NBI to drought. These are 1) the building of reservoirs to control temporal distribution of Nile's water and 2) treaties or agreements regarding timing of water when there are drought pressures.

The building of reservoirs to control the timing of water to mitigate drought impacts has been done in the Nile Basin. The Aswan High Dam is such an example, where the timing of water is regulated, and where Egypt has more than a year of storage to mitigate impacts of drought (Collins 2002). The NBI has been promoting the possibility of building dams mainly for irrigation and hydropower and it has helped in giving data and commissioning reports such as in the Abbay area of the Blue Nile (Blackmore and Whittington 2008). These promotional efforts address poverty alleviation strategies and could also be translated to drought impacts. As such, three

stages have been accomplished (medium resilience rank), but not the last two stages (Table 5.9).

Similar to the previous findings, this paper did not find clear evidence (rank of no resilience) that suggests the accomplishment of treaties and agreements relating to drought and timing (Table 5.9).

Resilience to flooding

Water **quantity** resilience to flooding

Four possible responses were assessed to determine water quantity resiliency of the NBI to flooding. These are as follows: 1) building of reservoirs to control water quantity increase due to flooding, 2) drainage methods to discharge excess water, 3) emergency evacuation or successful resettlements, and 4) treaties and agreements to address flood effect on water quantity of the Nile.

The building of reservoirs to control flooding has been one of the main research areas of the NBI. From conversations with the DSS branch in Addis Ababa, Ethiopia, the NBI through the DST has evaluated scenarios for flood and drought situations for hypothetical dam scenarios. A conversation with the director of Flood Preparedness and Early Warning (FPEW), a subdivision of the NBI under the ENSAP, in Ethiopia shows how the project has been progressing, especially in gathering data as well as communications at local and national levels (NBI 2010f). Similarly, the NELSAP has also been doing some feasibility studies regarding flood-associated storage (NBI 2010m). Thus, the findings of this paper suggest that the NBI has achieved the first three resilience stages (medium resilience rank), but not the last two (Table 5.10).

Drainage method to discharge excess water is mentioned in the DST, as the data considers spillages from reservoirs (Blackmore and Whittington 2008). This achieves the first stage of the resilience step. The irrigation and drainage program under the

ENSAP also mentions drainage, but most of its focus seems to be on irrigation (NBI 2009b). The findings also suggest that the NELSAP has helped implement a stormwater drainage project in Malaba, Uganda (NBI 2010z). Thus, this paper finds evidence that four stages have been accomplished (high resilience rank), but not that the last stage (evaluation) (Table 5.10).

Flood preparedness is one of the main objectives of the NBI, with a flood management center of the Nile Basin Capacity Building Network-for River Engineer (NBCBN-RE) located in Kenya (NBCBN 2010). A conversation with the Flood Preparedness and Emergency Evacuation (FPEW) director in Addis Ababa reveals the formation of the Regional Coordination Unit, which effectively communicates data to achieve the resilience response (NBI 2010f). The NBI has also recognized flood issues due to climate change as one of the factors that the JMP addresses (NBI 2010j). Moreover, the Nile DST has simulation data that includes flooding, and it considers low and high flow rates (Blackmore and Whittington 2008). Because of this evidence, this paper finds that the first four resilience stages are achieved (high resilience rank) by the NBI (Table 5.10).

Table 5.10: Resiliency of the NBI to flood pressure.

Quantity, quality or timing	Possible proposed responses to flooding pressures	Has stated in its vision statement	Doing research	Proposed specific projects	Helped implement projects	Monitoring and evaluation of implemented projects	Resilience rank
Quantity	*Reservoirs (Dams) to distribute water at opportune times*	✓	✓	✓	×	×	**Medium**
	Drainage of excess water	✓	✓	✓	✓	×	**High**
	Emergency evacuation and monitoring	✓	✓	✓	✓	×	**High**
	Treaties regarding flooding	×	×	×	×	×	**No resilience**
Quality	*Better design for reservoirs to avoid siltation*	✓	✓	✓	×	×	**Medium**
	Terracing	✓	×	×	×	×	**Very low**
	Treaties that consider impact of flood on water quality	×	×	×	×	×	**No resilience**
Timing	*Anticipation and monitoring due to disruption of water timing*	✓	✓	✓	✓	×	**High**
	Water diversions	×	×	×	×	×	**No resilience**
	Treaties that consider disruption of timing of water due to flooding	×	×	×	×	×	**No resilience**

The last resilience response assessed was the availability of treaties or agreements or cooperation related to flooding and water quantity. In this regard, this paper finds no evidence that suggests that any of the five resilience stages have been accomplished (rank of no resilience) by the NBI (Table 5.10).

Water **quality** resilience to flooding

Three possible responses were assessed to determine water quality resiliency of the NBI to flooding. These are as follows: 1) better design for dams (or reservoirs) to avoid siltation; 2) terracing to improve soil water absorption and thus decrease flooding and ultimately siltation of reservoirs; and 3) treaties or agreements that address water quality due to flooding.

The first proposed factor is the requirement for better design for dams to avoid siltation. The issue of siltation or sedimentation has been raised by many researchers (Billi and el Badri Ali 2010; Whittington, Wu, and Sadoff 2005; Blackmore and Whittington 2008). Siltation is mentioned by NELSAP as having a negative effect on the Cyohoha Basin in the Rwanda/Burundi border area (NBI 2010d). It does not mention flooding but states problems with erosion. Flooding and erosion go hand in hand when considering the relatively high rainfall in the region. Flood-related issues are mentioned in a document attributed to the NBI, specifically mentioning siltation as a serious issue facing Lake Tana in Ethiopia (GAES 2010). It has been suggested strongly by the NBI, and other authors supported by the NBI that the building of reservoirs, especially in upstream areas of Ethiopia would reduce sedimentation in Sudan (Blackmore and Whittington 2008; Whittington, Wu, and Sadoff 2005). Due to this evidence, this paper finds that the NBI achieves the first three resilience stages (medium resilience rank), but not the last two (Table 5.10).

Terracing to decrease siltation or sedimentation in upstream areas has been pursued by several Nile countries. For example, almost every year, just before the rainy season starts, many terraces are built or maintained in the Eritrean and Ethiopian highlands.

There is some mention of terraces and inherent recognition, meriting the accomplishment of the first resilience stage (NBI 2010g). The focus of the NBI seems to be on big projects rather than small projects regarding sedimentation issues. Thus, this paper finds that the first resilience stage is accomplished (very low resilience rank) by the NBI (Table 5.10).

Since it is not a permanent RBO, the NBI has not expressly addressed water quality issues and treaties or agreements arising from flooding. This paper finds no evidence that suggests that the NBI has achieved (rank of no resilience) any of the five resilience stages (Table 5.10).

Water **timing** resilience to flooding

Three possible responses were assessed to determine water timing resiliency of the NBI to flooding. These are 1) anticipation and monitoring due to disruption of water timing, 2) water diversion strategies to avoid untimely flood events, and 3) treaties or agreements that assess disruptions on water timing relating to flood of the Nile.

The first response assessed to address the timing effect of flooding is the anticipation and monitoring of flood events. As described for the effect on water quantity, the NBI, through the FPEW has been training personnel on flood data collection, communicated with locals to get information on the occurrences of flooding, and to communicate with it and with all interested (NBI 2010f). Similarly, the NELSAP has also been doing some feasibility studies regarding flood-associated storage (NBI 2010m). These two examples suggest evidence that the four stages of resilience have been accomplished (high resilience rank) by the NBI. There is no evidence to suggest that evaluations have been done to assess the successes and challenges of the progress that the NBI made regarding implemented flood projects (Table 5.10).

The second factor assessed is water diversion to mitigate pressures caused by timing of flood. Flood control has been practiced in the Nile basin for millennia by building

barrages and other diversions (Collins 2002). However, the focus of the NBI seems to be directed only to reservoirs rather than diversion systems to mitigate flooding occurring at different temporal phases. This paper finds no evidence that suggests that the NBI has fulfilled (rank of no resilience) any of the five resilience stages.

Similar to most of the findings of this paper, searches done regarding treaties or agreements relating to flood and water timing revealed no evidence (rank of no resilience) that the NBI has accomplished them (Table 5.10).

5.3.2 Socioeconomic resilience to increased demands for irrigation, hydropower, and domestic use

The NBI has focused more on building institutional resiliencies to mitigate socioeconomic pressures in comparison to biophysical. For example, the irrigation and drainage project has identified 100,000 hectares and is assessing implementation for irrigation among the three countries that make up the Eastern Nile countries (Egypt, Sudan and Ethiopia) (NBI 2009b). There are many dams being planned for both irrigation and hydropower benefits. These include proposed dams such as the Joint Multipurpose Program (JMP) (Blackmore and Whittington 2008; NBI 2010j). In the following subsections, the resiliency of the NBI will be assessed regarding the effect of irrigation, hydropower, and domestic components on water quantity, quality, and timing.

Resilience to increase in irrigation demand

Water **quantity** resilience to increase in irrigation demand

Four possible responses were assessed to determine water quantity resiliency of the NBI to growing irrigation demand. These are: 1) improving water efficiency (such as drip irrigation and canal construction) to conserve water quantity; 2) building of reservoirs to maintain water quantity; 3) the development of alternative water

resources (such as groundwater and desalinization); and 4) the development of treaties or agreements that addresses water quantity and irrigation relations.

Improving water efficiency utilization methods such as drip irrigation is the first response assessed to mitigate the impacts of an increase in irrigation demand on water quantity. One of the eight subdivisions of the Shared Vision Program (SVP) is efficient water management for agriculture. Under this program, there is a Rapid Baseline Assessment (RBA), which assesses water harvesting techniques and irrigation (WB 2004). Information from the NBD in Egypt mentions the application of drip irrigation (NBD 2010b). Although there are several cases where water conservation is mentioned or alluded to, and although research seems to have be done, this paper did not find clear evidence that suggests any of stages two to five resiliencies regarding the efficient use of irrigation water quantity were accomplished (very low resiliency rank) by the NBI (Table 5.11).

The building of reservoirs to maintain or meet irrigation demand has been envisioned both at large and small scales. At the small scale, the NBI seems to be succeeding in the implementation, while research and project proposals are under consideration regarding large-scale irrigation proposals. One small-scale irrigation project that was implemented is the Bisarwi dam in Tanzania (NBI 2010z). At large scale, most of the dams proposed, such as in the Tekeze, Abbay (Blue Nile), and the Kagera, consider the amount of irrigation water quantity. For example the ENSAP assessed 100,000 hectares of irrigation for Egypt, Sudan, and Ethiopia (NBI 2009b). Research that was supported by the NBI has also assessed the feasibility of irrigation in the Eastern Nile Basin (Whittington, Wu, and Sadoff 2005; Wu and Whittington 2006; Blackmore and Whittington 2008). Thus, this paper finds evidence that out of the five resilience stages, the first four (although small scale, the Bisarwi dam is considered as implementation) have been accomplished (high resiliency rank), but not the last two (Table 5.11).

Table 5.11: Resiliency of the NBI to increase in irrigation demand (socioeconomic pressures).

Quantity, quality or timing	Possible proposed irrigation responses to Pressures	Has stated in its vision statement	Doing research	Proposed specific projects	Helped implement projects	Monitoring and evaluation of implemented projects	Resilience rank
Quantity	*Water efficiency (drip irrigation etc)*	✓	×	×	×	×	**Very low**
	Building of reservoirs	✓	✓	✓	✓	×	**High**
	Alternative resources (groundwater and desalinization)	✓	×	×	×	×	**Very low**
	Irrigation quantity treaties	×	×	×	×	×	**No resilience**
Quality	*Availability of irrigation water quality data and improvement*	✓	✓	✓	✓	×	**High**
	Potential irrigation developments and water quality standards	✓	×	×	×	×	**Very low**
	Treaties regarding Irrigation water quality treaties	×	×	×	×	×	**No resilience**
Timing	*Availability of irrigation water timing data and improvement*	✓	✓	✓	×	×	**Medium**
	Potential irrigation developments and water timing standards	×	×	×	×	×	**No resilience**
	Treaties regarding timing of water in relation to irrigation	×	×	×	×	×	**No resilience**

Alternative water resources such as groundwater and desalinization have been considered in the Nile Basin. The relationship of groundwater and surface water has been mentioned by the NBI, such as in the Bugesera region of Rwanda and Burundi (NBI 2010e). Generally, desalinization of seawater has been viewed as too costly, while using brackish groundwater might be feasible (Elemam 2010). From an implementation point of view, as a cooperative gesture, Egypt has provided 4.2 million U.S. dollars to drill boreholes in Kenya (Elemam 2010). The boreholes, although not clearly stated for irrigation, presumably would contribute to agricultural production. However, in projects such as drilling boreholes, the NBI seems to not be involved closely in the implementation of groundwater issues. Thus, this paper finds evidence that the NBI has accomplished the first resilience stage (very low resilience rank) but not the remaining four (Table 5.11).

Treaties or agreements relating to irrigation water quantity were the primary concerns with the 1929/59 Nile water treaty. Similar to the findings of the previous resiliency responses, this paper does find clear evidence that suggests the accomplishment (rank of no resilience) of treaties or agreements by the NBI for any of the five resiliency stages relating to irrigation water quantity (Table 5.11).

Water **quality** resilience to increase in irrigation demand

Three possible responses were assessed to determine water quality resiliency of the NBI to growing irrigation demand. These are: 1) availability of data regarding acceptable irrigation water quality, such as less siltation and salinity and subsequent maintenance; 2) assessment of potential irrigation developments and thus development of water quality standards; and 3) the development of treaties or agreements that assess water quality relations to irrigation water.

The availability of data regarding irrigation water quality is the first resiliency factor that was considered. It has been noted that agricultural practices have been detrimental to water quality in Egypt (Hefny and Amer 2005). The Nile countries have had studies

that assessed water quality (NBI 2005). A recent report by the Nile Transboundary Environmental Action Project **(**NTEAP) compiling water data from all the Nile countries, except Eritrea, and utilizing mostly national data made very good progress regarding water quality in the Nile. In Egypt, regarding irrigation water quality, utilizing the Most Probable Number (MPN) method, the report utilized the value 1000 MPN/ 100 ml as standard (same as the World Health Organization) (NBI 2005). The report also addresses many other water quality issues regarding irrigation, such as the seasonal variation of water quality, standards for irrigation water quality in Ethiopia and irrigation water quality relation to pesticide among others (NBI 2005). Thus, this paper finds evidence that all the resilience steps except the last (evaluation) are being fulfilled (high resilience rank) by the NBI (Table 5.11).

The assessment of a potential irrigation water quality standard when facing irrigation demand is the second proposed response that was considered. Although there are many water quality monitoring by the national governments that NBI collaborates with (as discussed in the previous paragraph), there is yet no potential water quality standard for the Nile that the NBI has considered. The existence of national water data that NBI utilizes in itself accomplished the first resilience stage for potential assessment. Regarding the remaining four resiliency stages, this paper does not find clear evidence (very low resiliency rank) that the NBI is accomplishing them (Table 5.8).

Treaties and agreements regarding irrigation water quality is the last factor that was assessed. There are several cooperative efforts regarding water quality (as well as monitoring endeavors), such as the Lake Victoria Environmental Management Program (LVEMP) among Uganda, Kenya, Tanzania, Rwanda, and Burundi, where water quality monitoring is being accomplished (NBI 2010c). Nevertheless, this paper did not find any evidence regarding treaties or agreements (rank of no resilience) specifically for irrigation water quality for all of the five resilience stages (Table 5.11).

Water **timing** resilience to increase in irrigation demand

Three possible responses were assessed to determine water timing resiliency of the NBI to growing irrigation demand. These are 1) the availability of data regarding the existing temporal distribution of irrigation water and subsequent improvement regarding efficiency and conservation; 2) the assessment of potential irrigation water (temporal) distributions and subsequent improvement regarding efficiency and conservation; and 3) the development of treaties or agreements that consider the timing of irrigation water.

Availability of data regarding timing of irrigation water is the first factor that was assessed. It can be argued that the building of reservoirs effectively addresses the timing of irrigation water, since distribution can be made at opportune times. Thus, similar to the building of reservoirs as discussed for irrigation quantity (as well as for drought and flood discussions), this paper finds evidence that the first three stages (medium rank) have been accomplished, but not the last two (Table 5.11).

Potential timing of irrigation water is the second factor that was assessed regarding the timing of irrigation water. As mentioned earlier, there are potential irrigation projects and reservoirs that are being considered. However, this paper did not find conclusive evidence (rank of no resilience) that considered potential irrigation timing research, especially when considering climate change predictions on Nile's water resources (Table 5.11).

Treaties or agreement regarding irrigation timing was the last resilience response that was considered. Similar to most previous findings, this paper did not find evidence to suggest that any of the resilience stages were being accomplished (rank of no resilience) by NBI (Table 5.11).

Resilience to increase in hydropower demand

Water **quantity** resilience to increase in hydropower demand

Four possible responses were assessed to determine water quantity resiliency of the NBI to growing hydropower demand. These are as follows: 1) increasing existing hydropower efficiency to conserve water quantity; 2) the development of potential hydropower that have better designs and thus decrease water loss due to factors such as evaporation and seepage; 3) the possible utilization of other alternative water quantity (groundwater or desalination) or alternative energy resources; and 4) the development of treaties or agreements regarding the effect of hydropower on water quantity.

Compared to irrigation, the NBI has made tremendous progress in achieving the resiliency stages regarding hydropower responses. For example, research pertaining to hydropower development in Burundi and Rwanda, such as the Bujagali, Kagera (Rusumo Falls), is underway, promoted under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) (Nkurunziza 2010). There is much research (closely linked to NBI as it has provided data) that has assessed the quantity of water regarding hydropower in the Eastern Nile region, including but not limited to the Tekeze-Atbara and Blue Nile (Abbay) (Whittington, Wu, and Sadoff 2005; Blackmore and Whittington 2008; Wu and Whittington 2006). So far, none of the research and projects assessed has been implemented yet except for the Bujagali. However, it is not clear whether the Bujagali was done under the auspices of the NBI or not; thus, this paper has not considered it as a resiliency implemented stage (stage four). Similarly, during a visit to the Blue Nile, the author saw a hydropower plant built by China that generates approximately 75MWh of energy. It is not clear whether this hydropower was supported or assessed or implemented with help from the NBI. Thus, this paper finds that all the resilience stages have been accomplished by the NBI (medium resiliency rank) except the last two (implementation and evaluation stages) (Table 5.12).

Table 5.12: Resiliency of the NBI to hydropower demand increase (socioeconomic pressures).

Quantity, quality or timing	Possible proposed responses to pressures	Has stated in its vision statement	Doing research	Proposed specific projects	Helped implement projects	Monitoring and evaluation of implemented projects	Resilience rank
Quantity	*Increase existing hydropower efficiency*	✓	✓	✓	×	×	**Medium**
	Develop better designs for potential hydropower	×	×	×	×	×	**No resilience**
	Alternative water resources (groundwater and desalinization) or alternative energy resources	✓	✓	✓	×	×	**Medium**
	Treaties regarding relation of hydropower and water quantity	×	×	×	×	×	**No resilience**
Quality	*Dredging*	✓	✓	✓	×	×	**Medium**
	Treaties regarding relation between hydropower and water quality	×	×	×	×	×	**No resilience**
Timing	*Assess timing, and management*	✓	✓	✓	✓	×	**High**
	Treaties regarding relation of hydropower and timing	×	×	×	×	×	**No resilience**

Potential hydropower with efficient designs to minimize the impact on water quantity or water quantity on hydropower was the second resilience response that was assessed. The finding of this paper suggests that the NBI accomplished none of the five resiliency stages (Table 5.12).

Resiliencies associated with the development of alternative water for other uses besides hydropower and other alternative energy resources besides hydropower revealed a slightly different result than for potential hydropower efficiency. Alternative resources such as groundwater and desalinization, although not specifically addressed by the NBI, are mentioned (Elemam 2010). The power connectivity among Rwanda, DRC, Kenya, and Burundi through the Regional Transmission Feasibility Interconnection is more than just hydropower connectivity (NBI 2007; Ngowi 2010). It has the potential for integrating the economies of the involved countries. Similarly, Ethiopia and Sudan primarily but also Egypt are considering power transmissions that go beyond just the Nile Basin boundary (NBI 2009a). Due to this evidence, this paper finds that the NBI accomplishes the first three stages of resilience (medium resilience rank). This paper did not find evidence that the NBI helped in actual implementation and evaluation of alternatives (Table 5.12).

Although several scenarios regarding the feasibility of reservoirs, their hydropower capacity, and quantity relations were considered by the NBI, this paper did not find evidence that the five resiliency stages have been accomplished (rank of no resilience) regarding agreements or treaties (Table 5.12).

Water **quality** resilience to increase in hydropower demand

Two possible responses were assessed to determine water quality resiliency of the NBI to growing hydropower demand. These are 1) dredging to improve siltation and invasive species (as a measure of water quality decrease) due to existing hydropower resources, and 2) the development of treaties regarding the effect of hydropower on water quality.

Dredging was one of the factors considered to assess resiliency or institutional capacity of the NBI. A report by the Nile Basin Capacity Building Network for River Engineering (closely linked to NBI) mentions dredging as mitigation for flood control in river channels, such as in mitigating flood issues in the Kurimat Power Plan area in Egypt (Shawki et al. 2005). The report proposes different scenarios regarding dredging. In addition, regarding Lake Victoria, the Nile Basin Awareness Kit reports the awareness of invasive species and associated monitoring utilizing Earth Observation Satellite images (NBI 2010x). This evidence pertains to the resilience response at issue, as dams are utilized for hydropower generation. Although there were dredging projects being implemented in the Nile Basin through other organizations and the NBI, there were no actual cases (or clear data) to state that they have been done regarding the improvement of hydropower efficiency. Thus, this paper finds evidence that the first four resiliency stages have been accomplished (high resiliency rank) by the NBI, but not the last one, evaluation (Table 5.12).

Finally, the development of treaties or agreements regarding hydropower and water quality relations was assessed. Similar to most of the findings of this paper, this paper finds no evidence that any of the resiliency stages have been accomplished (rank of no resilience) by the NBI (Table 5.12).

Water **timing** resilience to increase in hydropower demand

Two possible responses were assessed to determine water timing resiliency of the NBI to growing hydropower demand. These are 1) the assessment and management of existing timing of water resources or the adjustment of new developments to existing timing of water due to hydropower development and 2) the development of treaties or agreement that consider the disruption of timing due to hydropower.

Assessment and adjustment of existing and/or potential aspects regarding the effect of water timing and hydropower was the first factor that was assessed. Here, the effect could be assessed from the hydropower energy perspective, where water quantity

affects hydropower utilization in different times (seasons, daytime or nighttime, etc.) or hydropower affecting water quantity distribution at temporal scales. During the visit made to Addis Ababa, Ethiopia in 2009, conversations with the NBI staff revealed that they were considering small hydropower dams by assessing water quantity, elevation, velocity factors, and proximity to power-consuming entities. Conversations with the DSS staff also revealed that water quantity flows at different temporal scales were considered. Other researchers besides the NBI (or closely linked to it) have also considered siltation or sedimentation rates such as for the Merowe dam in Sudan, which will affect hydropower capacity (Teodoru, Wüest, and Wehrli 2006). In addition, timing of water and its effects on hydropower generation and project feasibility studies was assessed by research that the NBI is closely linked with (Blackmore and Whittington 2008). This evidence suggests that the NBI accomplishes the first four stages (high resilience rank) but not the last, evaluation (Table 5.12).

Similar to most of the findings of this paper, this paper finds no evidence that any of the resiliency stages were accomplished regarding the relationship between hydropower and water timing (rank of no resiliency) by the NBI (Table 5.12).

Resilience to increase in domestic demand

Water **quantity** resilience to increase in domestic demand

Four possible responses were assessed to determine water quantity resiliency of the NBI to growing domestic demand. These are: 1) water supply 1) water recycling, 2) education, 3) the utilization of alternative water resources (such as groundwater, and desalinization), and 4) the development of treaties or agreements regarding water quantity demands for domestic uses.

The availability of water was the first resilience response that was considered in this paper. This issue has been mentioned several times by the NBI or via research that it closely supports. Regarding specific projects, several small projects including Bomet

(in Rwanda: serving 5000 residents), Angurai (in Kenya), and Mella (in Uganda) are some that have been completed through collaboration with NELSAP (NBI 2010z). Thus, regarding water supply, the NBI has accomplished all the first four resilience stages (high resilience rank). There were no findings or evidence to suggest that the last stage (evaluation) of implemented projects was or is being accomplished (Table 5.13).

The second resilience factor that was assessed is water recycling initiatives to accommodate domestic water demand pressures. Although there is water recycling achievements regarding irrigation at national levels independent of the NBI (Elemam 2010), this paper did not find clear evidence of water recycling any of the five resilience stages (no resiliency rank) for domestic use by the NBI (Table 5.13).

Education regarding domestic water utilization to mitigate domestic water quantity demand pressures was the third resilience factor that was assessed. Education is mentioned by the NBI in general terms but not specifically. During the 2009 visit to Ethiopia, a television program was showing graduates from a university relating to water resources management and its relation to the Nile Basin. Many of the students were responding to the need for cooperation with the Nile Basin states. Conversations with the NBI staff also revealed that they have been conducting workshops to educate people about the Nile, NBI and other related issues. These findings suggest that there is enough evidence that the NBI has accomplished all the first four resilience stages (high resiliency rank). There was no evidence to suggest that the evaluation stage had been accomplished (Table 5.13).

Table 5.13: Resiliency of the NBI to increase in domestic demand (socioeconomic pressures).

Quantity, quality or timing	Possible proposed responses to pressures	Has stated in its vision statement	Doing research	Proposed specific projects	Helped implement projects	Monitoring and evaluation of implemented projects	Resilience rank
Quantity	*Water Supply*	✓	✓	✓	✓	×	**High**
	Water recycling	×	×	×	×	×	**No resilience**
	Education	✓	✓	✓	✓	×	**High**
	Get alternative water	✓	✓	×	×	×	**Low**
	Treaties regarding domestic water use and water quantity	×	×	×	×	×	**No resilience**
Quality	*Assessment and monitoring of existing water quality*	✓	✓	✓	✓	✓	**Very high resilience**
	Potential developments and water quality standards	✓	✓	×	×	×	**Low**
	Treaties regarding domestic water use and water quality	×	×	×	×	×	**No resilience**
Timing	*Timely distribution of water for urban and rural areas*	×	×	×	×	×	**No resilience**
	Treaties regarding relation between domestic use and timely distribution of water	×	×	×	×	×	**No resilience**

Utilization of alternative resources, such as groundwater and desalinization, to mitigate growing domestic water quantity demand is the third resilience response that was considered. As discussed in the resilience response to drought, groundwater and desalinization have been considered or mentioned and research seems to have been done by the NBI (Droogers and Immerzeel 2009). Groundwater as a resource is commonly utilized for domestic uses in the Nile region, especially in dry areas such as in Egypt (Elemam 2010). Although groundwater projects have been implemented, such as Egypt giving financial aid to Kenya to drill boreholes, these issues do not seem to be related to the NBI. Thus, this paper finds that only the first two resilience stages have been accomplished (low resilience rank) by the NBI (Table 5.13).

The last resilience response to mitigate growing water quantity demand for domestic use is the availability of treaties or agreements regarding domestic water use and quantity. Similar to most of the findings of this paper, this paper finds no evidence to suggest that any of the five resilience stages were achieved (rank of no resilience) by the NBI regarding domestic water quantity and treaties or agreements (Table 5.13).

Water **quality** resilience to increase in domestic demand

Three possible responses were assessed to determine water quality resiliency of the NBI to growing domestic demand. These are: 1) assessment and monitoring of existing water quality, 2) potential developments to address water quantity for domestic consumption and thus sustainability, and 3) the development of treaties or agreements regarding water quality issues caused due to domestic demands.

The availability of data and monitoring of water quality when facing growing domestic demand was the first response that was assessed. There is much research that has assessed the water quality of the Nile and domestic uses (Mason 2003). As discussed before, a recent report by the NBI shows that it has considered water quality issues (using national government data as it cannot infringe upon the sovereignty of Nile states) (NBI 2005). In addition, with help from other organizations, for example

the International Livestock Research Institute (which is housed with NBI in Addis Ababa, Ethiopia (which collaborates with NBI)) suggests the separation of domestic and livestock drinking water sources to improve management of drinking water (Peden 2005). The NBI report in 2005 has explicitly identified those data relating to drinking water. Thus, this paper finds that the NBI has achieved all the resilience stages (even evaluation stage) as the Nile countries constantly monitor water quality; therefore, the NBI does not need to do the quality monitoring by itself, but can use national data (Table 5.13).

Regarding potential developments and drinking water quality demand pressures, this paper suggests that the NBI has achieved the first two resilience stages (low resilience rank) of the resilience responses, but not the last three). These findings are suggested as the NBD report in Rwanda clearly mentions and proposes that research is done regarding the achievement of Millennium Development Goals (which specifically address safe drinking water in its 7^{th} goal: Ensure Environmental Sustainability) (NBD 2007b).

Similar to most findings, this paper did not find specific evidence (rank of no resilience) that suggests treaties or agreements relating to domestic water quantity consumption. There was no evidence to show that any of the five resiliency stages were accomplished by the NBI.

Water **timing** resilience to increase in domestic demand

Two possible responses were assessed to determine water timing resiliency of the NBI to growing domestic demand. These are 1) the increase in timely domestic water distribution efficiency for Nile basin locations for both rural and urban areas (such as the provision of more pipes); and 2) the development of treaties or agreements that consider the former two.

Distribution of water in a timely manner to meet the needs of both urban and rural areas is the first resilience response that was considered. The NBI is aware and its supported research makes statements about the overall need for infrastructure (such as transportation) in order to increase cooperation and benefits for the Nile countries. The NBI makes references to the need for water for urban areas and also the role of women in rural areas is mentioned (NBI 2010zd, 2010y). However, this paper did not find literature that addresses the distribution of water (for example during different seasons, efficiency of distribution, and during hot and cold weather) and meeting the needs of urban and rural stakeholders through pipes and other methods by the NBI. Thus, this paper did not find evidence that any of the five resiliency stages had been achieved or were being achieved (rank of no resilience) by the NBI (Table 5.13).

Lastly, the availability of treaties or agreements regarding the timely distribution of water for domestic purposes was assessed. Similar to most of the findings, this paper did not find evidence (rank of no resilience) that suggests the achievement of the five resiliency stages by the NBI (Table 5.13).

5.3.3 Geopolitical resilience to local, national, regional and international stakeholders demands

Geopolitical resiliency is defined (by this paper) as the ability of the NBI to respond to perturbations arising due to tensions occurring between and among local, national, regional and international regarding the utilization of Nile water resources. This paper utilizes the good governance measures as geopolitical resiliencies required by the NBI to withstand these pressures. The six good governance indicators (used as responses for all the four scales to increase the institutional capacity of the NBI) are: participation, rule of law, accountability, responsiveness, transparency, and equity (UNDP 2010; NBI 2010n, 2010o; NBAK 2010). Similar to the biophysical and socioeconomic factors, the geopolitical resilience is mainly assessed utilizing information from the NBI website, and the Nile Basin Awareness Kit as well as the

Nile Basin Discourse (NBD) (NBI 2010v; NBD 2010d; NBI 2010t). This paper focuses on participation. The findings for participation and responsiveness and also for the rule of law and accountability were similar and thus are lumped together in the following result findings.

Participation and Responsiveness

In this paper, participation is defined as the ability of the NBI to represent the interests of all the stakeholders through informing, consulting, involving, collaborating, and empowering processes (NBAK 2010). And responsiveness is defined as a resiliency indicator which measures whether the NBI tries to serve all the stakeholders involved (UNDP 2010).

The NBI along with the NBD and Nile Basin Awareness Kit (NBAK) has been pushing for stakeholder participation (NBI 2010l). One such an example is the meeting held in Entebbe (Uganda) regarding Lake Victoria, where stakeholders from local, national, regional, and international scales were present (NBI 2010a). From the NTAP (Nile Transboundary Action Program) and also the NBAK, stakeholder participation responses will be utilized as the proposed response to assess geopolitical resilience to water quantity, quality, and timing pressures that might occur due to local, national, regional or international tensions (NBI 2010t). Stakeholder participation and responsiveness responses will be assessed for local, national, regional and international parties as to whether they accomplish the five progressive resilience (statement, research, project proposal, implementation, and evaluation) stages.

At the local scale, the NBD has been created to address local stakeholder concerns regarding the Nile Basin development and other aspirations (most of these discussions seem to focus on water quantity) (NBD 2010d). As such, it has held workshops and has done several education outreach events and programs. For example, in 2008, the

NBD held a forum representing stakeholders from national, and civil societies (local stakeholders) regarding dam development in Sudan (NBD 2010a). In addition, several countries are organizing country based NBD forums and websites (NBD 2010c). This paper also found that the NBI has evidence that suggests their achievement for the first four resiliency stages. The NBAK webpage shows that stakeholder participation through radio (in Ethiopia), sport competitions (in DRC) and even invasive weed removals (in Burundi) were achieved through the NTEAP (Nile Transboundary Environmental Action Program) for both water quantity and quality (NBI 2010l). A report about a forum held in Rwanda by the NBD extensively states participation as key to achieving sanitation, clean water availability and resolving the pollution of the Nyabugogo river in Rwanda among other issue (NBD 2007b) These evidences achieve responsiveness as a response as the NBD is created to represents local stakeholders (NBD 2010d). This paper finds that all of the five stages were achieved regarding participation and responsiveness for local water quantity and quality in regards to the first four (high resiliency rank) resiliency stages (Table 5.14 and Appendix 7.1).

Table 5.14: Resiliency of the NBI to local geopolitical pressures.

Quantity, quality and timing	Possible proposed responses to pressures	Has stated in its vision	Doing research	Proposed specific projects	Helped implement projects	Monitoring and evaluation of implemented projects	Resilience rank
Quantity	*Participation and Responsiveness*	✓	✓	✓	✓	✓	**Very high**
	Rule of Law and Accountability	✓	×	×	×	×	**Very low**
	Transparency	✓	✓	✓	✓	✓	**Very high**
	Equity	✓	✓	✓	×	×	**Medium**
Quality	*Participation and Responsiveness*	✓	✓	✓	✓	✓	**Very high**
	Rule of Law and Accountability	✓	×	×	×	×	**Very low**
	Transparency	✓	✓	✓	✓	✓	**Very high**
	Equity	✓	✓	✓	×	×	**Medium**
Timing	*Participation and Responsiveness*	✓	✓	✓	✓	×	**High**
	Rule of Law and Accountability	✓	×	×	×	×	**Very low**
	Transparency	✓	×	×	×	×	**Very low**
	Equity	✓	✓	✓	×	×	**Medium**

Regarding water timing and participation/responsiveness at local scale, this paper suggests that the first four resiliency stages are accomplished (high resilience rank) by the NBI. The evidence for such a finding is that the FPEW has been consulting with local stakeholders to help collect data regarding flooding and communicate flood time occurrences to relevant authorities (NBI 2010f). This paper did not find clear evidence that the last stage, evaluation is being accomplished by the NBI for water quality, quantity and timing.

Regarding national, regional, and international scales, all of the resilience stages are being accomplished as meetings are held regularly among the national representatives and international stakeholders to discuss water quantity issues. For example, recently (June 2010) the Nile council of Ministers met in Addis Ababa to discuss several issues including the signing of the Nile River Cooperative Framework, which was signed only by Ethiopia, Kenya, Rwanda, Tanzania and Uganda (NBI 2010w). This signing of a new agreement is opposed by Egypt and Sudan since the new framework is perceived as potentially decreasing the benefits (protection of historic rights) that have traditionally been enjoyed by the two Afro-Arab countries (Aljazeera 2010). The legacy of a shared past of conquest and slave raids – echoed in North-South war of the 20th century and the Darfur crisis in the 21st century – have exacerbated the tensions over water resources (Idris 2006). In addition, with the exception of Tanzania, all other countries have been engaged in intra-state wars against rebellious communities that have diverted investment from development projects to fight guerrilla wars and protracted insurgencies. The current refusal of Egypt and Sudan to sign the agreement is thus complicated by the legacies of conflicts, which can be traced to the nineteenth century, when Egypt and Sudan waged religious wars and engaged in slave raids on the populations inhabiting areas of Eritrea/Ethiopia, Tanzania, Uganda and Rwanda. Nevertheless, the injustices and inequalities of the past have been transformed by the attainment of political independence, which has endowed upstream countries with new capabilities. As members of the international state system and also of the various regional organizations (such as the African Union) there is increased use of diplomacy

and commercial trading between downstream and upstream countries. It is important to note that despite the occurrence of ethnic wars, border disputes and numerous insurgencies, none of these countries have gone to war in order to monopolize the Nile's resources. Water remains a highly prized and shared finite resource that is the basis of the survival and prosperity of all the Nile Basin countries.

Yet, pragmatism, complex diplomatic compromises and shrewd negotiations remain a key feature of the Nile Basin countries. The absence of inter-state wars stemming from disagreements over treaties and frameworks governing the use of Nile Water, thus, can be indirectly interpreted as a demonstration of the institutional resilience of the Nile Basin Initiative. At present, the Nile countries share national water quantity and quality data among themselves, with the NBI, and also with international stakeholders as became evident when the author visited the NBI office in 2008. All of these examples provide evidence that all five resilience stages are being accomplished (very high resiliency rank) in regards to participation and responsiveness by the NBI at national, regional, and international scales regardless of the disagreement over the recent 2010 Cooperative Framework regarding participation as a resilience response (Table 5.15 and Appendix 7.1).

Table 5.15: Resiliency of the NBI to national, regional and international geopolitical pressures.

Quantity, quality and timing	Possible proposed responses to pressures	Has stated in its vision	Doing research	Proposed specific projects	Helped implement projects	Monitoring and evaluation of implemented projects	Resilience rank
Quantity	*Participation and Responsiveness*	✓	✓	✓	✓	✓	**Very high**
	Rule of Law and Accountability	✓	×	×	×	×	**Very low**
	Transparency	✓	×	×	×	×	**Very low**
	Equity	✓	✓	✓	×	×	**Medium**
Quality	*Participation and Responsiveness*	✓	✓	✓	✓	✓	**Very high**
	Rule of Law and Accountability	✓	×	×	×	×	**Very low**
	Transparency	✓	×	×	×	×	**Very low**
	Equity	✓	✓	✓	×	×	**Medium**
Timing	*Participation and Responsiveness*	✓	✓	✓	✓	✓	**Very high**
	Rule of Law and Accountability	✓	×	×	×	×	**Very low**
	Transparency	✓	×	×	×	×	**Very low**
	Equity	✓	✓	✓	×	×	**Low**

At national scales, water quality is also achieved for all the resilience stages. This is evident as the NBI itself utilizes national water quality data (NBI 2005). At the national scale and relating to the NBI, the use of the national water quality report can be regarded as an accomplishment of participation and responsiveness responses as well as all the resilience stages. At the regional scale, the NTEAP has been addressing water quality issues (NBI 2005). The former chair of the Nile Basin Council of Ministers (the highest NBI body) and former Kenyan Minister, Martha Karua, praised the NTEAP for holding regional participation regarding water quality exchanges (Karua 2010). This evidence suggests that at national scales, all the five resiliency stages were accomplished by the NBI. Similar to regional scales, at international scales, participation and responsiveness in regards to the five stages are being accomplished due to funding by the World Bank and other rich nations including Japan and Italy (NBI 2010p, 2010j). Thus, this paper finds that there is enough evidence to suggest that the NBI accomplishes participation and responsiveness in regards to the five resilience stages when considering national, regional and international scales for both water quantity and quality (Table 5.15).

Regarding the timing of Nile water resources and accomplishing the six resilience responses, at national, regional and international scales some evidences do exist. A major study that was supported by the NBI is the Joint Multipurpose Program in the Eastern Nile Basin by two neutral renowned economists; where the memory (timing) of the Nile river flows was addressed (Blackmore and Whittington 2008). Another example of participation and responsiveness as evidences is the disruption in the timing of Nile water due to climate change (due to flood and drought effects), which was addressed by the Nile Council of Ministers in June 2010 (NBI 2010b). Representatives from national, regional and international stakeholders were involved in these meetings, suggesting that participation and responsiveness were accomplished by the NBI. Since these meetings have occurred several times, evaluations of previous meetings could very possibly have been discussed. Thus, this paper finds that the NBI has accomplished participation and responsiveness, as a resiliency response, for all

five resilience stages (very high resilience rank) (Table 5.15). The high resiliency values for geopolitical institutional capacity regarding quantity, quality, and timing (for all scales) mask the conflicts that occur over the water resources of the Nile. These limitations and explanations of the findings of the results are addressed using the other remaining five responses and in the discussion section.

Rule of law and accountability

The rule of law, as a resiliency response, is defined in this paper as the ability to effectively enforce treaties or agreements regarding water quantity, quality and timing of the Nile Basin (NBI 2010n). The accountability response is defined as an indicator for those responsible for implementing the rule of law on how well they have done in achieving the rule of law (UNDP 2010; NBI 2010n). The NBI has made statements regarding rule of law, thus effectively achieving the first resiliency stage (NBI 2010n). For the remaining four stages, there were no findings (no resiliency) for all scales regarding quantity, quality, and timing of water, since there is no agreement or treaty to be effectively governed (Table 5.14 and 5.15).

Transparency

Transparency, as a resiliency response, is defined in this paper as the clearness in communicating geopolitical processes (agreements and disagreements) regarding the Nile among and between the involved stakeholders (UNDP 2010). The NBI achieves the first stage of resilience criteria. Through the NBD and other institutions, there have been relatively clear communications at the local scale; for example regarding dam building in Sudan and addressing water quantity and quality through domestic water availability and safety (NBD 2010c, 2010a, 2010b). Meetings (achieving resiliency stage 3) have been held by the NBD and NBD offices involving many stakeholders have been established in almost all the Nile countries; it can be assumed that during meetings, evaluations regarding the transparency of information are raised (thus

achieving evaluation stage) (NBD 2007a, 2008). Thus, although there are critics who protest that the NBD should be more neutral and independent of the NBI and national political entities, this paper finds that the NBI achieves all the resiliency stages for water quantity, and quality (very high resilience rank) at local scale. This paper did not find any mention (no resilience rank) of water timing regarding transparency by the NBI at the local scale. At national, regional and international scales, the NBI has clearly made statements about water quantity, quality and timing (NBI 2010n). The statement achievement (first stage) can be verified by the publications regarding irrigation water quantity, timing of water (through memory of water flow), and water quality data availability from national stakeholders. Regional (NBI), national (the countries), and internationally (World Bank and IWMI) stakeholders make regular statements regarding the importance of clear communication (Blackmore and Whittington 2008; NBI 2005). However, this paper did not find evidences suggesting that researches, projects, implementations and evaluations have been done regarding transparent communication by the NBI. The findings thus suggest low resilience value for transparency as a response at national, regional, and international scales for water quantity, quality and timing (Table 5.15). Most of the meetings regarding the Nile Basin negotiations by the Nile-COM are held within closed doors. There is no communication regarding the details of the new agreement that was signed by five Nile countries and opposed by Egypt and Sudan.

Equity

Equity as a geopolitical resiliency strengthening response is defined as what is perceived as fair by the stakeholders regarding the sharing of the Nile Basin resources (Delli Priscoli and Wolf 2009; Sadoff and Grey 2002; Whittington, Wu, and Sadoff 2005). The word “equity” is one of the primary used of word for the creation of the NBI. The NBI makes the “equitable utilization” statement its guiding vision to bring cooperation among the Nile countries. These statements are not limited to sharing of benefits among national stakeholders but also to local issues such as gender equality

and the achievement of the Millennium Development Goals (NBD 2007b). Researches regarding equitable utilization of the Nile Basin Resources and how the Nile countries would gain or lose have been done through economic theories and models (Whittington, Wu, and Sadoff 2005; Wichelns 2002; Blackmore and Whittington 2008). Specific projects regarding the JMP on sharing hydropower and irrigation benefits in an equitable manner have been assessed as described for biophysical resiliency (building reservoirs) (Blackmore and Whittington 2008). Similar to treaties or agreements for the biophysical and socioeconomic resiliency building responses, no agreements or treaties for sharing the Nile Basin resources in an equitable manner have been implemented in the Nile Basin or through help from the NBI. Thus, the NBI has a medium geopolitical resiliency value regarding water quantity, quality, and timing when using equity as measure of adaptability (Tables 5.14 and 5.15). Since the projects studied that address the sharing of benefits are specific regarding geographic locations, the value holds for all the four scales considered in this paper.

5.4 Discussion

This paper assessed the institutional resiliency of the NBI in mitigating biophysical, socioeconomic, and geopolitical pressures. It provides a unique method for assessing the institutional resiliency of the NBI that can be applied to other RBOs. The methods utilized in this paper, along with other literature, enhance academic knowledge regarding transboundary institutional RBOs. The main findings of this paper suggest mixed institutional resiliencies of the NBI, ranging from high resilience for geopolitical components in all categories, water quantity, quality and timing, to a wide range of values for biophysical and socioeconomic components. The methods, similar to other methods utilized in literature, have limitations. Nevertheless, the findings of this paper and the dissertation contribute to the objectives of the NBI and the overarching purposes of this PhD dissertation (poverty alleviation, achievement of development aspirations, contribution to sustainable development, and enhancement

of cooperation among the Nile countries). The remainder of this section contains a discussion of the major points and implications of the resilience values, the contribution of this paper to knowledge, the limitations of the findings, and the relationship between this paper and relation to the objectives of the dissertation.

The simple management principles (planning, organizing, directing and evaluation) utilized to quantify institutional capacity in this paper clearly identify the strengths and weaknesses of the NBI. Most previous studies have utilized country-based institutional factors or assessed the Nile Basin or the NBI using a country focus, rather than evaluating the NBI in general terms including but not limited to assessments of treaties and current geopolitical conditions (Hamouda, Nour El-Din, and Moursy 2009; Dellapenna 2001; Delli Priscoli and Wolf 2009; Guvele 2003). This paper provides a more systematic approach than previous studies by assessing specific factors that were not considered in institutional research on the NBI. For example, minimum tillage and terracing, although inherently assumed and discussed in other literatures, have never been considered specifically in regards to institutional studies of the NBI. The findings suggested by this paper provide insights to further academic research.

Twenty three, twenty seven, and five resiliency strengthening possible responses were considered by the NBI for biophysical, socioeconomic and geopolitical components, respectively. Ranks, covering five stages of resilience (no resilience, very low, low, medium, high and very high), were given to each of these responses depending on how many of the five resiliency stages (statement, research, projects, implementation and evaluation) the NBI has accomplished.

Thirteen possible responses: eight for quantity, three for quality and two for timing of water were assessed for drought. Biophysical resiliency of the NBI to drought and flooding pressures was variable. Regarding quantity of water, a no resilience rank was given to two (minimum tillage and drought related treaties or agreements), very low to three (soil and water conservation, crop water management, and minimum water flow

for ecology), low to one (alternative water besides the Nile), medium to one (reservoirs), high to one (rain water harvesting) and very high to none of the possible responses. Minimum tillage, similar to rainwater harvesting, requires smaller investment relative to big projects such as high dams. Thus, lessons should be transferred from the achievements of rainwater harvesting to minimum tillage so as to better mitigate drought pressures. These small scale responses are highly recommended for the NBI as large projects require more negotiations and treaties, which inherently take many years and which are proving particularly difficult due to disagreements regarding the 1929 and 1959 Nile water treaties between upstream and downstream countries. Regarding soil and water conservation, crop water management, and minimum water flow for ecology, initial assessment should be conducted to determine feasibility of projects. Perhaps the best possible strategy is to assess how these projects would bring benefits to the various stakeholders involved. For example, soil and water conservation measures, such as small check dams increase infiltration rates and thus groundwater downstream while decreasing siltation (sedimentation) rates for upstream locations. Alternative resources such as groundwater and freshwater through desalinization require more specific proposals by the NBI. This is especially true in the Nile Basin as the costs (economic, geopolitical, and temporal), might very possibly be lower than utilizing the Nile. For example, cooperation (between Egypt and Ethiopia) on developing other alternative resources other than the Nile, such as the Awash river in Ethiopia as well as desalinization projects in the Eastern deserts of Egypt might be economically cheaper than utilizing the Nile. In addition, the negotiation will probably take less time (when compared for the Nile) as well as enhance geopolitical peace of the region. The no resilience rank given to drought related treaties is a common result for all the biophysical, socioeconomic and geopolitical responses and thus will be addressed separately.

Regarding quality and timing of water and drought pressures, three and two possible responses were assessed, respectively. The findings suggest a no-resiliency rank because there is no discussion of measures to decrease turbidity of water through

terracing, and no treaties or agreements relating to water quality and drought. The third response, monitoring and purification of water quality, garnered a medium resiliency response. We recommend that the NBI pursue terracing or other measures such evaporation control utilizing covers for reservoirs to decrease the amount of total dissolved solids, i.e., pollutants and siltation of reservoirs caused by decrease of water quantity during drought periods. Similar to the monitoring and purification responses (data used from national rather than from NBI), the NBI would not need to undertake these measures, but merely assess projects implemented by the Nile states. NBI attention to the challenges and successes of these projects may pave the way for better project proposals, implementation and evaluations resulting in increase of benefits to the stakeholders.

Ten possible responses, four for quantity, three for quality and three for timing of water were assessed regarding the biophysical resilience to flood pressures. The NBI earned a medium-resilience rating for flood control reservoirs, a high-resilience rating for both drainage of excess water and emergency evacuations, and no resilience for treaties addressing floods. Despite evidence of reservoir-building since the creation of NBI, there was no clear evidence to suggest that the NBI was involved. Implementation of a large reservoir is probably not being pushed by the NBI due to complexity regarding implication for downstream countries and fears that it might lead to reinterpretation of the 1929/59 Nile water treaty. It is recommended that the NBI push for smaller scale reservoir projects as they can be rectified relatively easily if detrimental factors are encountered. Thorough evaluation of implemented projects is recommended for the NBI regarding drainage and emergency evacuation responses. Regarding water quality, better dam designs to avoid siltation (medium resilience rank), terracing (low), and treaties relating to water quality associated with flood (no resilience) were the three resilience factors that were assessed to mitigate flood pressures. Better design of dams is highly recommended as downstream countries view it as a positive benefit (reduces siltation, for example to Aswan High dam). On the other hand, the building of dams with good design might set a precedent to

building more dams and as such threaten the 1929/59 Nile water treaty as upstream countries might withdraw more water which reduces irrigation, hydropower and domestic benefits for upstream countries. The NBI could address these fears by building trust and accountability measures. The NBI might need to revive ones of its nonexistent (stated as completed) shared vision projects, the Confidence Building and Stakeholder Involvement, in order to build trust.

The socioeconomic resiliency of the NBI was addressed utilizing ten possible institutional strengthening responses to mitigate increase in demand for irrigation, eight for hydropower and nine for domestic water supply systems. Of the factors used to assess resilience of quantity of water and irrigation, one (irrigation quantity related treaties or agreements) was rated as having no resilience, two were assessed as very low resilience (water efficiency such as drip irrigation and alternative water resources such as groundwater), and one had high resilience (building of reservoirs for irrigation). The same recommendations (for alternative water resources (drought) and reservoirs (drought and flooding)), i.e., utilizing other rivers besides the Nile (such as the Awash in Ethiopia), costs effective desalinization, better dam designs, and small scale reservoirs also apply socioeconomic resiliency. In addition, drip irrigation may contribute to socioeconomic resilience because it may reduce water demand and thereby mitigate water quantity issues, and thereby contribute not only to improved irrigation, but also to reduced geopolitical tensions. With drip irrigation, agricultural yield per water volume applied increases, because less water is lost through application to non productive areas and evaporation. Second, geopolitically, downstream stakeholders are relatively more receptive to water-saving methods when compared to other conventional irrigation methods. The results regarding irrigation and water quality and timing suggest a resilience rank of high for standards of irrigation water quality, very low for potential standards, medium for availability of data regarding existing irrigation water timing but no resilience for potential standards, and similar to the findings of previous responses no resilience rank for treaties regarding irrigation and water quality. Recommendations regarding water timing are

similar to those discussed for irrigation water quantity. However, the development of irrigation water quality standards should be pursued more intensively for both existing and future scenarios. This is especially true as (unlike for irrigation water quantity), it does not seem to conflict with the 1929/59 Nile water treaty. The negotiation, accountability and trust development from water quality could potentially pave the way for irrigation water quantity. Due to population growth rate and development aspirations, it is expected that there will be an increase especially in irrigation water quantity demand. Efficient water-use mechanisms such as drip irrigation, and alternative waters sources (groundwater and desalinization) should be strongly considered by the NBI.

The second socioeconomic system that was considered is hydropower. The findings indicate high resilience (for assessing timing of existing and potential hydropower), medium resilience (for dredging regarding quality and increased hydropower capacity and alternative water resource utilization), and no resilience for the remaining four factors (better hydropower designs and treaties relating hydropower and water quantity, quality and timing). We recommend that the NBI expand hydropower capacity. Both downstream and upstream riparians are more favorably inclined toward hydropower development, whether in downstream or upstream areas, than to increased irrigation. This is because hydropower generation in upstream locations does not result in decrease of water quantity in downstream areas, thus preserving the 1929/59 Nile water treaty. Several hydropower projects have been identified by the NBI. And, whether the NBI is involved or not, hydropower projects are being implemented on the Nile Basin (such as near the Blue Nile falls). Since there were no findings by this paper regarding outcries by downstream riparians opposing these implemented projects, it is highly recommended that the NBI get involved in these projects as it will not be infringing on the sovereignty of the Nile Basin states.

The socioeconomic resiliency of the NBI with respect to domestic water quantity was evaluated as high (for increasing water supply and education), low (for alternative water resources), and no resilience (for water recycling and treaties or agreements). We recommend evaluations for water supply increase and education responses. These evaluations should especially consider future population growth scenarios and new education methods (such as water conservation and recycling), for example using social network WebPages (such as Facebook and Twitter) to reach the young and wider audiences. Alternative water resources such as groundwater and desalinization are more likely to be implemented for domestic water use due to the political influence (will) of the urban populace. Regarding water quality and timing relating to domestic use, the findings of this paper also suggest a very high resilience rank (for assessment of existing domestic water quality), low (for potential domestic water quality), and no resilience (for timely distribution of water for urban and rural populace as well as treaties and agreements associated with quality and timing of domestic water use). We recommend that the NBI conduct evaluations of domestic water quality, and assist in the development of potential regional domestic water quality standards. These recommendations will not only ensure sustainable development but also basin wide accountability and no harm principle among the stakeholders. The development of regional standards is especially important when considering the finding of low resilience for potential effects of development and population growth pressures and no resilience value for timely distribution (that is, getting water to urban and rural populations when they need it) of water. It is recommended that the NBD look into the findings of the no-resilience rank for timely distribution as it asserts the rights of local stakeholders.

There was no evidence of treaties and agreements to assure timely responses to biophysical and socioeconomic pressures on quantity, quality, and timing of water. This is mainly due to the complexity associated with the 1929/59 Nile water treaty as well as the non-permanent status of the NBI as an RBO. However, it is recommended that the NBI make proposals (stage three resilience rank) for the combined fifty five

responses (for example terracing to mitigate drought impacts) for quantity, quality and timing of water of the two (biophysical and socioeconomic) systems. It is the "which comes first" argument, the chicken or the egg quandary. There can be no discussions regarding any treaties or agreements until all stakeholders ratify the 1929/59 Nile water treaty, or new agreements are reached. It is unlikely that the upstream riparians are going to agree to the Nile water treaty given the recent signing of a new agreement by five upstream riparians, effectively demonstrating that they are against it. Thus, this paper strongly recommends innovative new treaties or agreements that addresses the 1929/59 Nile Treaty as well as the relatively newer claim for equitable utilization by upstream stakeholders be considered for the responses assessed in this paper.

This paper defines geopolitical tension as factors that lead to conflict (from political rhetoric to violent war) over the use of Nile water resources. For example, there have been an estimated 70,000 displacement of the Borana people due to water (not located on the Nile Basin) conflict with the Somali ethnic group in Southern Ethiopia (BBC 2009). Six geopolitical resiliency strengthening responses, as defined by the UNDP and the NBI documents: participation, responsiveness, rule of law, accountability, equity and transparency are utilized to assess institutional capacity of the NBI in mitigating tensions affecting water quality, quantity, and timing at local, national, regional and international scales. At local scale, regarding geopolitical resiliency for water quantity and quality, the findings suggest very high (for participation, responsiveness and transparency), medium (for equity), and very low (for rule of law and accountability) values. For water timing at local scale, the findings suggest the same values as for the quantity and quality with the exception for the high (for participation and responsiveness), and very low (for transparency). The results among the national, regional and international suggest the same findings. Compared to the local scale, national, regional, and international scale findings suggest the same except for the transparency response (very low values for water quantity and quality), and participation (high resilience rank value water timing).

It is recommended that a more comprehensive and multi-dimensional evaluation of these five responses be conducted by entities other than the NBI in order to ensure transparency especially at the national, regional, and international scales. External reviews of the method and processes used to produce these responses should take into account historical and political factors that may not be primary driving forces of cooperation over the quest for equitable sharing of the resources of the Nile. The fluidity of political processes, shifts in diplomatic alliances and the brokering of commercial deals make the process of signing of new treaties (rule of law and responsiveness) a very complicated and time-consuming task. The fact remains, though, that despite political tensions and socio-economic conflicts between downstream and upstream countries no war has been waged over the Nile. The politicization of the Nile as a foreign policy issue through, for example, statements that upstream countries such as Ethiopia pose threats to Egypt by building dams have not produced major (violent war) geopolitical tensions. Even the potentially imminent independence of Southern Sudan where the greater part of the White Nile is located, has not yet triggered an inter-state war (Helly 2009). The findings in regards to participation and responsiveness (two of the six responses) at local, national, regional and international scales, suggest a high to very high resiliency rank for all five resiliency stages. These results show that the Nile countries are committed to achieving cooperation. We hope that the commitment will gradually lead to the achievement of higher resiliency rank for the remaining four resiliency strengthening responses.

Limitations are inherent in almost all research. This is because it is impossible to address all the complexity associated, especially in such a broad subject as institutional resiliency of an RBO. The limitations deemed most crucial will be discussed. These are: 1) political limits of NBI and its nonpermanent status, 2) the binary method utilized, 3) confidence of findings and 4) measures utilized in this paper that mask geopolitical tension among and within local, national, regional, and international stakeholders. It is an inherent assumption in this paper that the NBI has

the political authority to achieve the five resiliency stages although it cannot infringe on the sovereignty of the Nile states. The role of the NBI, thus, is to facilitate cooperation and decrease conflicts, which it has succeeded in doing. Because the NBI has nonpermanent status, it has no clear mandates that allow it to fulfill its duties. This paper utilized a *yes* and *no* method (binary) regarding the achievement of the five resilience stages. It is does not address how well the NBI has done regarding the particular response being assessed. Moreover, if the NBI achieves the response in one geographic area (for example in Egypt) but not in Ethiopia, it is still considered an achievement. Lastly, the findings are suggestions rather than conclusive statements as all the possible evidence was not gathered. This paper utilized the NBI, NBD and Nile Basin Awareness Kit and numerous internet sites as its primary resources and thus crucial sources regarding evidences may have been missed. Further, since the Nile Basin is under intense negotiations, information and data might not be available yet. Nevertheless, this paper contributes to both academia and NBI regarding institutional resiliency of RBOs in achieving poverty alleviation, development aspirations, sustainable development and cooperation among the Nile countries.

The methods utilized in assessing the geopolitical resiliency of the NBI masks the multiple political factors and the policy choices of national leaders who may be engaged in internal wars which result in getting support from one of the Nile countries, which then leads to diplomatic standoffs and the making of deals to cut off aid or support for their rebellious constituencies. For example Sudan supported the LRA which led to political tensions with the government of Uganda (Apuuli 2004). The government of Sudan, also found itself engaged in a conflict over water and grazing by nomads and sedentary farmers (Abdalla 2004). Tanzania sought to provide a forum for Hutu refugees, which led to tensions with the post-genocide government of Rwanda. Egypt's support for Eritrean guerrillas led to many diplomatic problems with Ethiopia, which at present is harboring Eritrean dissidents against the post-1993 government of Eritrea. Conflict over land, oil resources, minerals and access to water by the citizens of each country should not be confused with national policymaking

over the shared water resources such as the Nile. The findings of this study point to an urgent need to refine methods of analysis and for research which link the political with the geographic dimensions**.** Although there have been no inter-state wars over water, nevertheless, there are a myriad of political disagreements between and among the stakeholders of this study. Some examples of bilateral (regional) geopolitical tensions, specific to Nile relations linked to cultural andgeographical proximity are explained in the Appendix 7.2. The fluid alliances and diplomatic tensions of all the parties (Aljazeera 2010) are evident in a recently reported disagreement among the Nile countries regarding the signing of a new cooperative framework (that is opposed by Egypt and Sudan) by five of the Nile countries. Thus the high and very high resilience values findings regarding participation and responsiveness may be misleading. The true state of geopolitical relationships among NBI countries is difficult to determine when there is a great deal of political posturing involved (Aljazeera 2010). These conflicts do not undermine the resiliency of the NBI, which is likely to persist. The Sudan Tribune reported on July 5, that representatives of the World Bank (the most important international stakeholder and financier of the NBI) remain confident that the recent impasse over the signing of the new framework will be overcome (Uma 2010). Thus far, based on accessible data, the ability of the NBI to avoid the transformation of a serious disagreement into a violent conflict can be interpreted as an indicator of its institutional resiliency.

The recommendations discussed for the biophysical, socioeconomic and geopolitical systems and pressures help in the achievement of poverty alleviation, development aspirations, sustainable development and cooperation among the Nile countries. For example, poverty alleviation measures could be achieved by improving the resiliency of the NBI to drought through the building of terraces so as to conserve water and increase food production. Development aspirations can be achieved if the NBI provides more data to implement hydropower projects providing badly needed energy to industries in the region. Sustainable development can be achieved by assessing the provision of research for minimum water flow to maintain ecological habitats in the

region. Finally, the NBI is helping in bringing cooperation among the Nile countries. The distribution of water (timing) at the local scale would also enhance cooperation not only among the Nile countries but also within them.

5.5 Conclusion

The Nile countries are striving to utilize the Nile River Basin equitably in order to alleviate poverty, achieve development aspirations, provide sustainable development and enhance cooperation among the stakeholders. One of the methods utilized to achieve these end results is the strengthening of river basin organizations. The Nile Basin Initiative is a river basin organization formed in 1999 to achieve these objectives. This paper assessed the institutional resiliency of the Nile Basin Initiative in mitigating impacts from biophysical, socioeconomic and geopolitical pressures. It assessed twenty three, twenty seven and five resiliency strengthening responses regarding water quantity, quality and timing for each of the three pressures. The findings suggest a wide range of response values, from no-resilience to very high resilience, for the biophysical and socioeconomic, and mostly high to very high resiliency values to mitigate geopolitical pressures. This research provided unique perspectives on assessing the institutional resiliency of the Nile Basin Initiative. Further research is recommended regarding the findings in order to enhance benefit sharing and cooperation among the Nile countries.

5 GENERAL CONCLUSION

Due to the increasing pressures associated with development aspirations, poverty alleviation associated with population growth, the need to utilize sustainable methods and reduce conflict, the rate of transboundary basins resource utilization is likely to increase. The increase in the rate of utilization of shared basin resources, between or among sovereign states, might lead either to conflict and/or cooperation. In order to build resiliency to the pressures, several international laws, rules, regulations, and principles have been proposed to promote sustainable development and cooperation to simultaneously meet water demands. Principal among these is the 1997 UN Convention. The 1997 UN Convention, although not ratified, is the most influential, as many transboundary basins arrangements utilize it during negotiations. The most powerful statements in the Convention are the "no significant harm" and "reasonable and equitable utilization" terms. These two terms fulfill the requirements of both those stakeholders that propose to harness the basin as well as those that do not want to be significantly harmed due to the utilization. Although these statements fulfill both of the needs discussed, actual implementation based on the 1997 UN Convention has proven difficult. However, due to its acceptability by many countries, it is important that other international rules regarding transboundary basins find consistency with the 1997 Convention. The focus of the dissertation is centered on the principle of equitable distribution of benefits (EDB) and building the institutional capacity of the Nile Basin Initiative (NBI) in order to enhance the resiliency and adaptability of the system and thus build or enhance cooperation, achieve development objectives, and also to improve the chances of actual implementation. This dissertation discusses: 1) the alignment of the EDB principle with the UN Convention and suggests recommendations to increase the relative ease of implementation, 2) whether the Nile countries have the right conditions or not to implement the principle, and 3) assessing

the institutional capacity of the NBI to manage resiliencies of the biophysical, socioeconomic and geopolitical systems.

The dissertation finds that the EDB principle can be aligned with the 1997 UN Convention and also has a high likelihood of being implemented. The dissertation suggests a centered framework focusing on potential specific benefit projects along with thirteen factors that are required to be fulfilled as a conceptual model for implementing EDB based projects. These thirteen required actions are: 1) to utilize the natural character of the basin area for the best possible productivity, 2) to prioritize economic sectors that contribute the most to the National GDP, 3) to address specific concerns of basins (such as local rights and biodiversity protection), 4) to be proactive and thus anticipate future challenges such as population growth rate needs, 5) to protect vulnerable job sectors or find ways to enhance or create jobs in other sectors, 6) to increase information sharing among riparians, 7) to have conflict resolution mechanisms in hand, 8) to create institutions especially RBOs that host a platform for cooperation and regulations, 9) to assess impacts at different spatial and temporal scales, 10) to consider all factors that can be shared, including water, non-water, within basin and out-of-basin resources, 11) to provide for extreme conditions such as drought and flooding, 12) to use the precautionary principle especially regarding large benefit sharing projects such as big dams, and 13) to enhance the availability of funding to create RBOs, support research and implement projects. The dissertation also suggests four phases as conditions for successful implementation of benefit sharing proposals. These four are 1) the identification of mutually agreed benefits, 2) cost benefit analysis to derive net benefits that should be shared, 3) the involvement of stakeholders to decide how to share the benefits and 4) the development of management strategies with clear planning, organizing and directing stages and identification of parties that are held accountable through evaluation sub-stages. The alignment of the principle with the 1997 UN convention aids in the reduction of conflict, one of the four overarching objectives of this dissertation. Stakeholders would prefer agreements that allow them to utilize shared basins in ways that do not

cause harm to others. The “no significant harm” clause is not exclusive to relationship among the nations sharing basins but also includes indigenous and biodiversity rights, thus meeting the sustainable management objectives. The EDB principle has substantial opportunity in achieving conflict resolutions and sustainable management objectives, through the suggested thirteen actions that are centered on specific due to its stance not cause significant harm to stakeholders while also allowing reasonable and equitable utilizations of benefits.

The second objective of the dissertation was to assess the ambiguities in benefit sharing and discuss whether the Nile Basin countries have the right conditions to be resilient to pressures and thus implement the EDB principle. The dissertation derived lessons from three basin case studies (Columbia, Aral and Jordan) to identify conditions that were an impediment as well as successes in implementing the EDB principle. Six conditions were evaluated: 1) cooperation, 2) treaties or agreements, 3) integrated economies, 4) funding, 5) geopolitical peace, and 6) sustainable management. The dissertation finds that the Nile countries lack in the integrated economies condition, but partially fulfill the remaining five. This chapter aids in achieving cooperation or conflict resolution, one of the main objectives of this dissertation, through insights that help in addressing ambiguities and identifying conditions required to achieve successful implementation of projects that are based on the EDB principle. For example, the chapter addresses that commonality in defining the “benefits” terminology. Commonality in definitions leads to better communication, a critical factor in decreasing conflict. Similarly, the chapter also finds that the Nile countries partially fulfill the required conditions of sustainable management. The Nile countries should formulate policies that further fulfill these requirements in order to have successful projects that not only fulfill development aspirations, alleviate poverty, and decrease conflicts but also are sustainable.

The third objective of the dissertation is to manage the resiliency factors by assessing the institutional capacity of the Nile Basin Initiative (NBI). More specifically, it assesses whether the NBI has the factors necessary to be resilient to biophysical, socioeconomic, and geopolitical pressures. Precipitation, runoff, evaporation, and vegetation processes were the biophysical system factors that were considered. Socioeconomic system factors are: 1) irrigation, 2) hydropower, and 3) domestic. The geopolitical system factors that were utilized are stakeholders at local (farmers, industries, fishery and Nile Basin Discourse), national (the stances of the ten Nile countries sharing the basin), regional (the NBI, bilateral treaties, and Non-governmental organizations (NGOs)), and international (World Bank, International Water Management Institute (IWMI), the UN and other NGOs) scales. For each of these three systems, factors that enhance resiliency, such as 1) soil and water conservation to mitigate biophysical pressures, 2) water efficiency for drip irrigation for socioeconomic pressures, and 3) local stakeholder perspective and participation for geopolitical pressures are considered. Five management stages regarding implementation of resiliency factors were utilized to assess the resiliency of the NBI. These are: 1) vision statement, 2) doing research, 3) proposal of specific projects, 4) implementation of projects, and 5) evaluation of implemented projects. The findings suggest that the NBI has a mixed resiliency values ranging from no resilience to very high for the fifty responses to mitigate impacts of biophysical and socioeconomic pressures while a mostly high to very high values for geopolitical. The factors assessed fulfill the four overarching end objectives (development aspirations, sustainable water management, poverty alleviation and conflict resolution). For example, assessing the socioeconomic pressure by addressing irrigation efficiency helps in the fulfillment of sustainable water management while stakeholder involvement at different geographic scales leads to conflict resolution. The recommendations regarding the resiliency factors will enhance the institutional capacity of the NBI and thus ultimately bring greater benefits and cooperation among the stakeholders involved in the Nile Basin.

The dissertation adds to the literature surrounding the study of transboundary rivers resiliency, and more specifically the benefits sharing principle and institutional capacity building of RBOs. It provides interested persons, institutions and entities a unique perspective regarding the complex concepts and factors that have to be surmounted to implement the EDB principle on the ground. It is hoped that interested parties assess the lessons from this dissertation and pursue the objectives to meet current and future development aspirations, poverty alleviation, sustainable management and conflict resolution objectives.

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7 APPENDIX

7.1 Participation Detail Results

Participation: Resiliency of the NBI to local geopolitical pressures.

Quantity, quality and timing	Possible proposed responses to pressures	Has stated in its vision	Doing research	Proposed specific projects	Helped implement projects	Monitoring and evaluation of implemented projects	Resilience rank
Quantity	*Inform*	✓	✓	✓	✓	×	**High**
	Consult	✓	✓	✓	✓	×	**High**
	Involve	✓	✓	✓	✓	×	**High**
	Collaborate	✓	✓	✓	✓	×	**High**
	Empower	✓	✓	✓	✓	×	**High**
Quality	*Inform*	✓	✓	✓	✓	×	**High**
	Consult	✓	✓	✓	✓	×	**High**
	Involve	✓	✓	✓	✓	×	**High**
	Collaborate	✓	✓	✓	✓	×	**High**
	Empower	✓	✓	✓	✓	×	**High**
Timing	*Inform*	×	×	×	×	×	**No resilience**
	Consult	×	×	×	×	×	**No resilience**
	Involve	×	×	×	×	×	**No resilience**
	Collaborate	×	×	×	×	×	**No resilience**
	Empower	×	×	×	×	×	**No resilience**

Participation: Resiliency of the NBI to national, regional and international geopolitical pressures.

Quantity, quality and timing	Possible proposed responses to pressures	Has stated in its vision	Doing research	Proposed specific projects	Helped implement projects	Monitoring and evaluation of implemented projects	Resilience rank
Quantity	*Inform*	✓	✓	✓	✓	✓	**Very high**
	Consult	✓	✓	✓	✓	✓	**Very high**
	Involve	✓	✓	✓	✓	✓	**Very high**
	Collaborate	✓	✓	✓	✓	✓	**Very high**
	Empower	✓	✓	✓	✓	✓	**Very high**
Quality	*Inform*	✓	✓	✓	✓	✓	**Very high**
	Consult	✓	✓	✓	✓	✓	**Very high**
	Involve	✓	✓	✓	✓	✓	**Very high**
	Collaborate	✓	✓	✓	✓	✓	**Very high**
	Empower	✓	✓	✓	✓	✓	**Very high**
Timing	*Inform*	✓	✓	✓	✓	✓	**Very high**
	Consult	✓	✓	✓	✓	✓	**Very high**
	Involve	✓	✓	✓	✓	✓	**Very high**
	Collaborate	✓	✓	✓	✓	✓	**Very high**
	Empower	✓	✓	✓	✓	✓	**Very high**

7.2 Geopolitical, Cultural and Proximity Related Interstate Issues

Country being assessed	Countries' perspective on each member									
	Egypt	Sudan	Eritrea	Ethiopia	Kenya	Uganda	Tanzania	DRC	Rwanda	Burundi
Egypt		Influencing politics in Sudan but still favors 1959 treaty, very strong cultural ties	No significant issues regarding Nile river usage, medium cultural ties	Hegemonous in terms of the 1959 Nile treaty, uncooprative interms of developing water development projects, low cultral ties	Slight politicians' view that the 1959 treaty is unfair but otehrwise cooperative, very low cultural ties, very low cultural ties	No significant issues regarding Nile river usage; slightly coopperative agreements, very low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties
Sudan	Harbors Islamic fundamentalists, its growth due to oil might lead to more usage of the nile, but still favors 1959 treaty Very strong cultural ties	None	Endangeres national security by supporting EIJM, strong cultural ties	Fears that it might support Islamic fundamentalism, medium cultural ties	No significant issues regarding Nile river usage; Kenya's and Sudan's sovereignty is unclear in the "Ilemi Triangle," and small Migingo Island in Lake Victoria, low cultural ties	Supports is complacent to Ugandan (LRA) rebels, medium cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, low cultural ties
Eritrea	No significant issues regarding Nile river usage, Medium cultural ties	Supports rebels, very uncoperative, endanmgers national security, strong cultural ties	None	Endangeres national security, border war effect still continuity, very strong cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, medium cultral ties	No significant issues regarding Nile river usage, medium cultral values
Ethiopia	Most resource of Nile, afraid that it will use the nile more which affects Egypt most, low cultural ties	Supports US agenda in the region, medium cultural ties	Endangeres national security, border war effect still continuity, very strong cultural ties	None	No significant issues regarding Nile river usage, medium cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage,medium cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, medium cultral ties	No significant issues regarding Nile river usage, medium cultral values
Kenya	Infrequent rhetorics about Nile usage, But also cooperation regarding water resources, low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, strong cultural ties	None	No significant issues; LRA forces have also attacked Kenyan villages across the border, , very strong cultural ties	No significant issues regarding Nile river usage, , very strong cultural ties	No significant issues regarding Nile river usage, very strong cultural ties	No significant issues regarding Nile river usage, strong cultural values	No significant issues regarding Nile river usage, strong cultural ties
Uganda	Cooperation regarding water resources, very low cultural ties	Supports rebels (SPLA) , very low cultural ties, medium cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties, low cultural ties	No significant issues; LRA forces have also attacked Kenyan villages across the border, very strong cultural ties	None	No significant issues regarding Nile river usage, , very strong cultural ties	Supports rebels, very strong cultural ties	Slightly endangering its national security as it helps different rebel groups, very strong cultural ties	No significant issues regarding Nile river usage, very strong cultural ties
Tanzania	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very strong cultural ties	No significant issues regarding Nile river usage, very strong cultural ties	None	No significant issues regarding Nile river usage, very strong cultural ties	No significant issues regarding Nile river usage, very strong cultural ties	No significant issues regarding Nile river usage, very strong cultural ties
DRC	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, , low cultural ties	average geopilitical conflict Harms ethnic groups along the boredr to its instability	No significant issues regarding Nile river usage, , very strong cultural ties	None	Harbors Hutu militants that are threat to national security, very strong cultural ties	Harbors Hutu militants that are threat to national security, very strong cultural ties
Rwanda	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage,low cultural ties	Slightly endangering its national security as it helps different rebel groups, very strong cultural ties	No significant issues regarding Nile river usage, , very strong cultural ties	Supports rebels, very strong cultural ties	None	Supports rebels, very strong cultural ties
Burundi	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, very low cultural ties	No significant issues regarding Nile river usage, low cultural ties	No significant issues regarding Nile river usage, very strong cultural ties	No significant issues regarding Nile river usage, , very strong cultural ties	Supports rebels, very strong cultural ties	Supports rebels, very strong cultural ties	None