TRANSBOUNDARY AQUIFER MANAGEMENT: THE GUARANI AQUIFER SYSTEM

***WWC Theme:* 12: Transboundary river basins and shared aquifers**

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ABSTRACT:

Groundwater is one of the most important natural resources on the planet, comprising 97% of the world's accessible freshwater resources . The global utilization of groundwater has expanded over the past 60 years due to increased availability of cheaper drilling and pumping technologies , increased pollution of surface water and population growth. Many nations look toward groundwater as an alternative source of fresh water to accommodate their needs. Since groundwater, like surface water, is a fugitive resource which does not conform to administrative or political boundaries , many aquifers are transboundary. International organizations such as the International Law Association, the UN, World Bank, GEF, and the like have promulgated various legal instruments for transboundary aquifers but aquifers in international water resources law has its limitations.
The Internationally Shared (Transboundary) Aquifer Resource Management Program (ISARM) was developed by UNESCO's International Hydrological Program during its sixth phase to promote the integrated and sustainable management international river basins and groundwater resource systems . The ISARM Project identified six transboundary aquifers of regional importance one of which is the Guarani Aquifer System in South America.
In 2000, Argentina, Brazil, Paraguay, and Uruguay initiated the Environmental Protection and Sustainable Development of the Guarani Aquifer System Project (PSAG). The aim of the PSAG was to develop and implement the first comprehensive transboundary management framework on groundwater and eventually some type of agreement. The PSAG concluded in January of 2009, falling short of its objective "to have a technical, legal, and institutional framework for the management of the protected Guarani Aquifer System." However, the project did develop a plan for the Coordinated Management Framework of the SAG in accordance with the Strategic Action Plan (SAP) of the PSAG, with the long term vision of the four nations to develop and implement the Guarani Aquifer Agreement.

This paper analyzed the Coordinated Management Framework with respect to the five elements an international agreement. Although a concrete management framework was not achieved, the Framework encapsulates customary international law principles in its precautionary approach. Incorporating the management tools developed by the PSAG, the Framework can be seen a great leap for the progressive development of international groundwater law. The Guarani Aquifer Agreement demonstrates the dedication toward the development of transboundary aquifer management. However, further work is needed and a consensus by the international community for an international legal regime on groundwater is necessary.

Introduction

Aquifers are one of the most important natural resources in the world, containing almost 96% of the planet's freshwater. Globally, 65% of groundwater is devoted to irrigation, 25% to the supply of drinking water and 10% to industry. (UNESCO Website) Global utilization of this resource has expanded over the past 60 years due to increased availability of cheaper drilling and pumping technologies increased pollution of surface water and population growth concurrently (FAO 2003). As such, many nations look toward groundwater as an alternative source of fresh water to accommodate their needs. Groundwater, like surface water, is a fugitive resource. It does not conform to administrative or political boundaries, thus many aquifers are transboundary. In regards to international water resources law, groundwater regulations have limitations.

Firstly, the scientific and technical knowledge of groundwater and the complexity of hydrogeology contribute to the difficulty of assessing transboundary groundwater availability and boundaries. (FAO 2003) Secondly, in many states where groundwater is linked to land ownership, territorial sovereignty is a concern and governments are hesitant to share its management. (FAO 2003) In those cases where it is not linked to land ownership, the "hidden" nature of the resource also precludes policy makers from treating the resource as a mined resource similar to oil or gas. Thirdly, the limited and insufficient inclusion of groundwater and its special needs in international water agreements, as compared to surface water, is also an issue. (Freestone 1999) In spite of these reasons, recent developments by inter-governmental and non-governmental organizations have increased efforts to promote the development of an international legal regime for groundwater.

The International Law Association first included groundwater in its 1966 Helsinki Rules, but its limited scope led to the ILA drafting the 1986 Seoul Rules. In 2004, the ILA developed the Berlin Rules, with a chapter dedicated to transboundary groundwater. The United Nations International Law Commission's (UNILC) 1997 Convention on the Non-Navigational Uses of Water (hereinafter the 1997 Convention) was a milestone for the international regime on groundwater, as it formally stated the application of customary international law for the international management of groundwater. (Eckstein 2003) However, the 1997 Convention only covers one classification of aquifers. Five years later, the UNILC embarked on Draft Articles on the Law of Transboundary Aquifers, which were adopted by the UN General Assembly on December 11, 2009 and are in the provisional agenda of its seventy-first session of the UN General Assembly to be held on September 13, 2016. (UNBISNET) Built upon the work of the ILA and its Helsinki, Seoul and Berlin rules, these Articles aim to codify the progressive development of aquifers in international law. (Eckstein 2007)

In addition to the ILA and UNILC, there have been other contributions to the cannon of tranboundary aquifer law. The Bellagio Draft Treaty is recognized as an important advancement on transboundary aquifer management, however, its application in practice has been minimal. (Hayton et al 1989, Hall 2004) The *Internationally Shared (Transboundary) Aquifer Resource Management Program (ISARM)* was developed by UNESCO's International Hydrological Program during its sixth phase to promote the integrated and sustainable management of international river basins and groundwater resource systems.(Puri et al 2001) The ISARM Project identified six transboundary aquifers of regional importance one of which is the Guarani Aquifer System in South America.

The Guarani Aquifer System (SAG)

The Guarani Aquifer System is named after the indigenous tribe living within the area of the aquifer. It covers a geographic area of 1,087,879 km^2, with an estimated volume of 30 trillion m^3 under the nations of Argentina, Brazil, Paraguay and Uruguay. (World Bank 2009). In 2000, Argentina, Brazil, Paraguay, and Uruguay initiated the *Environmental Protection and Sustainable Development of the Guarani Aquifer System Project* (PSAG), with the support of GEF, OAS and WB in order to study and plan for the long-term management of the SAG. (World Bank PAD 2002) The aim of the PSAG was to develop and implement the first comprehensive transboundary aquifer management framework. (World Bank PAD 2002) The PSAG concluded in January of 2009, falling short of its objective "to have a technical, legal, and institutional framework for the management of the protected Guarani Aquifer System." (World Bank 2009) However, the project did develop a plan for the *Coordinated Management Framework* of the SAG in accordance with the Strategic Action Plan (SAP) of the PSAG. (PSAG 2007, PSAG 2009) In 2010, the four SAG states drafted the Guarani Aquifer Agreement but it has not been ratified by them. (Villar and Ribeiro 2013).

The contributions to the progressive development of groundwater in international water law by various international organizations as well as legal and hydro experts has been a yeoman's task. However, the limitations of groundwater in international water law, the inconsistent state practice and limited international treaty practice all demonstrate that there is still no consensus in the international legal regime for transboundary aquifers. Moreover, there has not been enough on the actual application of law and policy, i.e. the governance of transboundary aquifer management.

This paper will analyze how the Coordinated Management Framework applied the principles and obligations of international customary law for the management of the SAG. The paper is organized into six sections, including this introduction. Section two will provide background on the limitations of groundwater in international water law, decentralization governance of natural resources. Section three will elucidate the principles and obligations for groundwater in international water law. Section four will describe the PSAG. Section five will analyze the Coordinated Management Framework. Section six will provide concluding remarks and recommendations.

Limitations of Groundwater in International Law

In order for an international legal regime on groundwater to be sufficient, the current gaps in legislation need to be filled. (Mechlem 2003) McCaffrey notes, "The law of international groundwater may only be said to be, at best, in the embryonic stages of development." (McCaffrey 2001) Considering the numerous international agreements on water in general, groundwater has received insufficient attention in international law as compared to surface waters. (Freestone 1999)

There are four main limitations concerning groundwater. The first is the heterogeneity and uncertainty of the resource. The heterogeneity refers to the anisotropic properties of groundwater, which causes variations of flow characteristics and residence times. (FAO 2003) Uncertainty refers to the lack of comprehensive scientific understanding of the physical properties groundwater. (Matsumoto 2005, Mechlem 2003, Puri 2005) The second limitation, also stemming from uncertainty, is the hidden nature of the resource, resulting in the "out of sight, out of mind" approach to groundwater management for many states. (McCaffrey 2001) In other words, the boundaries of groundwater are not readily visible and do not always

understand the probability of the transboundary nature of the resource. This results in states claiming sovereignty over the development of resources within their borders. These states are often reluctant to enter into legal agreements over the shared resource. (Wouters 2005) The third is state practice is inconsistent with regards to national laws: some focus on quality and others on quantity. Rarely are there comprehensive laws dealing with both. (Daibes-Murad 2005) The fourth limitation is the minimal number of international agreements for groundwater in which these limitations are observable.

Although there were close to 400 treaties regarding transboundary surface waters as of 2009, only nine included semi-sufficient sections on qualitative or quantitative aspects of groundwater. (Burchi 2005, Matsumoto 2005) The 1977 Convention on the Geneva Aquifer is the only agreement that deals with groundwater quality, quantity, abstraction, and recharge. However, because it was done on a local context it has limitations. The work of the International Law Association (ILA) and the UNILC have contributed toward an international legal regime for groundwater, but are still subject to critique.

The 1966 Helsinki Rules include groundwater, but only those hydraulically connected and flowing into a common terminus with those surface waters (ILA1966) The 1986 Seoul Rules amended the 1966 Helsinki Rules, however there was still a gap in the comprehensive treatment of groundwater. (ILA 1986) The 1997 Convention had the similar problem of only those aquifers that are hydraulically linked and flowing into a common terminus were considered.

Both these documents have three main issues with regard to groundwater. The first is they are limited by the definition of their scope, as not all aquifer sources are connected with surface waters, nor do they flow into a common terminus. (Eckstein, G 1998) In 1986, Barberis conducted a study for the UN Food and Agriculture Organization (FAO) that resulted in four classifications of transboundary groundwater. These classifications were considered as the generic paradigm for international water law regarding groundwater. (Eckstein, Y 2005) However the classifications have been criticized as limited in scope and hydrogeologically inaccurate. Therefore, not all types of groundwater could fall under its jurisdiction. (Eckstein, G 2003) Eckstein and Eckstein developed six common aquifer classifications to elucidate these characteristics of the most common types of international aquifers in the world. (Eckstein, G 2003)

The second issue is the misnomer of equating unrelated or unconnected aquifers to confined aquifers (Eckstein, G., et al. 2003) In hydrogeological terms, unconfined aquifers are those which are in direct contact with the atmosphere whereas confined do not. (Nonner 2003) Those unconfined aquifers are not always connected directly with surface water; conversely not all confined aquifers are isolated from surface waters. In the cases of the 1997 Convention and the 1966 Helsinki Rules, the “confined” aquifers they are referring to are those which are fossil, a specific category of confined aquifers which receive minimal or no recharge at all.

The third limitation of these documents is the failure to address the specific needs of transboundary groundwater management. (Eckstein, G., et al. (2003) The case of the 1997 Convention, Helsinki Rules and various other treaties in which groundwater is mentioned, apply the same principles, obligations and standards of surface water to groundwater. McCaffrey notes, “The different characteristics and behavior of groundwater would seem to justify stricter standards and more stringent protection than is applicable to surface water.” (McCaffrey 2001) Aquifers require stricter abstraction controls due to problems of aquifer

depletion, land subsidence, saltwater intrusion, and increased pumping costs. (Foster et al 2006) Aquifers of all types are significantly more vulnerable to pollution due to the relatively slow flow rate of groundwater and high residence time as compared to surface water. (Eckstein, G., et al. 2003) Hence, the pollution of aquifers will be observable after a significant period of time, in which it is difficult if not impossible to remediate and is often very expensive. Therefore, pollution controls for groundwater also need to be stricter than those of surface water and should include land use as non-aquifer utilization activities such as agriculture, mining activities, and construction can have an adverse effect on recharge zones of aquifers.

Transboundary Aquifer Governance

If you consider the law and policy as the rules of the game, governance is how the game is played. However, the rules of the game are always dependent on where it is played. In looking at the management of the Guarani Aquifer System, a snap shot of the institutions behind water resource governance within the four party states is necessary.

Argentina is a republic with 23 provinces and one autonomous city whose legal system is a civil law system based on West European legal systems. (CIA Factbook) The management of water resources in Argentina is administered by multiple institutions operating at the national, provincial, and river basin level. Each institution has various responsibilities and jurisdictional foci. On the national level, the *National Institute for Water and the Environment (INA)* and the *National Water and Sanitation Utility (AySA)* are charged with the duties of researching, water resources preservation, developing services, and implementing water projects. (World Bank 2000)

Brazil is a federal republic with 26 states and one federal district whose legal system is a civil law legal tradition. (CIA Factbook) Water resources management functions in Brazil are similar to Argentina in complexity. On the national level, *the National Council on Water Resources (NCWR)* promotes the integration of water resources planning at the national, regional, and state levels and between user sectors and the *National Water Authority (Autoridade Nacional da Agua – ANA)* is charged with implementation of the National Plan for Water Resources determined by the NCWR along with ten other core responsibilities. (Garrido 2008) The River Basin Committees (RBC) and River Basin Water Agencies act as the executive secretariats of the RBC's. Finally, various Water Resources Civil Organizations that range from river basin organizations (different that the RBC's) to academic and technical organizations are also involved in water resources management.

Paraguay is a constitutional republic, with 17 departments whose legal system civil law system reflects influences from the Argentine, Spanish, Roman, and French civil law models. (CIA Factbook) It is not as complex as the other three party states in regards to water reources management, which is divided between the Ministry of Public Works & Communications and Ministry of Agriculture & Livestock.

Uruguay is a constitutional republic, with 19 departments whose civil law system based on the Spanish civil code. (CIA Factbook) The National Water Authority (NWA) is part of the executive branch of Uruguay combined with the Public Works and Transport Ministry (MTOP) and the Ministry of Housing, Territorial Organization and Environmental (MVOTMA). The NWA is responsible for designing and implementing water resources management national policy, granting water user rights, establishing priorities for water use

by regions or watersheds giving priority to drinking water, establishing water user fees, and developing the Water Code through regulation. (CSC 2004) There are other ministries with tangential ties with water resources management.

Koimann calls governance, "the totality of interactions, in which public as well as private actors participate, aimed at solving societal problems or creating societal opportunities; attending to the institutions as contexts for these governing interactions; and establishing a normative foundation for all those activities". (Koimann 2003) The problems that water management faces throughout history indicate that governing water via usual formal state institutions has not worked, and that new governance structures for water management need to be created and developed. The emergence of the idea of governance relates to the fact that such problems need to be tackled simultaneously at all relevant policy levels, from the local to the regional to the national to the supranational levels, and that these levels need to be connected in some feasible way. (Finger, 2006)

Renewed governance is also one of the core ideas of the new phase of water management, with the following core principles: decentralization and the development of new forms of local governance, participation and the quest of greater equity, sustainability and environmental concerns, liberalization and overall state/public withdrawal in technical and financial terms.

According to the UNDP, "Decentralized governance of natural resources concerns the ownership and control of, access to and use of resources. For any level of government, it involves decision-making and the execution of laws and policies within a given boundary defined by a governing body. DGNR is a strategy for promoting sustainable management; equitable decision-making, promoting efficiency, participatory governance and equitable sharing of benefits accrued from exploitation of natural resources at the local levels. It entails the process of transferring some of the decision-making powers and responsibilities (fiscal, administrative, legal and technical) to sub-national institutions at the provincial, district, city, town and village levels." (UNDP.org)

The work done by these organizations and experts, in spite of their limitations, are valuable contributions toward international groundwater law. This field is still in the inceptive stages in the development of legal and institutional responses for its management but the application of the principles and obligations of international customary law has been vital for its progressive development. (McCaffery 1999) Furthermore, these draft articles, supranational laws and the like of aquifers still come short as they do not look at the management and governance part of the equation. In going back to the Dublin Principles in 1992 as the birthplace of the widely critiqued concept of Integrated Water Resources Management (IWRM), we see that it is even more complex with transboundary aquifers as it would be with surface waters.

The following section will elucidate the principles and obligations necessary for its progression.

Principles and Obligations of Customary International Law and Groundwater

Article 38(1) of the Statute of the International Court of Justice (ICJ) states the sources of rules and principles of international law. (UN 1945) Considering these sources, there is no international custom for groundwater as the main source is *opinio juris*, not sufficient to establishing international customary law. (Vinogradov et al 2003) However the adoption of the 1997 Convention allowed for the principles and obligations of international customary

law on surface water to be translated to groundwater related to international watercourses. The notable elements of this legal decision included: equitable and reasonable utilization, no significant harm, obligation to cooperate and good faith negotiations. In addition the ILA's Seoul Rules and the Bellagio Draft Treaty conferred these principles and obligations to those aquifers not connected to surface water. Therefore this section will elucidate the application of these principles and obligations and others of relevance to international groundwater in general.

Sovereignty

The current norms and principles of international customary law on the non-navigational uses of water are based on the allocation theory of "limited territorial sovereignty", in which all watercourse states have an equal right to the utilization of a shared water resource but each state is obliged to respect the correlative rights of other states who share the same water resource. (McCaffrey 2001, Rieu-Clarke 2005) However, as stated in the previous chapter, the tendency of states is to legislate and manage aquifers and the groundwater therein under the paradigm of absolute territorial integrity. The ISARM Project, as well as the Bellagio Draft Treaty suggest an obligation to cooperate, in essence the paradigm of limited territorial sovereignty, for the sustainable management of international groundwater resources. The 2008 Draft Articles also suggest the aquifer states are conferred sovereignty of their portion of the aquifer but should take into account equitable and reasonable utilization as well as no significant harm in doing so. (Eckstein, G 2007)

Equitable and Reasonable Utilization & No Significant Harm

According to Wouters et al (2005), equitable and reasonable use can be defined as:

> *"Each TWC State is entitled to (and obligated to provide) an equitable and reasonable utilisation of the international watercourse. This correlative right and duty is determined on a case-by-case basis through a consideration of all relevant factors – including the extent of harm caused -- considered together and a conclusion reached on the basis of the whole. This rule of law is consistent with State practice and is a rule of customary international law."*

The principle of no significant harm is derived from s*ic utere tuo ut alienum non laedas*, is defined as the obligation of each state through its own actions or the allowance of actions on its territory not to cause injury to another state. (Eckstein, G 1995) For international groundwater, this translates to aquifer abstraction controls.

Abstraction controls are necessary to prevent the problems caused by overexploitation of aquifers, such as depletion, land subsidence, infiltration of polluted, contaminated or saline waters, and altered subsurface flows. (Puri et al 2001) In order to ensure equitable and reasonable utilization and no significant harm, these controls should include the sustainable yield of the international aquifers and/or systems needs to be determined, and the proportional population utilizing the resource identified.

Obligation to Cooperate

The obligation to cooperate can be defined as the duty of states party to an agreement of a shared water resource to work together for its sustainable management. It is regarded as the due diligence for the states party to the agreement and serves as the backbone for other obligations such as notification, information exchange and consultation and is often cited as the primary goal of an international water resource agreement. These procedural rules are affirmed for international groundwater management in the Bellagio Draft Treaty, 2008 Draft Articles as well as the ISARM Project.

Other Principles of Relevance

In addition to the aforementioned, the precautionary principle, obligation to protect the environment and monitoring and assessment are necessary for international groundwater management.

The inclusion of the precautionary principle is necessary for any international agreement on groundwater. Considering the one of the limitations of groundwater in international law is uncertainty of the resource, according Rio Declaration (1992), uncertainty should not be a cause for inaction. Although its status of as a rule of customary law is disputable, it is necessary for groundwater due the uncertainty of the resource and its vulnerability to contamination and pollution which if occurs is difficult if not nearly impossible to remediate.

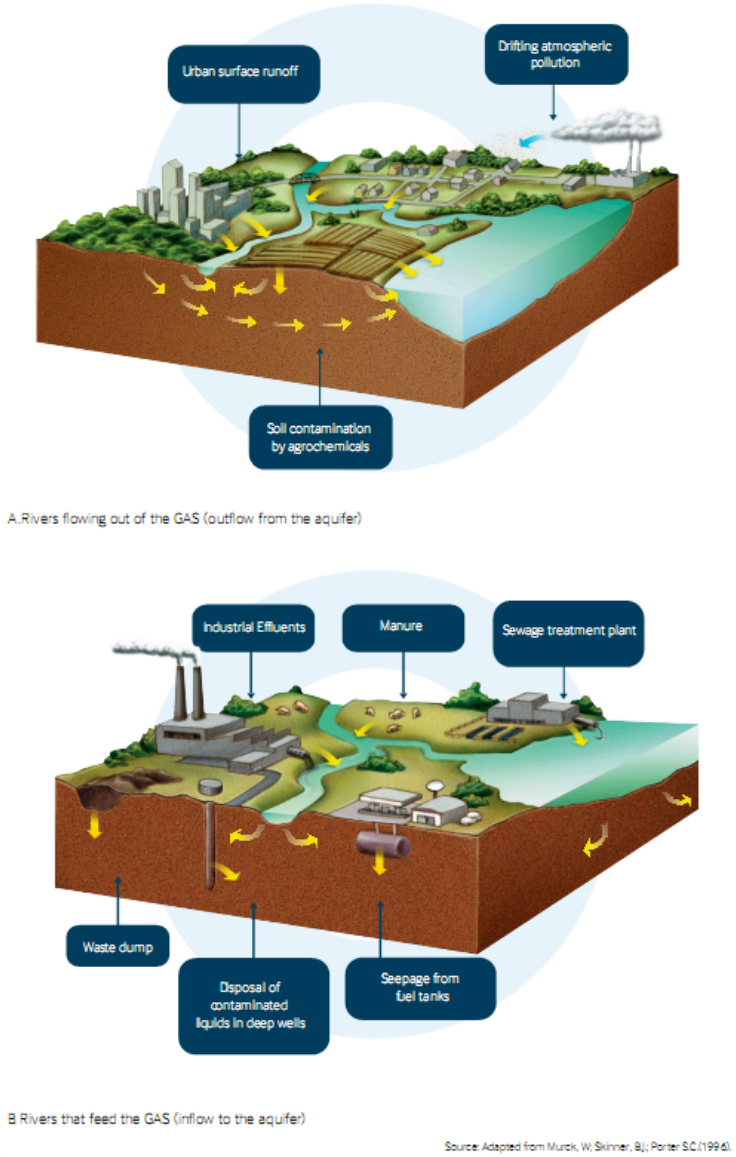

Figure 1: Influent and Effluent sources of groundwater pollution for the SAG. From PSAG Strategic Action Plan.

The obligation to protect the environment for groundwater focuses on conservation areas. These are the areas of recharge and points of abstraction, which need to be protected as these are the zones where contaminants and pollutants can infiltrate an aquifer. Aquifers and the groundwater therein are more vulnerable to pollution and if the aquifer's integrity is compromised, it is difficult, if not impossible to remediate and expensive, as stated earlier.

Hence the necessity to have stricter pollution controls on these areas, and should restrict activities which can increase the risk of polluting the resource such as agriculture, mining, land filling and other polluting industries. The Bellagio Draft Treaty and 2008 Draft Articles highlight these points in various articles.

Monitoring and assessment flow from the duty to exchange information and obligation to protect the environment. It allows the competent authorities to observe the aquifers and conservation areas to ensure their integrity. In the event a contaminant and/or pollutant is observed in the conservation areas, immediate action can be taken before the aquifer is beyond remediation. It allows the states party to the agreement to have congruent information on abstraction to check each other as to not breach the agreement. Finally, monitoring and assessment allows for the allocation and dissemination of aquifer data to be shared transparently between the states party to the agreement.

The Environmental Protection and Sustainable Development of the Guarani Aquifer System Project (PSAG)

The PSAG was developed under a precautionary principle, as there were no "hot" conflicts between the nations regarding the utilization of the SAG. The objective of the project was the long term sustainability, integrated management and use of the SAG through jointly elaborating and implementing a common institutional and technical framework for managing and preserving the SAG for current and future generations.(World Bank PAD 2002) The development and implementation of the PSAG was to have regional and international importance. Regionally, it would help develop the necessary tools and provide institutional strengthening to for better coordination and management of the SAG. For the international community, it would be the first comprehensive international framework on groundwater and for the WB it would aid in its policy development on international groundwater management. (Krishna et al 1999, World Bank PAD 2002) In essence this project was trying to develop a framework that could serve as a replicable model in other countries and regions and contribute to the progressive development of international groundwater law. (World Bank PAD 2002)

The PSAG was unique in its approach for two reasons. First, the PSAG was not reacting to an existing problem, rather it utilized the precautionary principle to prevent the possibility of future international disputes arising from overexploitation, contamination and pollution of the SAG.(World Bank ICR 2009) Second, the SAG is 90% confined, with the remaining 10% constituting the recharge zone of the aquifer system, which necessitates a hybrid approach for its management. (World Bank PAD 2002) The four state parties in coordination with external agencies (OAS, GEF, WB, IAEA, BNWPP, BGR) collaborated on the implementation of the PSAG to demonstrate legitimacy, encourage participation, and provide transparency of the project and its outputs. The long-term objective was to develop and implement a sustainable concrete management framework of the Guarani Aquifer System (SAG) to be administered cooperatively by the four nations of Argentina, Brazil, Paraguay and Uruguay. (World Bank ICR 2009) In order to achieve this, the PSAG was seen as the first step toward the final agreement through the implementation of the following seven components:

- *Component I - Expansion and Consolidation of the Current Scientific and Technical Knowledge Base on the Guarani Aquifer System;*
- *Component II - Joint development and implementation of the Guarani Aquifer System Management Framework;*
- *Component III - Public and stakeholder participation, education and communication;*

- *Component IV - Project Monitoring and Evaluation, and Dissemination of Project Results;*
- *Component V - Development of Management and Mitigation Measures within Identified "Hot Spots"*;
- *Component VI - Assessment of Geothermal Energy Potential; and*
- *Component VII - Project Coordination and Management*

The Strategic Action Plan (SAP) recommended during the final year of the PSAG, integrated the results from the TDA of Component II to develop the joint management framework. Its implementation was delayed due to initial public misinformation and the harmonization of procedural differences between the OAS and WB regarding procurement of services. (World Bank ICR 2009) The initial objective to develop and implement a technical, legal and institutional regional framework agreement for the management and protection of the Guarani Aquifer System, however, was not achieved for two reasons: the delays related to the PSAG and information provided by the SAP. During the legal and institutional assessment of the four nations, it was found that the existing legal frameworks in each country were sufficient for the management of the aquifer only needing institutional strengthening and management of the SAG is essentially local in nature. (World Bank ICR 2009)In light of these developments, the SAP proposed a *Coordinated Management Framework* maintain the coordination and cooperation established by the PSAG among the four nations for the management and protection of the SAG with the aim of a more concrete framework to be established in the future. The framework will be the subject of analysis in the following chapter.

Analysis of the Coordinated Management Framework

Although the PSAG's objective "to have a technical, legal and institutional framework for the management of the protected Guarani Aquifer System"(OAS DSD Evaluation of the PSAG ICR was an indicator of the success of the program was not achieved, the Coordinated Management Framework was implemented. Its purpose was twofold, to maintain the level of cooperation and coordination established during the project and to serve as a first step towards a more concrete legal and institutional agreement. The Framework integrated the instruments developed by the components of PSAG in its execution to manage the SAG until a concrete agreement is adopted. The analysis of the Coordinated Management Framework will look at the five key elements of an effective agreement, scope, substantive rules, procedural rules, institutional mechanisms and a means dispute settlement as well as how the principles and obligations described in section three are integrated.

Scope

Scope defines which waters, which users, and which uses of an agreement. Determining the scope of any agreement is vital as many disputes can arise due to misinterpretation of the scope, such as the River Oder case and others. Vinogradov et al (2003) posit the scope of an agreement needs to be clear as many legal controversies arise from its misinterpretation or ambiguity. The PSAG understood the problems with defining the scope and took explicit measures to properly identify these three aspects.

The waters were first clarified by the name of the project, the Guarani Aquifer System and the users are those nations that overlay it. The scope of the waters was all the aquifers hydrogeologically linked which created the system. The IAEA conducted isotope analysis to properly map the entire system. (PSAG SAP) The result was the understanding of the hydrodynamic behavior and demarcation of the boundaries of the SAG. A map of the SAG

was created to identify the scale of the system, and the identification of the outcropping (recharge), transition and confined zones, essential for the management of groundwater. The uses of the SAG also needed to be identified to determine the scope of the agreement as well. The SAG is utilized 66% for public water supply, 5% for rural water supply, 16% for industrial use and 13% for recreation (thermal tourism). Consensus was achieved for the scope of the Framework regarding waters governed, which users and uses through the due diligence of the PSAG recognizing these possible issues which can arise.

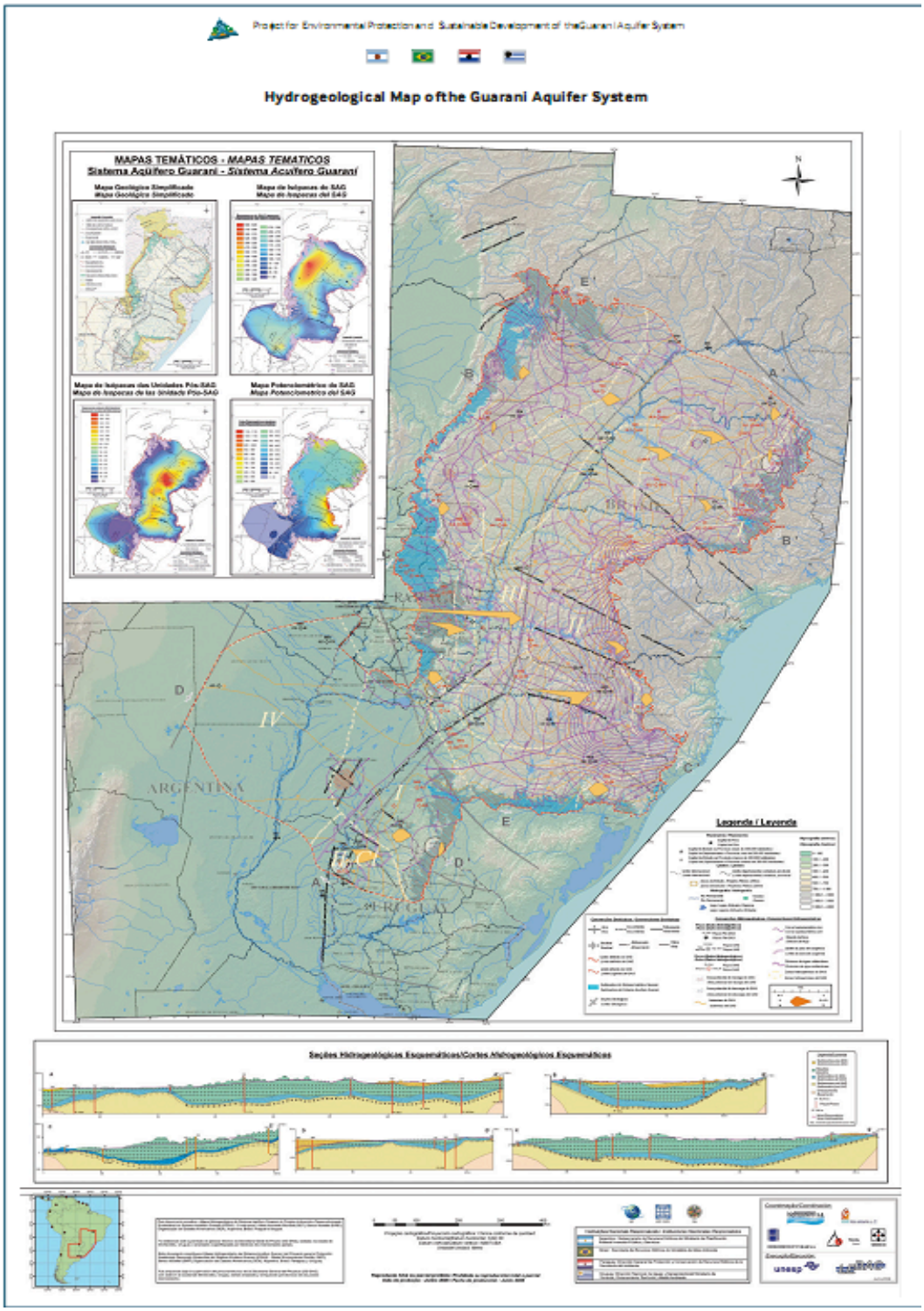

Figure 2: Hydrogeological Map created by the PSAG. From the PSAG Strategic Action Plan.

Substantive Rules

The substantive rules of equitable and reasonable utilization and no significant harm are the nucleus of any international agreement. The Considerations of the Framework contain the substantive rules and comprise of four principles: Principle I states management of the SAG the strict liability of each of the countries subject to the respective legal frameworks; Principle II states coordination and cooperation by the states to protect and utilize the SAG in a sustainable manner; Principle III states the scientific information obtained from the PSAG is the current state of knowledge and should be implemented for the management and protection of the SAG; and Principle IV states the management tools developed by the PSAG support decision making and strengthen ties of cooperation.

To ensure equitable and reasonable use and no significant harm, abstraction controls should be developed, implemented, and monitored for the reasons stated earlier. For the controls to be accurate, first the sustainable yield must be determined. The scientific knowledge developed by Component I of the PSAG in addition to determining the boundaries established the total volume (30 trillion m^3 but it should be noted it is still scientifically difficult to determine the exact volume: volume established was significantly lower then previous estimates which did not have the proper tools as the PSAG did to establish a viable estimate), rate of recharge (the recharge of Guarani aquifer is estimated to be 5 billion m^3/year which equals the total sustainable yield and the current abstraction of the SAG is in total 1.04 billion m^3/year, with Brazil abstracting 93.6% of the total annual volume), the predominance of use and population served by each state party by the aquifer, basics for sustainable yield.(PSAG SAP, World Bank ICR 2009)

Monitoring and assessment of the SAG are necessary to maintain the abstraction controls. Component II of the PSAG developed the Guarani Aquifer Information System (SISAG) and monitoring network of 202 wells were strategically selected across the SAG to monitor flow dynamics and identify areas of existing or potential overexploitation, which are integrated with Principle III. The information obtained will be mirrored and disseminated for the nations as well as public inquiry to ensure transparency and enhance legitimacy of the Framework and its bodies for abstraction management.

In addition, protection of the conservation areas is necessary to ensure no significant harm. The outcropping or recharge area (which was less than 10% of the aquifer system is "unconfined" and is located primarily in Brazil) was determined by Component I, which is extremely vulnerable to contamination and pollution of groundwater. (World Bank ICR 2009) It also provided studies on land use covering the SAG, to understand the current uses and trends of future uses which can contribute to its contamination and pollution as well as created manuals to standardize abstraction and construction procedures as well as buffer zones to prevent well-head contamination. (World Bank ICR 2009) The monitoring network would also supply qualitative and quantitative information to the competent authorities and Framework bodies to ensure SAG integrity.

Procedural Rules

The principles inherent to the substantive rules would be difficult to achieve without the obligation to cooperate established by procedural rules. The procedural rules of the Framework are found in the Declarations, operationalize the substantive rules and describe the methods to address the obligations of cooperation, prior notification, and exchange of information. There are six activities; the first five activities state the procedural rules, and the sixth states the institutional mechanisms that will be discussed in the subsequent section. The first activity states updating and maintenance of the SISAG; the second states the operation,

maintenance, and development of the SAG monitoring network should be done jointly by the relevant institutions of each country in a coordinated manner; the third states deployment of local management structures that consolidate the work of the Local Management Support Committees in areas defined by the PSAG; the fourth states dissemination and harmonization of information produced by the PSAG amongst the states parties; and the fifth states coordination of monitoring of strategic actions agreed upon to ensure the continuity and integration of the management tools developed by the PSAG. (PSAG SAP)

The obligation of cooperation is the essence of the Framework, as the sustainable management of the SAG would not be possible without it. The institutions, which will be discussed in the subsequent section, coordinate the activities within the States with the others to ensure transparency of SAG development. The operation of the SISAG and the monitoring network are responsible for information exchange and mirroring it regarding the utilization of the SAG by the States, as mentioned in Section 4.1. The National Management Units are responsible to relay information from the water-management related institutions within the States regarding their current and future activities to the Regional Cooperation Council, which encapsulates the principle of prior notification.

Institutional and Dispute Settlement Mechanisms

Activity six of the Framework Declarations states the institutional mechanisms that will execute the management tools operationalized by the PSAG and administer the obligations of the agreement, which are based on the development of Component 7 of the PSAG. The Framework establishes four key bodies: the Regional Cooperation Council, the National Management Units, Liason Unit and the Local Management Support Committees. There are four LMSC's in which each state party is responsible: the SISAG, which is the responsibility of Argentina; the Monitoring and Modeling or the Information System Committee which is the responsibility of Brazil; The Capacity Building and Dissemination Committee which is the responsibility of Paraguay; and the Local Management Promotion Committee, which is the responsibility of Uruguay. These institutional bodies will be incorporated into the scope of the Intergovernmental Committee of the Plata Basin (CIC) to integrate with the existing structure for its operation.

A key institutional mechanism, dispute settlement, is not described by either the PSAG or the Framework. As it is a first step towards a concrete agreement and there are no current disputes regarding the SAG between the states, this mechanism was not integrated into the PSAG of the Framework. It is believed that the MERCOSUR tribunal and the CIC serve as the dispute mechanism, should one arise.

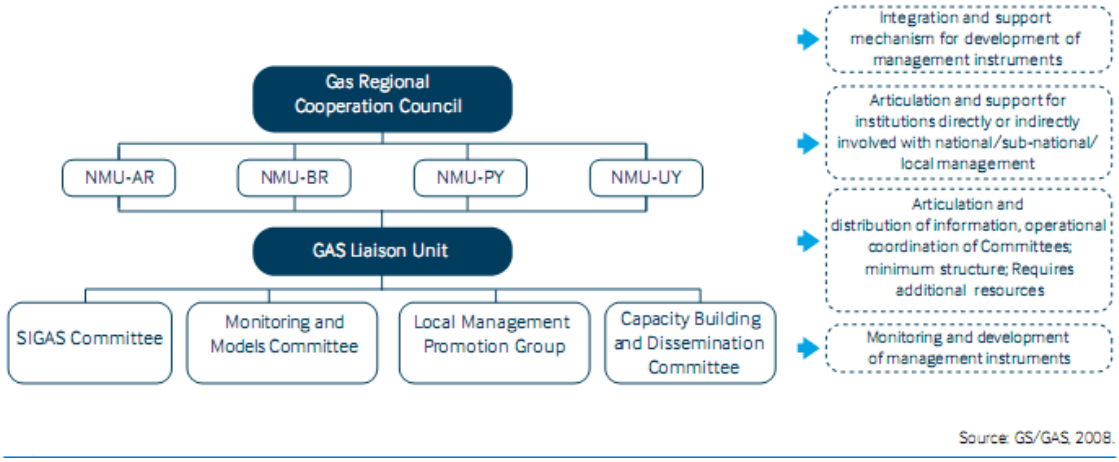

Figure 3: Institutional Structure of the Coordinated Management Framework. From the PSAG Strategic Action Plan

Summary

The Framework contained four of the five elements of an effective treaty. Although a dispute settlement mechanism is not inherent, the four nations will refer to an existing regional organization which has an established dispute mechanism. In spite this setback, the Framework sufficiently addresses the principles and obligations described in section 3 for the proposed management of the SAG.

Conclusions

Surface water is the "tip of the iceberg" for freshwater resources, where the lion's share is groundwater found in aquifers. (McCaffrey 1999) Similarly to surface water, many aquifers are transboundary and international in nature. However, treaty practice of groundwater is meager in comparison, mainly due to the limitations of sovereignty, the uncertainty and heterogeneity, and the lack of state and international practice that can fully address the specific characteristics of aquifers. The increase utilization of transboundary and international aquifers denotes the impetus for an international legal regime on groundwater. Although the resource is similar in its uses, the approach towards its management and utilization is inherently different. A consensus on transboundary and international aquifer management should integrate the customary international laws for surface waters while taking into account the precautionary principle and other aquifer-specific obligations. Moreover, the promuglations of any supranational legal doctrine should attempt to understand the governance and management aspects of the water resources sector of each party.Current developments such as the UNILC Law of Transboundary Aquifers and the ISARM project as well as the progress of the UN Draft Articles on the Law of Transboundary Aquifers are built on the continued work by legal scholars whom have demonstrated the exigency of an international groundwater regime.

In response the PSAG was implemented by the nations of MERCOSUR with the help from GEF, OAS, and WB to create a concrete management framework for the SAG and then the drafting of the Guarani Aquifer Agreement. The PSAG saw the necessity of integrating hydrogeology into the framework development process to overcome the obstacles commonly associated with groundwater. Although the concrete management framework was not achieved, the PSAG developed the Coordinated Management Framework. The Framework encapsulates customary international law principles of equitable and reasonable utilization,

no significant harm, and obligation to cooperate in its precautionary approach to the sustainable management of the SAG for current and future generations. The Framework incorporates the management tools developed by the PSAG to tackle specific characteristics of international groundwater. In so doing, the Framework can be seen a great leap for the progressive development of international groundwater law.

The mission is not yet accomplished. Further work needs to be done, and a consensus by the international community for an international legal regime on groundwater needs to be reached in order for it to be achieved.

Recommendations

When this paper was originally written, the Guarani Aquifer Agreement had not been drafted. Villar and Ribeiro provided a review of the new agreement, stating, "*Guarani Aquifer management juxtaposes local, provincial, national and international scales, as well as different types of governments interests concerning water and soil, which require cooperative management between the different scales and actors."* The last part of the statement highlights one of the main critiques I have of the SAG and the transboundary aquifer law movement at large. The negotiations regarding international legal doctrine are very difficult, but there is not enough focus on the real actors involved. It is a fact that the states are usually party to international agreements, but those who carry out the day-to-day governance of water resources are subnational institutions and organizations with widely varying mandates. A stakeholder analysis should be done in this or any other regional transboundary aquifer agreement to fully develop and understand the rules of the game and who will be playing. In short, the governance of the resource is lost and needs to be established prior to drafting laws.

The new Guarani Aquifer Agreement does reflect the provisions of the Watercourses Convention, containing the usual obligations of international law. Contrary to the Watercourses Convention, the Guarani Aquifer Agreement designates final resolution of disputes to an established commission under the Treaty Rio Plata Basin rather than some supranational organization like the International Court of Justice. Although it may allow for the development of regional customary law to organically develop, as we saw with the Pulp Mills case, that regional dispute mechanism was not sufficient. I would contribute this to a lack of understanding of the water resources governance within each party as well as the lack of horizontal as well as vertical communication between subnational institutions. When looking at the development of dispute resolution mechanisms as well as the substantive and procedural rules, a legal analysis of each of the parties involved should be undertaken.

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