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# Groundwater Governance: Drawing Connections between Science, Knowledge and Policy-Making

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CeReGAS

Centro Regional para la Gestión de Aguas Subterráneas en América Latina y el Caribe

# Groundwater Governance: Drawing Connections between Science, Knowledge and Policy-Making


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Alberto Manganelli is a hydrogeologist with wide experience in environmental and management issues, especially those transboundary. He participated in the Guarani Aquifer Project (2002-2009) as a technical resource. He holds a Bachelor's of Science from the University of the Republic, Faculty of Sciences in Geology. He also holds a Master's of Science in Management and Environmental Auditing from the University of Las Palmas de Gran Canaria. In his professional career he has worked as a consultant in the areas of management, use and conservation of groundwater and environmental resources. He has also worked in the following main projects: Environmental Protection and Sustainable Management of the Guarani Aquifer System Project - OAS-GEF; UNESCO – OAS ISARM – Américas Project; UNESCO TWAP Project – Groundwater Component; UNEP-OAS-GEF - Framework Program for Sustainable Management of Water Resources of the River Plate Basin in Relation to the Effects of Climate Variability and Change– Groundwater Group. Mr. Manganelli has also worked as a professor in the Department of Basin Studies, Faculty of Science, University of the Republic of Uruguay, teaching courses about Environmental Geology and Environmental Impact Assessment. He is currently working as Executive Director at the Regional Centre for Groundwater Management in Latin America and the Caribbean (CeReGAS).



## Abstract

This working paper brings together contributions from participants to the Groundwater Governance: Drawing Connections between Science, Knowledge and Policy-Making workshop organised by the Strathclyde Centre of Environmental Law and Governance (SCELG) and CEREGAS (Centro Regional para la Gestion de Aguas Subterraneas en America Latina y el Caribe) in Uruguay between 22 and 26 February 2016. The workshop was funded by the British Council in the framework of its Researcher Links Programme and built upon the results of the 2011-2014 Groundwater Governance Project, funded by the Global Environmental Facility and implemented by UNESCO-IHP, FAO, the World Bank and the International Association of Hydrogeologists.

# Groundwater Governance: Drawing Connections between Science, Knowledge and Policy-Making

## 1. INTRODUCTION

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Assume something is broken and you need at least four people with four different skills to repair it. Now assume that these people talk different languages and cannot communicate to each other. Worse, imagine that each one thinks their skill is more important than the other one and can solve the problem alone. The four people do not want to make an effort to stop, and try to slowly understand the other people's languages and their skills. It is difficult to see how a problem can be solved in such a scenario.

Groundwater governance presents similar challenges. It requires many different sets of skills from different fields: hydrogeologists, lawyers, economists, water managers, anthropologists, just to name a few. All of these speak, in their own way, very different languages and often, especially the lawyers, do not make the necessary effort to communicate between each other. This challenge was successfully dealt with throughout the "Groundwater Governance: Drawing Connections between Science, Knowledge and Policy-Making" workshop organised by the Strathclyde Centre of Environmental Law and Governance (SCELG) and CEREGAS (Centro Regional para la Gestion de Aguas Subterraneas en America Latina y el Caribe) in Uruguay between 22 and 26 February 2016. The workshop, funded by the British Council in the framework of its Researcher Links Programme, was attended by 28 researchers, 14 from UK based institutions and 14 from Uruguay. Altogether 4 continents and 17 countries were represented. The workshop took place in Salto, in the North-Western part of Uruguay, on the border with Argentina and was hosted by the local branch of the Universidad de la República.

The groundwater governance workshop organised by Strathclyde and CEREGAS built on the results of the 2011-2014 Groundwater Governance Project. The latter produced a Global Diagnostic, a Shared Global Vision for 2030 and a Global Framework of Action, all of which were used extensively throughout the workshop. The Groundwater Governance Project was a joint initiative of UNESCO-IHP, FAO, GEF, the World Bank and the International Association of Hydrogeologists.

What you have in front of you is a working paper that brings together contributions from participants to the workshop. It is important to highlight that in this case the final result is, precisely, what the term working paper implies: "work in progress". We gave the participants a very tight deadline to submit 1000 words on a topic of their choice that linked their own research interest or professional work with the discussions laid out in the workshop. We deliberately

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told them to refrain from using footnotes or endnotes (as much as possible) and to build on the momentum gathered during the week. We also told them, where possible, to clarify the link between their contribution and the Groundwater Governance Project Global Framework of Action. You will see that in some of the contributions references to the five phases of the Framework of Action are present: diagnosis, institutions, linkages, finances and planning and management. However, despite the number of disciplines featured in the workshop, the latter did not provide a full coverage of the areas covered in the Framework of Action, hence the decision not to divide the working paper based on the five areas that one can find in such document.

The working paper you have in front of you is divided instead in four discrete parts. The first one brings together contributions that focus on *Groundwater Governance in Uruguay* with a particular emphasis on the experience of the Salto Concordia Guarani Aquifer Binational Commission. This leads nicely to the second part of the working paper which focuses on *Transboundary Groundwater Governance*. The third part moves to explore some of the *Principles, Tools and Management* practices that participants to the workshop have highlighted as interesting or relevant for groundwater governance. Finally, the working paper concludes with a part on *Linkages* where contributors have focused on selected fields (such as energy or food) whose relationship with groundwater governance is crucial.

In conclusion, this working paper is just the beginning and both editors and single contributors welcome comments and feedback in order to take individual and collective projects forward. Strathclyde and CEREGAS look forward to continuing both academic and practical work that increases awareness in groundwater governance and helps build capacity and knowledge in this much needed field.

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## PART I - GROUNDWATER GOVERNANCE IN URUGUAY



## 1. LA IMPORTANCIA DEL REGISTRO DE LAS PERFORACIONES EN LA GOBERNANZA DEL AGUA SUBTERRÁNEA.


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Uruguay posee una extensa Normativa referente al aprovechamiento y gestión de los recursos hídricos. La característica intrínseca de las aguas subterráneas relativa a su visibilidad dificulta el correcto cumplimiento del marco legal inherente a la construcción de las perforaciones, extracción y registro ante el Organismo estatal responsable.

Para poder desarrollar una correcta gestión de las aguas subterráneas es fundamental la caracterización hidrogeológica de los acuíferos. Esto se logra a partir de un inventario detallado de sus perforaciones, el que deberá contener datos de índole constructivos, hidráulicos y geológicos. La principal forma de acceso a esta información es a través del registro de las perforaciones de agua subterránea en la Dirección Nacional de Aguas (DINAGUA), Unidad Ejecutora del Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente (MVOTMA).

### MARCO LEGAL

El registro de las perforaciones para el alumbramiento de agua subterránea ejecutadas dentro de la República Oriental del Uruguay está determinado desde el año 1978 por la Ley N° 14.859 (Código de Aguas). Dentro de esta Ley se incluye a su vez la obligatoriedad de las empresas perforadoras de contar con la Licencia de Perforador vigente expedida por el Ministerio competente (MVOTMA-DINAGUA).

En el año 2004 se llevó a cabo una reforma constitucional en su Artículo N° 47 el que manifiesta: …"*Las aguas superficiales, así como las subterráneas, con excepción de las pluviales,*

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*integradas en el ciclo hidrológico, constituyen un recurso unitario, subordinado al interés general, que forma parte del dominio público estatal, como dominio público hidráulico*".

A partir de la entrada en vigencia de la Ley N° 18.172 del 31 de Agosto de 2007 las competencias en materia de evaluación, administración y control de los recursos hídricos fueron transferidas al Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, a cargo de su Dirección Nacional de Aguas (DINAGUA). En el año 2004 se aprueba el Decreto de Normas técnicas para construcción de pozos perforados (Decreto 86/04) . En el mismo se detallan las características constructivas que deberán cumplir las perforaciones tanto si se ejecutan dentro de un acuífero de tipo sedimentario o de tipo fisurado.

Un punto a destacar de la gobernanza de las aguas subterráneas en Uruguay son las perforaciones ejecutas dentro de la zona infrabasáltica del Sistema Acuífero Guaraní, las que por su profundidad (mayores a 1000m) y gradiente geotérmico erogan aguas termales. Éstas adquieren un tratamiento especial respecto a todas las perforaciones ejecutadas dentro del territorio Nacional. Los parámetros de gestión específicos se enuncian en el Decreto 214/00 denominado "Plan de Gestión del Acuífero Infrabasáltico Guaraní". Se señalan:

- El caudal instantáneo máximo será menor o igual a 150 m3/h, pudiéndose en circunstancias debidamente fundadas en el interés público, acceder a la extracción de un caudal mayor.
- Las perforaciones estarán situadas a distancias mayores de 2000 m. de otras perforaciones debidamente inscriptas en el Registro Público de Aguas, salvo que el permisario anterior permita la ejecución de una nueva perforación a una distancia menor
- El régimen de extracción diario de cada perforación será no mayor a 16 horas, permitiéndose en casos debidamente justificados, mediante la presentación de un plan de explotación, acceder a un número mayor de horas diarias.

## METODOLOGÍA DEL REGISTRO DE LAS PERFORACIONES

Como se mencionó previamente las aguas subterráneas dentro del Uruguay pertenecen al Estado, son públicas. El trámite de Registro de las perforaciones les otorga a los usuarios del recurso hídrico un derecho de uso y extracción por determinado lapso.

Esta vigencia dependerá de varios factores, por ejemplo:

- Vinculación jurídica de los usuarios con el predio asiento de la o las perforaciones (propietario, arrendatario, comodatario, etc.).
- En caso de empresas de la permanencia y representación de la Sociedad propietaria de la misma.
- En pozos con destino de riego agrario el plazo de la Resolución será determinado en función de la validez del Plan de Uso de Suelos y Aguas aprobado por la Dirección General de Recursos Naturales Renovables (RENARE) perteneciente al Ministerio de Ganadería, Agricultura y Pesca (MGAP).

Para la solicitud del otorgamiento de Derechos de Uso y extracción de aguas subterráneas el usuario deberá presentar la documentación requerida por DINAGUA.

Según lo manifestado en el Código de Aguas para el alumbramiento de nuevas perforaciones deberá solicitar un Permiso de perforación de estudio. Es requisito fundamental la presentación de un estudio hidrogeológico del área involucrada a fin de conocer las características geológicas y el perfil constructivo proyectado de la nueva perforación. Se analizará esta nueva solicitud respecto a las obras de extracción de

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agua subterránea registradas con anterioridad ante la Institución, ya que los Registros son prelativos.
En la Normativa actual no se delimitaron radios de protección ni distancia mínima entre perforaciones, por lo que se toman distancias arbitrarias en función de las características del acuífero en el que se localiza la perforación proyectada. Si el acuífero es de tipo sedimentario las distancias permitidas entre perforaciones serán menores respecto a un acuífero de tipo fisurado. Esto se relaciona con la posibilidad de ocurrencia de interferencia entre perforaciones.

La realidad demuestra que la mayoría de los usuarios que se presentan a registrar sus perforaciones lo hacen una vez que las obras han sido ejecutadas. Para estos casos es imprescindible que las perforaciones construidas cumplan con todos los artículos establecidos en el Decreto 86/04 sobre las Normas constructivas y que la empresa perforadora encargada tenga Licencia de Perforador vigente. Las perforaciones desarrolladas anteriormente a la entrada en vigencia de este Decreto (año 2004) deberán adaptarse al mismo en lo que refiere a las características externas de la perforación (alto tubería, losa de protección, tapa a boca de tubería).
Sí esto no se cumpliera se denegará el Registro.
En caso de que las distancias entre perforaciones registradas con anterioridad y una nueva solicitud sugieran una posible interferencia entre las perforaciones se deberá realizar un estudio con el objetivo de cuantificarla. Sí existiera, el usuario registrado con antelación deberá recibir la cuota de agua determinada en el estudio de parte del usuario que se presentó con posteridad
Se puede convenir un acuerdo de partes de conformidad entre usuarios cercanos sin necesidad de realizar el estudio de interferencia. Dependerá de la voluntad de las partes involucradas.

### IMPORTANCIA DEL REGISTRO

Si bien está reglamentado por Ley, la realidad evidencia que las perforaciones registradas en Uruguay difieren en relación del total de las perforaciones ejecutadas dentro del territorio Nacional. Este valor no está cuantificado.
Sin un conocimiento fehaciente de las mismas es muy difícil alcanzar una gestión adecuada del recurso porque la etapa del diagnóstico inicial es incierto.
Es imprescindible profundizar en la difusión de la información brindada a los usuarios sobre la importancia del registro y en las relaciones interinstitucionales a nivel de gobierno y sociedad civil.
A su vez, es fundamental el fortalecimiento institucional que permita alcanzar las metas planteadas.

Información adicional:

- www.mvotma.gub.uy
- http://www.parlamento.gub.uy/IndexDB/Leyes/ConsultaLeyesSIPXXI.asp

## 2. THE ROLE OF UNIVERSITIES AND INSTITUTIONS IN TRANSBOUNDARY AQUIFER SYSTEMS AND THE GEOLOGICAL DATA ACCESS

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Sedimentary basins are depressions in the upper crust filled mainly by sediments and volcanic igneous rocks, which commonly form tabular strata which are similar to the layers of a cake. These basins, distributed worldwide, possess some of the most important natural resources: the largest reserves of conventional and unconventional oil-gas, groundwater and some mineral resources. Links

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between academics, the public and private sectors could guarantee a direct access to the geological data and this is necessary in order to preserve the quantity and quality of the underground water resources.

## THE GEOLOGICAL KNOWLEDGE AND THE WATER RECOURSES

Note that the understanding of the geometry and main characteristic of the porous sedimentary rocks system (e.g. sandstones, shales and conglomerates) is linked with the geological history and the development of the sedimentary basins. Both water and hydrocarbons main resources are located in the sedimentary strata. Recently access to water and sanitation has been declared a "human right" and it is estimated that 99% of drinking water is in aquifers and therefore States must guarantee to citizens' access to this vital resource, despite occasional conflicts of interest between the stakeholders related to the energy sector and potable water users.

Since large reserves of gas are hosted in clayey impermeable rocks with high total organic content, the fossil energy sector focus on their exploitation by unconventional methods, but it is important to understand that this type of rocks in most of the cases are spatially related to aquifers. In particular, the threat of exploitation of gas by the method of hydraulic fracturing (shale gas), among others, exerts significant pressure on quality and quantity of the underground water resources. It is recognized that the hydraulic fracturing method requires injection of considerable amount of water and chemical products (10.000 to 30.000 $m^3$ and 180 to 580 $m^3$ respectively) in the underground system, in order to generate artificial rock porosity and fractures that are difficult to control in their extension and could serve as conduit for water pollution. The injected water with high concentrations of strongly polluting chemicals can easily leak into aquifers putting them at risk. The latter is so high that these practices, after thorough analysis, have been prohibited in countries like France and Germany. Therefore, in countries where there is no regulatory legal framework as in most countries of South America it is essential that States guarantee the investigations of geological and hydrogeological conditions (locally and regionally) in order to detect and evaluate possible migration paths of fluid fracturing.

## DATA OWNERS AND USERS

Large private and State economic groups know in detail several of these sedimentary basins around the world since their activities are related to hydrocarbon exploration and mining resources (e.g. uranium mining), but in most of the cases confidentiality agreements do not allow this information to come to light. Access and the analysis of the raw data would be useful to the rest of the community and particularly to academics that can provide a thorough understanding of the mining and extractive activities and risk assessment regarding the possibility of over-exploitation or pollution of water resources. Therefore, it should be compulsory for both the public and private sectors to provide the necessary information for proper evaluation and resources uses.

## THE GUARANÍ AQUIFER AND URUGUAY

Whenever the sedimentary basins cross geopolitical boundaries the scenario for Groundwater Governance turns more complicated and, therefore, neighboring countries should get together to take measures against their depredation in the case of transboundary aquifers. As an example, while the Uruguayan government and stakeholders are making an effort to prevent contamination of the Guaraní Aquifer in collaboration with their neighbors (in 2010 Paraguay, Argentina and Brazil signed an international agreement in this regard, the Guarani Aquifer Agreement), recently the Uruguayan state oil company ANCAP signed a contract with overseas companies with the main objective of exploring the shale-gas resources in the Paraná Basin and opening the possibility of exploitation by hydraulic fracturing,

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which seems like a real threat to the quality and quantity of the water contained in the Guaraní Aquifer. None of the provisions of the contract are available to the public, nor is the detailed information regarding the sedimentary records that form part of the Guaraní Aquifer.

## CONCLUSIONS

According to the Sustainable Development Goals, higher education universities and institutions can play a major role in planning and implementation processes. Following this recommendation, researchers from the geosciences should be able to identify the best practices in strategy and innovation, and they can help to monitor the agenda through the collection, analysis, and interpretation of primary data. In order to reach this goal, I believe that the scientific community must strengthen their public compromise to preserve the underground water reserves worldwide.

## 3. ¿CÓMO DESARROLLAR PROCESOS DE APROPIACIÓN DE LA POBLACIÓN DEL DESAFÍO SDG-6?

Marcos Musso

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El acceso al agua potable de los seres humanos así como el manejo sustentable de la misma, respetando los servicios ecosistémicos para la diversidad vegetal y animal, es uno de los objetivos planteados en la Agenda del Desarrollo Sustentable hacia el 2030, aprobado por la Asamblea General de las Naciones Unidas en setiembre de 2015. Específicamente “Goal 6. Ensure availability and sustainable management of water and sanitation for all” abarca un conjunto de objetivos específicos que deberían ser alcanzados, algunos en 2020 y otros en 2030. El objetivo principal es el acceso al agua potable y a sistemas de saneamiento adecuados en forma segura para toda la humanidad. Otro objetivo específico es proteger y restaurar las relaciones ecosistémicas del agua en diferentes ambientes como lagos, humedales, bosques, ríos, acuíferos entre otros. Este está asociado a otro objetivo que es reducir la polución, minimizando el derrame de productos químicos peligrosos y de agua residuales no tratadas de diferentes orígenes, promoviendo el reciclado y el reuso. Además se debe promover la cooperación internacional para desarrollar capacidades locales para el manejo sustentable del agua así como fortalecer la participación de las comunidades locales en la toma de decisiones. Estos últimos objetivos específicos son muy importantes para desarrollar y generar conciencia en las poblaciones locales que puedan incidir en la situación global.

El desafío consiste en educar a la población en el uso y manejo responsable y sustentable del agua. El público objetivo principal identificado está conformado por dos grupos: uno son los educadores con los estudiantes de los ciclos iniciales del sistema educativo y otro los tomadores de decisión como gobernantes locales y representantes en el parlamento local. En el caso de los educadores es necesario realizar talleres de aprendizaje de varios días, donde se desarrollen las capacidades, habilidades y destrezas para incorporar la información y poder desarrollar actividades creativas con los grupos de estudiantes una vez terminado el taller. Además debe incorporarse en la currícula de formación de los futuros profesores, de manera que las nuevas generaciones de educadores ya tengan los conocimientos y las destrezas sobre el agua como derecho humano a preservar.

Además deben usarse las Tecnologías de la Información y Comunicación (TICs), dado que en

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Uruguay está facilitado el acceso por el plan Ceibal (un niño, una computadora) desarrollado por la educación pública y de forma gratuita. Desarrollar contenidos para disponer en la WEB es una actividad que debe ser impulsada, permitiendo el acceso de los niños del plan Ceibal así como disponibilizarlo para otras entidades educativas.

Además se debe aprovechar el programa una "Tablet" para adultos mayores que lleva adelante el gobierno de Uruguay, de forma que pueda existir una interacción niños –abuelos sobre esta temática.

El otro grupo son los gobernantes locales, donde la preocupación es por las condiciones locales de acceso al agua potable y saneamiento así como la preservación de las fuentes de agua tanto superficial como subterránea. Allí los interlocutores deben ser integrantes de la sociedad civil organizada, para que promuevan y exijan las mejores prácticas de uso del agua. Actividades no formales de divulgación como charlas, conferencias y talleres se pueden desarrollar durante la semana de la Ciencia y Tecnología (organizadas por el Ministerio de Educación y Cultura MEC en mayo de cada año). Son instancias para promover el objetivo de la Agenda de Desarrollo Sustentable 2030 de acceso al agua potable de calidad y la preservación de los recursos hídricos y los ecosistemas asociados.

Referencias:


- ONU (2015) Transforming our world: the 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly on 25 September 2015. 35 pp.
- Página web Plan Ceibal http://www.ceibal.edu.uy


## 4. THE IMPORTANCE OF EDUCATION AND SOCIAL AWARENESS IN GROUNDWATER GOVERNANCE IN URUGUAY


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### INTRO, THE CONTEXT

In October 2004, Uruguayan voters approved an amendment to their constitution to provide that the access to potable water and sanitization is a fundamental human right. This plebiscite put Uruguay on its way to becoming one of the first countries to declare access to water and sanitation as a constitutional human right. For Uruguayans, the participation of citizens in direct democracy is not an unusual occurrence, nor is the fact that this plebiscite has been the result of popular demand. This is because, for the most part, in recent decades popular initiatives have resulted from citizens' participation through direct democracy, and not from government organizations.

The numerous instances of citizen action through direct democracy are, for the Republican organization of Uruguay, an important part of the exercise of citizenship, and a way to make their voices heard outside of election cycles and the legislative process. How does Uruguay begin the process that leads to modification of the Constitution? The Constitution itself provides direct participation mechanisms that can lead to its own modification. The signatures of a mere 10% of the voter registry can call a plebiscite to launch the proposed modification of the constitution. The popular movement that carried out the campaign to sign the petition for calling a plebiscite in 2004 emerged as resistance to the trend of privatization of water services and sanitation throughout Latin America; these services had already been privatized in some regions from the country at that time. In fact,

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the modification of the constitution that emerged from this plebiscite specifies that the water resources, both surface water and groundwater, correspond to the public domain, and books that tell the story of this modification of the constitution describe it as resistance the privatization of water (See the book “Aguas en movimiento”).

Today, a decade after the constitutional reform the majority of the population has access to drinking water. The reform has also led to the implementation of a new National Water Policy, which among other things advances the National Water Direction and created (DINAGUA) within the Ministry of Housing, Land-Use Planning and Environment (MVOTMA). DINAGUA has within its mandate both surface waters and groundwaters.

Nevertheless, groundwater governance is still in its first steps, with the process of borehole registration currently underway (see the paper submitted by Ximena Lacues) and with little social awareness about either the characteristics and weaknesses of groundwater or the need for groundwater resource protection.

## THE GOVERNANCE OF THE UNDERGROUND AND THE MYTHS TO OVERCOME IN URUGUAYAN SOCIETY

In order to achieve success in the 2004 plebiscite, convening NGOs conducted awareness campaigns in order to overcome myths established in society, such as "Water is a limitlessly renewable resource".

In the past ten years in Uruguay, agricultural production increased and consequently intensified land use, generating use of non-traditional lands and advancing techniques for production from these lands. These events directly impacted the quality of surface water, even affecting the sources of drinking water supply for some of the main cities in Uruguay. These problems have led not only to increased formal study of the sources of contamination of these surface waters and monitoring, but have also increased the visibility of water resources for the population, as well as enhancing their perception of the need to take care of their water sources.

Uruguay is a country proud of its natural beauty, and in fact for more than two decades the slogan "Uruguay Natural" has been used in tourist advertisements. Unfortunately, most people are unaware of the importance of resources that lie underground. Today, a large portion of the population thinks that the soil and rocks in the ground act as a universal filter, avoiding any entry of contaminants into aquifers. Given the variability in the quality of surface water sources, and repeated eutrophication problems, some have been advocating the idea of replacing or complementing the surface water sources by the use of well water. Currently the main users of groundwater resources are industry and the agricultural sector which, as has been mentioned previously, in recent years has increased and intensified its production. In a country that refused to privatize water distribution, private groundwater users still obtain it practically for free, because, although the water law envisages charging for the service, the necessary provisions have not yet been implemented. Given the increasing pressure on groundwater resources, we must take urgent action to achieve greater social awareness of the unique characteristics of the resource, including consequences of extraction and the risk of contamination from human activities in groundwater recharge areas.

In conclusion, as a new step in Uruguayan water protection activities, there is a need for more information and awareness-raising among all segments of the population on groundwater issues, not only in the formal setting (see Marcos Musso's contribution), but also to a wider audience that includes voters.

For further information:

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- Constitución de la República Oriental del Uruguay: http://www.parlamento.gub.uy/constituciones/consto04.htm
- Ley de aguas: http://www.parlamento.gub.uy/leyes/ley17283.htm
- http://www.mvotma.gub.uy/administracion-de-aguas.html

## 5. WATER CULTURE FOR THE GUARANI AQUIFER GOVERNANCE

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Cultural understandings are frequently mentioned as fundamental drivers when discussing groundwater governance, even more when the focus is on international transboundary aquifers. It is assumed that people from different nation-states carry diverse cultural values expressed in the ways they relate to environmental components and furthermore, these cultural understandings emerge strongly when partners sit in a roundtable with their neighbours to discuss the way shared groundwater would be managed.

This piece revolves around Uruguayan water culture traits in relation to groundwater that local people and decision makers might perform when participating in political and technical spaces like the Salto/Concordia Guarani Aquifer Binational Commission, resulting from the Inter-governmental Guarani Project (see the contribution from Francesco Sindico).

### THE OBJECTIFICATION OF GROUNDWATER

The Guarani Aquifer was known in the Northwestern Litoral of Uruguay, until the end of the last century, as part of a localized Salto groundwater hydrogeological formation. It was by 1997 that a group of international University hydrologists determined the existence of a transboundary aquifer system and called it Guarani, to honour that indigenous group and to give it a regional transnational flavour. From that moment on, and thanks to the scientific mapping of such an aquifer and the educational campaigns carried on by the Guarani Project (2003-2009) people in Uruguay in general, but particularly in the so-called pilot projects (Salto/Concordia and Rivera/Santana do Livramento), began to objectify their groundwater in a different manner. In the past, common people from Salto just bathed in the municipal and private spas ("Las Termas"); nevertheless, they now do touch, sense and enjoy the waters of the Guarani Aquifer, as it is constantly reminded by a male voice in the loudspeakers of the Dayman municipal spa. The change is not just in the name, but of a different meaning construction, because the Guarani Aquifer is presented officially as an objective entity characterised by scarcity, vulnerability and as a shared wealth of nature to be protected, not only by local people but rather by all nations that govern its surface and subsurface territories. This has been a process of objectification and abstraction of groundwater. The Guarani Aquifer became a two dimensions' map (see figure 1) and a resource to be managed, ambiguously disembedded from day to day practice. Probably most of the people and tourists that bath themselves into the thermal pools are not completely aware of this shift. Yet, the Guarani Aquifer is increasingly becoming a hydrohegemonic object. It must be said, notwithstanding, that until now the management of this reify natural resource did not signify any particular limitation of use in Uruguay, out of the existing norm that regulates the distance between wells, as well as the required technical

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quality in their construction. Thus, the Guarani Aquifer is not a fully "modern water" in the sense that its management has not compromised strong regulations and exclusions as it is usually the case in processes of disengagement of waters from their social fabric.

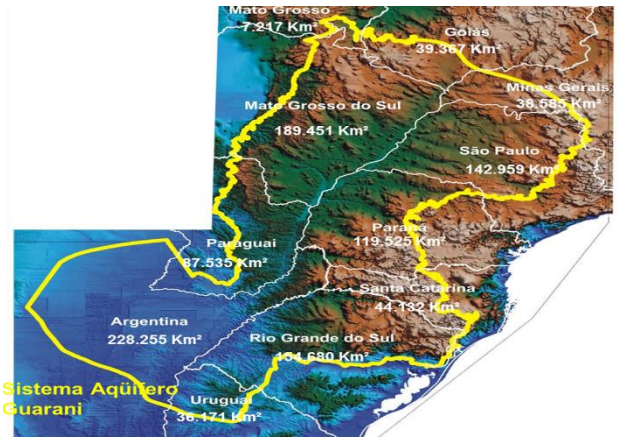

Figure 1: The Guarani Aquifer System

## HUMAN RIGHT TO WATER AND SUSTAINABLE MANAGEMENT

People in Salto do not depend on the Guarani Aquifer for potable water or household consumption. Yet, in the Uruguayan society all waters are increasingly culturally understood as part of the fundamental human right to water, after the Constitutional Reform in 2004 resulting from a popular consultation. The amendment of Article 47 of the Constitution, states that the consumption and use of water for basic human needs is prioritized in relation, mainly, to agriculture and industrial uses. According to the manager of the Dayman municipal spa, who also represents the province of Salto in the Binational Commission, the recreational and health use of the thermal water from the Aquifer must also be regarded as a human right, broadening in practice and discourse the legal definition.

Moreover, the sustainable management of watershed became linked also, since the legal reform, to the human right to water; a topic of rising concern in the country, due to the environmental impact of agriculture intensification and urban expansion on the main sources of fresh water for potabilization. In this regard, since 2013 a Guarani Aquifer Commission was created in Uruguay, led by the Water National Directory along with other participant delegates from the government, civil society and groundwater users. It is not surprising then that, since its first meetings, civil society delegates raised complains against the potential use of *fracking* (hydraulic fracturing) to exploit the yet to be discovered shale gas deposits in Uruguay. They promoted an advocacy campaign to ban that energy technology in the name of the human right to water, envisioning that the Guarani Aquifer might be in the near future a principal source for drinkable water for human populations, while current water sources are under growing risk of pollution and degradation.

## WATER TRUST

Trust between people seems an obvious requirement for modern and sound transboundary groundwater governance. However, there is another relation of trust that might be in place: the one developed between people and groundwater regarding its quality, safety, and continuous presence. As it was shown above, the reification of the Guarani Aquifer came hand in hand with a notion of scarcity and vulnerability despite the simultaneous discourse of its enormous potential and richness; in other words, we seem to be witnessing a fall in the trust on the Aquifer.

There seems to be a hegemonic belief among citizens, that Uruguayan society has not trespassed any irreversible ecological threshold; there is confidence that technology, science and education, along with coherent public policies, contribute to neutralize or reverse any negative trend. It is not that sources of risks are not perceived. For instance, climate variability and climate change, difficulties to control agriculture and industrial effluents, damming of internationally shared rivers and the lack of sanitation in expanding cities, are all taken into account.

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Notwithstanding, a cultural value that Uruguayans until now share is a hopeful approach to waters' ability to keep going despite human intervention; probably a dimension of considering water as a common good.

It could be said that trust towards groundwater is much required as it is inter-personal trust, in the cultural context that affords the work of organizations like the Salto/Concordia Bilateral Commission. The perceived and expressed need, in both margins of the Uruguay River, to institutionalize the work of that commission in a formal agreement, might represent a decreasing trust both to people and waters. The risk is that a human radical distrust to water might lead to a rather obsession to control and domesticate it, as it is generally the case with interpersonal relations when confidence is lost.

For further information:


- Taks, J. (2008) El Agua es de Todos/Water for All: Water resources and development in Uruguay, Development, 51: 17–22.
- El acuífero guaraní en debate (2009) Montevideo: Cotidiano Mujer. http://www.laredvida.org/im/bolentines/acuifero_guarani09.pdf


## 6. ARGUMENT TO IMPLEMENT GROUNDWATER GOVERNANCE IN NATIONAL WATER PLAN


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As a result of major advances in water well drilling, pump technology, geological knowledge and rural electrification in modern times, a 'silent groundwater revolution' has been taking place. Groundwater withdrawal has more than quadrupled in volume over the last 50 years, a trend that is likely to continue. Uruguay did not escape this trend, but the regulatory and management framework addressing groundwater is insufficient to ensure long-term sustainability of the resource. Including groundwater governance in the recently developed National Water Plan is essential to generating policies, plans and financial structures to create political commitment and leadership to provide adequate and sustainable management of the resource. As counseled in the Groundwater Governance project, the resource "should not be managed in isolation, but conjunctively as appropriate with other water sources to improve water security and assure ecosystem health. Groundwater can often play the vital role of strategic reserve to cover variations in surface-water availability, and is both recharged by and discharging to surface-water bodies."

### PAST

Uruguay has made a commitment to advance in integrated and participatory water management, as established by the constitutional reform in 2004. This constitutional amendment was backed by citizens through a referendum, and then regulated through the National Water Policy in 2009. In 2010 the Water Plan was initiated by the National Water Directorate,

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following adoption of the law that established the National Water Policy.

The plan assumes that responsible and sustainable management of water resources is necessary to maintain a comprehensive overview of all activities involved and to preserve associated ecosystems, landscapes and even culture. It is then necessary to change the sectoral planning paradigm that prevailed historically and to move to a comprehensive vision that recognizes the synergies and influence of various activities.

In support of more integrated water management, in 2010 the UNDP project URU/07/012 established a consultancy for the implementation of a national system of environmental indicators for groundwater. The result was an Action Plan for control, monitoring and evaluation of groundwater, designed to preserve the quality of groundwater and provide for sustainable development of the resource.

## PRESENT

For the first time, Uruguay intends to establish and implement a Water Plan, addressing water issues in an integrated manner and with a strategic long-term perspective. This approach is expected to open the way to a new form of relationship with water resources in order to facilitate and support sustainable development.

The Water Plan has been inserted into the planning strategy of the Ministry of Housing, Land Planning and Environment, joining the National Plan for Environment and Sustainable Development, which is currently being prepared by the Ministry through the Directorates of Environment, Land Planning and Water. The Regional Centre for Groundwater Management in Latin America and the Caribbean (UNESCO Category II) created in 2014 is also part of a strategy to strengthen, mainly transboundary groundwater management in the countries of the region, but also to create and strengthen tools for groundwater management at national level.

This first National Plan of Integrated Water Resources Management aims to contribute to and advance sustainable development for the country. The Plan had its genesis in an analysis of a conceptual framework in which the objectives of the Plan were based on access to water for consumption and sustainable development and on the prevention of associated risks.

A chapter in the Plan is devoted to an analysis of the regulatory and legal framework that has developed activities related to water, to understanding the causes and processes that originated the framework and the existing rules that determine the rights and duties of each of those involved, and to identifying possible changes to achieve the desired objectives.

To meet the proposed challenges, a diagnosis summarizes the current status and history of the various water-related factors that are needed to identify both weaknesses and strengths. Part of the diagnosis was based on the progress made by the Watershed and Aquifer Commission since its recent inception. As a guideline for further action, future scenarios including projected development were anticipated, and climate change was one of the key aspects considered. However, the proposal for revision of the National Water Plan does not yet reflect the management plans on groundwater that were recommended in the previously-mentioned Action Plan, and the measures currently proposed for groundwater are considered inadequate.

## AND FUTURE

To achieve the objective of the National Water Plan to ensure water quantity and quality for sustainable social, economic and productive development of the country through integrated and participatory management of water resources, incorporation of specific measures for groundwater is essential. Among other factors, the capacity of each basin/aquifer, the cumulative impacts of human activities, the balance between supply and demand, a

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plan for efficient use of water, and the health of aquatic ecosystems must be carefully considered. Groundwater is every bit as critical as surface water and deserves to receive the same attention as surface water in the National Water Plan.

For further information:


- Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente (eds.) Plan Nacional de Aguas. Propuesta en revision. Version 31th of October, 2015. Uruguay.
- Manganelli, A. (2010) Plan de Acción para el Control, Monitoreo y Evolución de Aguas Subterráneas. Consultoría para la puesta en marcha del sistema nacional de indicadores ambientales en la componente agua subterránea. Proyecto PNUD URU/07/012, préstamo BID 1866/OCUR. Uruguay.
- Constitución de la República (2004) Reforma constitucional. Uruguay.
- Ley Nº 18.610 (2009) Política Nacional de Aguas. Uruguay.


## 7. EL DERECHO DE AGUAS EN URUGUAY: UN BREVE PANORAMA ENFOCADO A LA POLÍTICA NACIONAL DE AGUAS


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### MARCO CONSTITUCIONAL

En el año 2004 la Constitución uruguaya fue modificada a los efectos de incluir en el Art. 47 referencias específicas sobre al agua como recurso natural. Por lo que a través de un referéndum nacional el derecho al agua se ha constitucionalizado. En ese sentido, la disposición establece *"La protección del medio ambiente es de interés general. Las personas deberán de abstenerse de cualquier acto que cause depredación, destrucción o contaminación graves al medio ambiente. La ley reglamentará esta disposición y podrá prever sanciones para los transgresores"*. Hasta 1996 este era el único párrafo, pero con la reforma se agregó lo referido a la Política Nacional de Aguas (en adelante P.N.A.) y saneamiento. Además, el agua fue considerada como un recurso natural esencial para la vida, así como que el acceso al agua potable y el acceso al saneamiento constituyen derechos humanos fundamentales.

Si bien la Leyes vinculadas a la gestión del agua establecen que se puede cobrar un canon por la explotación del agua, la realidad socio-económica del país es que no se cobra y que cada particular puede extraer el agua para su consumo interno sin abonar ningún precio, salvo por los gastos de conexión, pero no de suministro.

Por otro lado, sobre la política nacional de aguas la constitución asienta algunos principios: a) protección del medio ambiente y restauración de la naturaleza, b) la gestión sustentable y solidaria entre generaciones presentes y futuras, además, la preservación del ciclo hidrológico, c) participación de la población en todas las instancias de planificación, gestión y control de recursos hídricos, d) prioridad en el uso de agua: abastecer a las poblaciones, e) la prestación de agua potable y saneamiento se antepondrá ante cualquier razón económica. Con relación a este último punto la autoridad pertinente (DINAGUA en este caso) podrá dejar sin efecto los permisos o concesiones que vulneren lo ya expuesto (puntos a-e).

Por otro lado, la Constitución refiere a las aguas superficiales como subterráneas. Dentro de estas últimas exceptúa a las pluviales, pero no incluye a los acuíferos específicamente. Aún así el concepto de aguas subterráneas es abarcativo de los acuíferos por situarse éstos debajo de tierra. Tanto una como otra son consideradas parte del dominio público hidráulico. En tal sentido se ha conformado una Comisión sobre el Acuífero Guaraní dentro de Uruguay.

Ahora bien, la norma de mayor rango en el ordenamiento jurídico uruguayo dispone que la Ley

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reglamentará varios aspectos de los ya mencionados. Procede, entonces, mostrar el cúmulo de leyes que obran al establecimiento de la P.N.A.

## EL MARCO JURÍDICO LEGAL

Actualmente, el marco legal y reglamentario es amplio, por lo que una P.N.A. se integra de la articulación de estas disposiciones (por momentos carente de coherencia y coordinación). Desde un punto de vista orgánico, la política nacional de aguas (y saneamiento) se encuentra a cargo del Poder Ejecutivo y de la delegación de éste en el Ministerio de Vivienda Ordenamiento Territorial y Medio Ambiente (Ley 17.930). No obstante, de algunos Decretos también se puede observar que el Ministerio de Transporte y Obras Públicas (M.T.O.P.) tiene como cometido elaborar tal P.N.A. (Decreto 214/000). En este sentido, el M.T.O.P. podría autorizar la extracción de agua del acuífero intrabasáltico Guaraní, mediante la perforación de pozos. Véase que dos Ministerios de la órbita del Poder Ejecutivo asumen iguales competencias, sin embargo, por un criterio de que la norma posterior deroga a la anterior en todo lo que no se oponga, hoy quien asume esa competencia en materia de política nacional de aguas es el M.V.O.T.M.A. (Ley 17.930), junto al Poder Ejecutivo. Además, esta norma se integra con la Ley 17.283 que encarga al Ministerio de Vivienda Ordenamiento Territorial y Medio Ambiente (M.V.O.T.M.A.) la aplicación de instrumentos de gestión para la protección del medio ambiente. Un ejemplo de esto es la aplicación de las medidas de impacto ambiental (evaluaciones). Asimismo, se lleva un Registro de las E.I.A. en todas las actividades que pongan en riesgo el medio ambiente. Por otro lado, este Ministerio es quien se encarga de llevar un inventario hídrico de los recursos acuáticos.

Tan importante es su actividad que el M.V.O.T.M.A. envía un informe anual del estado de la situación ambiental al Poder Ejecutivo y al Parlamento. Es más, asume el control y suspensión de aquellas actividades que afecten el patrimonio cultural natural y ecológico del país. En ese sentido, tiene la facultad de imponer sanciones y tomar medidas cautelares para prevenir. Este órgano es la autoridad competente en Uruguay para articular lo relativo al Cambio Climático.

A estos efectos, se creó la Dirección Nacional de Aguas y Saneamiento (DINASA) que fue sustituida por la actual Dirección Nacional de Aguas (DINAGUA). Su cometido principal es la elaboración y articulación de la Política nacional de aguas (que incluye el servicio de saneamiento). Ambas de carácter constitucional y conceptualmente parte de los derechos humanos fundamentales.

Por otro lado, los recursos estratégicos para el Uruguay, donde se puede incluir a las aguas (en términos generales) quedan su salvaguarda en manos de las Fuerzas Armadas del Estado (Ley 18.650 sobre Política Nacional de Defensa). Nótese, entonces, la importancia de un tratado sobre el Acuífero Guaraní y la previsión de un procedimiento de solución pacífica de disputas (que actualmente carece).

Finalmente, esta política nacional de aguas, en pleno cumplimento de la norma constitucional, prevé a través del Decreto 214/000, la Ley 16.466 y el Art. 177 del Código de Aguas que se realizará una audiencia pública a los efectos de oponerse al otorgamiento de algún permiso o licencia que pueda afectar a las poblaciones o algún interés nacional específico. Este procedimiento es netamente administrativo, no judicial, por lo que las garantías de un proceso a efectos de proteger un derecho humano fundamental establecido en la Constitución (Art. 47) quedan desprovistas de las más básicas aspiraciones en materia de derechos humanos. Por otro lado, una apreciación crítica de la disposición del Art. 47 de la Constitución es que no previó de forma equilibrada el uso de los suelos y el riego para la agricultura. Entiendo que se debió prever que el uso de agua para riego que tan importante resulta para la producción

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de alimentos (como derecho básico de ser humano a la alimentación) también es prioritario al igual que el abastecimiento de agua para la población. Ambos intereses van de la mano (se puede aplicar aquí un criterio análogo al de la solidaridad entre generaciones).

Para mayor información:

- www.parlamento.gub.uy
- Leyes:
- 17.283.
- 17.930.
- 16.466.
- 16.858.
- 18.650.
- 17.234.
- Decretos:
- 214/000

## 8. THE GUARANI AQUIFER SYSTEM (GAS) IN THE CONFINED AREA

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This designation (confined area) defines the aquifer that underlies the basaltic lavas of the Arapey Formation. Lithologically, the Guarani Aquifer System (GAS) is composed by sandstones, which present medium particle sizes predominating on fine sizes, and in some cases there are also coarse sand and gravel.

Knowledge about the structure of the aquifer in this region relies heavily on the study of the North Basin aimed at promoting oil exploration, there being a large number of drilling and geophysical studies.

Several geological boreholes during oil exploration campaigns between 1957 and 1958 produced hot springs that gave rise to four spas in the Northwestern territory of Uruguay: Termas del Dayman, Arapey, Guaviyú and Almiron. From a hydrogeological point of view, the first three water wells extract water from the GAS.

From a hydrochemical point of view, waters vary from calcium bicarbonate to sodium bicarbonate and sodium chloride. It can also be noted that the pH values are in the range of 7.7 to 8.3.

Within the confined area the occurrence of thermalism is notorious in the western region, with temperatures reaching 48º C, also presenting artesian zones (flowing wells) due to the geological structure of the aquifer, reaching hydraulic loads on the order of 60 m above the ground level.

Subsequently, new drillings were made, all in a relatively close area, which led to the drafting of Decree No. 214/000, which regulates the management of the GAS in its thermal portion.

### CONCORDIA-SALTO AREA

Under the Project for Environmental Protection and Sustainable Development of the Guarani Aquifer System (2003-2009), agreed between the governments of Argentina, Brazil, Paraguay and Uruguay and financed by the Global Environment Facility (GEF) and the World Bank (WB), a pilot area Concordia-Salto was defined as that extends to both banks of the Uruguay river, which is the international border between Argentina and the Oriental Republic of Uruguay, and is centered in the cities of Concordia and Salto.

This pilot region was selected because of the potential demand due to the exploitation of hot water from the GAS, which should be the great tourist development of Concordia-Salto.

Also, its border location gives it a particularity with regard to the management of groundwater resources.

In this area, there is the largest concentration of population in the Argentina-Uruguay border area, with approximately 200,000 inhabitants.

Topographical elevations of the pilot area range between 30 to 60 meters above sea level in the nearby

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of dividing of waters. The direction of groundwater flow occurs from west to east approx. There are no recharge areas in the pilot area. In fact, the closest recharge area is about 200 kilometres east, and the only discharge is produced by the active deep wells in the pilot area. Due to the depth in which it is located, the temperatures of the water (from the GAS) ranges from 43 to 48 °C.

The performance of geothermal wells is usually 100 to 300 $m^3/h$, with drilling depths up to 1,400 m. Access to the aquifer is expensive for deep wells of at least 1000 meters, which demands high investments.

Water uses from the GAS in Concordia-Salto are mainly in the tourism sector for thermal tourism, health aspects and other economic sectors.

The information related to the Thermal Tourism, shows that five private enterprises (Posada del Siglo XIX (Uy), Aguas Claras (Uy), Hotel Quiroga (Uy) Vertientes de la Concordia (Ar) and Ayuí (Ar)) have their own well while the well-used (concession) by the Termas Dayman Complex (in operation since approximately 60 years) is owned by the Municipality of Salto. Touristic operators point out that the pilot area has been experiencing a great dynamism in terms of diversification of its offer.

In addition, some operators sell water to several establishments, for example, Termas del Daymán sells to Aquamanía, Posta del Dayman and outsourced spa, located within the complex itself.

In most cases, thermal extraction by flowing well occurs and also possesses pumping equipment (just for support, in case of strong demand).

The rules for the extraction of water from wells in Uruguay is regulated by the National Directorate of Water - DINAGUA (see X. Lacues), which grants the permits for such activity, including maximum extraction, pressure, instant flow rate and accumulated flow rate. The effluent control is performed by the National Directorate of Environment (DINAMA).

Another user in the area is the Club Remeros de Salto (Uy), that uses the water extracted from the aquifer basically for sporting purposes, especially for swimming as well as for showers. Water is extracted by upwelling (no pump is used), while the overflow water is poured directly into the Uruguay River. For some activities, such as irrigation of the tennis courts and bathrooms, surface water is used. The club has six facilities (thermal pools), of which two are for sports and four for recreational activities.

## VULNERABILITIES AND MANAGEMENT

The Hydrogeological study conducted under the GAS Project analyzed the vulnerable areas in Concordia-Salto and reached the following conclusion:

The GAS in Concordia-Salto has a considerable depth and is covered by a large basalt aquitard thickness of low permeability. In addition, the piezometric head in the GAS is very high, estimated in the order of 50 m above the surface in some wells. This physical framework ensures that the aquifer is well protected from the impact of surface pollution sources, and therefore the quality of the aquifer is not sensitive to the impacts that may occur due to different land use (industrial, commercial, agricultural or residential).

Therefore, the main problems facing the GAS in this area are linked to:

- Hydraulic interference between neighbouring wells (to date there are already nine geothermal wells in a relatively restricted area), reducing (and in some cases eliminating) the artesian flow. This would lead to higher costs due to the necessary pumping and, in addition, it could also decrease groundwater temperature, which is the main tourist attraction of the area.
- Risk of saline intrusion from south-southeast where the SAG contains thermal water with high salinity of a natural origin.

In addition, many of the thermal spas do not have yet adequate demand management and water use, and

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therefore need to develop, and disseminate to the community, those practices leading to a more efficient use of geothermal water, including its management, such as:

(a) recycling,
(b) cultivating irrigated gardens,
(c) heating of some areas in the hotel facilities,
(d) the reuse and the safe disposal of effluents (particularly if there is high salinity), and

(e) conveniently combine the thermal resource with the cold water of the shallow aquifer for uses that do not require hot water.

There is also an urgent need to define and implement good standardized criteria for design, construction and operation of thermal wells, thus avoiding possible asymmetries between countries. In general, it is necessary to develop the capacity to manage the water and geothermal resources in a coordinated way.


Further information:

- Guarani Aquifer Project publications: http://www.ceregas.org/index.php?option=com_content&view=article&id=16

## 9. PAST, PRESENT AND FUTURE OF THE SALTO/CONCORDIA GUARANI AQUIFER BINATIONAL COMMISSION

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Just 242 kilometres south of the Uruguayan city of Salto lies Fray Bentos, also on the banks of the River Uruguay. Between 2004 and 2010 Fray Bentos and its neighbouring city in Argentina Gualeguaychú witnessed an international dispute over the construction and operation of a pulp mill plant. The dispute ended up before the International Court of Justice, where it was settled in 2010. In those same years, the municipalities of Salto in Uruguay and Concordia in Argentina tell us a different story. Not one of conflict of tension, but one of cooperation. This short piece explores the Salto/Concordia relationship by focusing on the current Salto/Concordia Guarani Aquifer Binational Commission (hereinafter "Binational Commission"), highlighting its origins, current work and future prospects.

### PAST

The seeds of the Binational Commission can be traced to the Guarani Project. The latter ran from 2003 and 2009 and was co-funded by the governments of Uruguay, Argentina, Brazil and Paraguay and the Global Environmental Facility. It was implemented by the Organisation of American States and aimed at developing a better understanding of the science, the socio-economics and the legal and institutional setting of the Guarani Aquifer System. One of the most interesting features of the Guarani Project was the decision to have four pilot projects where work would be undertaken on particularly critical and vulnerable areas of the aquifer. One of these pilot projects was Salto/Concordia, with the others being

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Rivera/Santana do Livramento (also transboundary between Uruguay and Brazil), Riberao Preto in Brazil and Itapúa in Paraguay. Salto/Concordia was chosen for its peculiar socio-economic and hydrogeological characteristics. The Guarani Aquifer is confined and very deep (more than 1000 metres) in this region and its waters are used only for thermal recreational purposes both in Salto and Concordia. Salto, in particular, has developed a very successful leisure business based on spas and other water related activities. There had been no tension over the use of the groundwater and the rationale for setting a pilot project was also conflict prevention.

In the context of the Guarani Project the two cities of Salto and Concordia created a Pilot Project Commission, which was responsible for the activities undertaken throughout the six years of the project. With a dedicated budget line, the Pilot Project Commission was able to successfully launch joint well monitoring programmes, capacity building programmes and an encompassing education programme aimed at providing a wide range of stakeholders (including children in schools) with a better understanding of the importance of groundwater and of the Guarani Aquifer.

## PRESENT

When in 2009 the Guarani Project came to an end there was the serious risk that the positive experience of the Pilot Project would also become a part of history. However, the project has been extremely successful in bringing people together and to build confidence, trust and even friendship between them. This led to an informal bottom up process aimed at keeping the Pilot Project Commission alive. In other words, those who had worked in the Commission saw no reason for it to be dismantled with the completion of the Guarani Project. However, without a dedicated budget line nor an overarching institutional framework, keeping alive the institution was not an easy task. Nevertheless, the city of Concordia passed a Decree establishing the Commission from the Argentinean side and the city of Salto decided to participate since it considered the Guarani Aquifer as key in the framework of its management of thermal waters.

The Binational Commission was so established and comprised also a member from the DINAGUA (the Uruguayan Department of Water Affairs) and the Subsecretaría de Recursos Hídricos (the Argentinean Water Authority), providing it with further legitimacy. The other members were local councilmen and women from Salto and Concordia. From the Salto side municipal representatives of the key sectors of the spa and tourism were included in the Commission. The latter meets as regularly as it can and its main remit is to manage joint monitoring of the wells (there are now 6 in Salto and 3 in Concordia) and to promote education. Wells are jointly monitored twice a year with samples taken to a lab in Concordia and results disseminated to both municipalities and also made available to the wider public on the web. Education is not as active and strong as it was under the Guarani Project, but some projects are still ongoing. It is important to highlight that the Binational Commission does not have any decision making power as to the management of the wells. In other words, groundwater quality and quantity standards are not set by the Binational Commission, and cannot be changed by it. Granting of new licences or revocation of already existing ones is also not something the Binational Commission can do. In other words, its main activity is to collect and exchange information. However, one thing the Binational Commission can do, and has done, is to decide to increase or reduce the frequency in which the wells will be jointly monitored, based on a joint assessment of its results. In fact, in 2015 the Binational Commission has decided to stop joint monitoring the wells twice a year, and move to a reduced frequency, due to the apparent lack of interference between wells on the two sides of the border.

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## AND FUTURE OF THE SALTO/CONCORDIA GUARANI AQUIFER BINATIONAL COMMISSION

Despite the fact that the Binational Commission operates also because of a decree of the city of Concordia, the truth is that it depends mainly on the will of individuals who see value in the work the Binational Commission carries out. This reliance on personal capacity and personal leadership may be seen as a positive characteristic by some, but not by the members who constitute the Binational Commission. They are concerned that, if it is not institutionalised through some sort of formal written document, the Binational Commission may languish and disappear, should the people who constitute it lose interest or not be given time and resources to work on it. If the Binational Commission is to be institutionalised, the cities of Salto and Concordia will be obliged to frame it more formally into their respective political structures. The Binational Commission will be able, or so they believe, to live on any personal circumstances that may occur to specific people comprising it. Whether that is the case is a matter of speculation, but the real question explored elsewhere in this working paper (see the contribution from Juan Manuel Rivero Godoy) is whether institutionalisation of the Binational Salto/Concordia Commission can be done directly by the two municipalities of Salto and Concordia themselves, or whether it requires the involvement of the governments of Argentina and Uruguay. Without giving too much away, the answer probably depends also on the nature of the activities and the powers sought for the Binational Commission.

In conclusion, institutionalised or not, the Binational Commission constitutes an example of good practice in the field of transboundary aquifer cooperation. Collection and exchange of information are the crucial first step towards joint management of a transboundary natural resource, and Salto and Concordia have been doing so for more than years now, previously under the framework of the Guarani Project and currently thanks to the leadership of committed individuals. The real challenge is to ensure that such cooperation continues so that the people and the ecosystems of Salto and Concordia can benefit together of the waters of the Guarani Aquifer System.

For further information:

- Project for Environmental Protection and Sustainable Development of the Guarani Aquifer System, 'Guarani Aquifer Strategic Action Programme' (2009) ('SAP'), found at: http://iwlearn.net/iw-projects/974/reports/strategic-action-program/view
- Information about the Salto / Concordia pilot project (in Spanish) can be found at http://www.siagua.org/sites/default/files/documentos/documentos/piloto.pdf

## 10. A LEGAL COMMENTARY ON THE POSSIBLE INSTITUTIONALIZATION OF THE SALTO/CONCORDIA BI-NATIONAL COMMISSION

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The Groundwater Governance Workshop activities revealed how an informal and non-institutionalized Transboundary Commission works as well as any formal organization. This was shown in particular for the case of the Concordia-Salto Commission (hereinafter the Commission), developed in adherence to the principle of cooperation prescribed in international law. Thus, the question here is to decide whether or not the working Commission should be institutionalized. This is not only a formal question with a legal answer, but it is important in order to achieve national goals in management and governance of renewable resources such as water.

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## WHY INSTITUTIONALIZE?

International law does not provide full solutions to transboundary matters, but it can help to improve this informal Commission by empowering its activities and making them enforceable. However, the Commission has a lack of national government support, which is very important in order to consolidate its outcomes and to obtain funding for projects. Of course, institutionalization is not a guarantee of good performance, but it can be a starting point for governments to commit to cooperative governance and sustainability for both countries. On the other hand, an agreement between Concordia and Salto presents many legal difficulties. First, according to the constitutional and legal arrangements in Uruguay, municipalities are not allowed to sign or ratify International Treaties (Art. 301 of the Constitution). This competence is reserved for the Executive Public Power (hereinafter E.P.P.) who has the authority to sign and ratify international legal instruments that oblige the country into international relations (Art. 168 N°20). Secondly, the Parliament plays an important role in approving the full text of the international agreement (Art. 85 N°7). Finally, the E.P.P. ratifies treaties and its entry into force depends on treaty provisions provided for in the 1969 Vienna Convention on the Law of the Treaties.

## REASONS TO INSTITUTIONALIZE THE BI-NATIONAL COMMISSION

To what extent will the institutionalization of the bi-national Commission of Concordia-Salto make it work better? There is no evidence for this, but an informal institution can face future obstacles. It is not necessarily true that the Commission will come to an end due to the absence of government support. If an international legal instrument institutionalized this Commission, the present activities would become enforceable by both Argentina and Uruguay's governments. Another reason (for Uruguay at least) is to comply with its constitutional provisions. Apart from that, formal institutions receive budgets and funding. This provides a specific guarantee that the Commission can continue its operations. Moreover, a logical argument is behind the likelihood of a treaty that legalizes it can be reached in future international negotiations between both neighboring countries.

The "Guarani" Aquifer Agreement signed by Argentina, Brazil, Paraguay and Uruguay provides that an International Commission shall be established, which will undertake the responsibility to continue working together and to realize the main goals of the Guarani Agreement. Unfortunately, only Argentina and Uruguay have ratified the agreement, while the parliaments of Brazil and Paraguay have doubts. Why? Political or sovereignty issues are supposed to be the answer.

Despite the negative political relations between Argentina and Uruguay in dealing with an international agreement (see the previous conflict about Pulp Mills on Uruguay´s River) I think negotiations can be achieved as soon as possible. There are many reasons for this. First of all, both countries have ratified the Guarani Agreement, thus, a solid base was established for it (to improve the Commission's legal power). For instance, the present Commission does not have the authority to grant or revoke licenses to avoid full depletion of water wells coming from its abuses (such as overexploitation). Specifically, this power, along with the regulation of water quantity and quality, is national responsibility of DINAGUA (Uruguayan Authority of Water). Indeed, a Commission without enforcing powers can only issue non-binding recommendations, which affects the confidence and ability of the Commission to face new challenges in management and sustainability for groundwater and transboundary aquifers. Notwithstanding the magnificent example of cooperation between Concordia and Salto, and the reliance they have on each other through the operation of the Commission, the latter could be

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established through a bilateral treaty between Argentina and Uruguay.

## ADVANTAGES AND DISADVANTAGES OF INSTITUTIONALIZATION

Institutionalization through a bilateral treaty could allow both parties to reach better conditions for groundwater and aquifer governance. If the Commission obtained more powers to pass decisions regarding groundwater governance in both countries, Uruguay and Argentina could make its decisions enforceable through dispute settlement provisions. Moreover, this decision-making body could coordinate all of the national institutions in specific areas (such as land use and planning, sustainability and transboundary cooperation) in both Argentina and Uruguay. The region on both sides of the River has thorough experience in bi-national commissions, with existing commissions including the Administrative Commission of the River Uruguay, and even the Administrative Commission of the River La Plata. Through all these years, cooperation and communication have been successful in both countries, with the exception of the Pulp Mills´ case, the only formal dispute in more than 40 years of cooperation. As previously stated, the Commission works in its current state, and its knowledge must be powered by establishing strong institutions with similar competence as the Guarani Aquifer Treaty foresees for its own commission.

The institutionalization of the Commission is supposed to continue the informal project of Concordia-Salto's current and on-going management. Apart from that, the process of negotiation is a long-lasting political decision and all the effort that both communities (and municipalities) have put in place could be wiped away.

## RECOMMENDATIONS FOR INSTITUTIONALIZATION

First, the informal Commission must continue working as it does today. Second, a full engagement of the national governments in groundwater and aquifer management is required. Accordingly, while both Argentina and Uruguay's diplomatic bureaus meet to exchange information and structure the institutionalization of the Commission, I suggest two approaches. Firstly, the actual functioning of the informal Commission and its people must be kept as it is. Secondly, diplomatic memorandums (exchange of notes) between both Uruguay and Argentina's International Affairs Bureaus can be the bridge, as the first step of institutionalization. International law recognizes the legal force of unilateral acts. This is not a closed debate, but a starting point.

For further information:

- www.parlamento.gub.uy
- www.mvotma.gub.uy

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## PART II – TRANSBOUNDARY GROUNDWATER GOVERNANCE



## 11. THE ROLE OF PUBLIC INTERNATIONAL LAW IN TRANSBOUNDARY GROUNDWATER GOVERNANCE AND THE GUARANI AQUIFER AGREEMENT


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Public international law is an essential component of transboundary groundwater governance. Global and regional conventions and guidelines, as well as *ad hoc* legal mechanisms for transboundary aquifers (TBAs), may provide orientation, certainty, institutional frameworks, enforceable obligations or means for the settlement of disputes. However, the international law of transboundary aquifers it is still in a nascent state, with very recent and underdeveloped global and regional legal frameworks and scant *ad hoc* agreements and arrangements on TBAs. The 2010 Guarani Aquifer Agreement constitutes one example of these very few existing specific legal frameworks on TBAs.

### TRANSBOUNDARY GROUNDWATER GOVERNANCE AND PUBLIC INTERNATIONAL LAW

According to the Groundwater Governance project, groundwater governance is facilitated by an enabling framework and guiding principles. Therefore, the project recommends providing a regulatory framework consistent with the fundamentals of groundwater governance. In addition, it recognizes that TBAs constitutes a special case that requires more efforts to promote cooperation among the jurisdictions involved, starting with building confidence and developing relations between professionals and stakeholders from the neighbouring countries. If the circumstances allow, it recommends negotiating agreements for collaboration over groundwater

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shared across the political boundaries of countries, or of states or provinces forming a federal jurisdiction.

The 1997 UN Watercourses Convention represents one of the few frameworks to include groundwater; this treaty applies to groundwater connected to surface water but has no substantive rules taking into account the particular features of TBAs. Far from being universally accepted, the UN Watercourses Convention to date has attracted only 36 parties. Another agreement, the 2000 Revised Protocol on Shared Watercourses of the Southern African Development Community, is also recent and underdeveloped as a framework. In the context of the UN Economic Commission for Europe (UNECE), the 1992 UNECE Water Convention also applies to groundwater but, despite its global opening in 2013, it still has only a regional, pan-European, scope of application. Another product from the UNECE, the 2012 UNECE Model Provisions on Transboundary Groundwater, provides non-binding guidance on aquifer governance. Finally, the 2008 UNILC Draft Articles on the Law of Transboundary Aquifers constitute the most comprehensive universal legal instrument on TBAs, although the future legal form of this framework is still uncertain. For the time being the Draft Articles and the resolutions of the UN General Assembly regarding the Draft Articles encourage States to make appropriate bilateral or regional arrangements for the proper management of their TBA, taking into account or using as guidance the provisions of the Draft Articles.

In respect of those bilateral and multilateral legal mechanisms addressing specific TBAs, those in existence have a diverse legal nature, status, scope and content. Moreover, the number of legal mechanisms is surprisingly sparse compared with the hundreds of existing agreements on surface water and with the more than 500 TBAs already identified. Apart from the Guarani Aquifer Agreement, which is not yet in force, we can barely find less than a dozen: a) an agreement creating a joint authority for the study and development of the Nubian Sandstone Aquifer System signed in July 1992 by Egypt and Libya and joined by Sudan in 1996 and Chad in 1999, as well as two informal agreements for the monitoring and exchange of data and information on the same aquifer adopted on 5 October 2002; b) an informal agreement on the establishment of a consultation mechanism on the North western Sahara Aquifer System adopted by representatives of Algeria, Tunisia and Libya in December 2000; c) a Memorandum of Understanding (MoU) on the Iullemeden- Taoudeni / Tanezrouft Aquifer System, underlying Algeria, Benin, Burkina Faso, Mali, Mauritania, Niger, and Nigeria, devised on March 2014; d) an agreement on the Al-Sag/Al-Disi Layer adopted by Jordan and Saudi Arabia on 30 April 2015; e) a Convention on the Protection, Utilisation, Recharge and Monitoring of the Franco-Swiss Genevois Aquifer, between the involved local communities from the French and Swiss side, signed in 2007 and that supersedes a previous convention of 1978; or f) other MoUs concluded between subnational entities such as El Paso Water Utilities Public Service Board (USA) and the Junta Municipal del Agua y Saneamiento de Juárez (Mexico), in 1999, or between the State of Washington as Represented by the Department of Ecology and the Province of British Columbia as Represented by the Minister of Environment, Lands and Parks, on the Abbotsford-Sumas Aquifer, in 1996.

## THE GUARANI AQUIFER AGREEMENT

The Guarani Aquifer Agreement is one of the few TBA-related international treaties. It applies to the Guarani Aquifer System (GAS), one of the largest reserves of freshwater in the world that covers an area of more than 1 million $km^2$ beneath the surface of Argentina, Brazil, Paraguay and Uruguay and holds approximately 30,000 $km^3$ of water. Despite the vast extension of the GAS, most of the aquifer is confined, and the areas more likely to present transboundary

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conflicts are those located closely to the international boundaries.

While there is still some lack of knowledge on this aquifer, the level of scientific knowledge increased enormously in the last years mainly as a result of the Project for the Environmental Protection and Sustainable Development of the Guarani Aquifer System (2003-2009). During the development of this project, a draft Declaration of Basic Principles and Action Guidelines for the GAS was approved by its Steering Committee on June 2004. Later the same year, a Guarani Aquifer High-Level Group was established in the context of MERCOSUR with the mandate to elaborate a draft agreement for the management of the GAS. However, a pact could not be reached on key issues such as the dispute settlement mechanism, and negotiations were abandoned in 2005.

Conversely, on 2 August 2010 and after the completion of the GAS project, the adoption of the UNILC Draft Articles and the end of the conflict between Argentina and Uruguay on the Pulp Mills, the four States were able to sign the Guarani Aquifer Agreement during a meeting of the Heads of State of MERCOSUR in the city of San Juan, Argentina. UN General Assembly Resolution 63/124, which annexes the 2008 UNILC Draft Articles, is mentioned in the preamble and most of the provisions of the Draft Articles are also reflected in the articles of the agreement.

The Guarani Aquifer Agreement starts by highlighting the ownership, the sovereign territorial control and the sovereign rights of the Parties over their portions of the GAS. However, that exercise of the sovereignty must be in agreement both with the applicable international law and the reasonable and sustainable uses criteria, respecting the obligation of not causing significant harm to the other Parties or the environment. It also establishes general obligations of: a) promoting the conservation and environmental protection of the GAS as to ensure multiple, reasonable, sustainable, and equitable use of its water resources; b) exchanging technical information about studies, activities and works that contemplate the sustainable utilization of the GAS or that may have effects on the aquifer beyond its boundaries; and c) establishing cooperation programs with the purpose of extending technical and scientific knowledge. It also includes more specific provisions such as the obligation the Parties to cooperate in the identification of critical areas, especially boundary areas that require specific treatment measures. Further, a Commission for the coordination of cooperation on the aquifer is designed in the framework of the Plata River Basin. Lastly, the agreement establishes a mechanism of dispute settlement based on direct negotiations, recommendations of the aforementioned Commission and an arbitration procedure to be designed by an additional protocol to the agreement.

It should be highlighted that this Agreement was concluded in the absence of noteworthy problems or conflicts over the aquifer, representing, therefore, a preventive and precautionary approach to the management of this TBA. Nevertheless, it has only been ratified by Argentina and Uruguay so far. Consequently, only time will tell if the agreement will be finally in force, implemented and able to effectively manage and protect the GAS.

For further information:


- English version of the Guaraní Aquifer Agreement available at: http://faolex.fao.org/docs/pdf/mul-143888English.pdf
- Movilla Pateiro, L. (2014). El Derecho Internacional del Agua: los Acuíferos Transfronterizos. J. M. Bosch Editor.
- Sindico, F., & Hawkins, S. (2015). The Guarani Aquifer Agreement and Transboundary Aquifer Law in the SADC: Comparing Apples and Oranges? *Review of European, Comparative & International Environmental Law*, 24(3), 318-329.
- Sindico, F. (2011). The Guarani Aquifer System and the International Law of Transboundary Aquifers. *International Community Law Review*, 13(3), 255-272.

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- Villar, P. C. and Ribeiro W. C. 2011. The Agreement on the Guarani Aquifer: a new paradigm for transboundary groundwater management? *Water International*, 36 (5), 646-660.


## 12. LEADERSHIP IN TRANSBOUNDARY AQUIFER GOVERNANCE


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Governance of transboundary aquifers can be complicated by many factors. By their very nature, aquifers are generally hidden from sight, sheltering their water resources in geologic rock formations beneath the surface of the planet. Resources that cannot be seen can easily be subjected to overexploitation, much as the ocean's riches are being depleted with little indication on the surface of the dwindling fish stocks. With transboundary aquifers, nations sharing the aquifer can construct wells and bore holes without the drilling operations being seen by other parties. The first indication that the water is being extracted might come when water tables begin to drop and deeper wells have to be dug.

Very few transboundary aquifers benefit from any kind of governance regime. Of the more than 400 transboundary aquifers that have been identified, only four are the subject of fully ratified agreements – the Franco-Genevese Aquifer, the Nubian Sandstone Aquifer System, the North-Western Sahara Aquifer System, and, recently, the Disi Aquifer. Thus, the vast majority of transboundary aquifers do not have bi-national or multi-national controls over their usage. Without such controls, nations can become dependent on the groundwater beneath them to serve vital human needs and quench thirsty ecosystems. Once this dependence is established, imposing restrictions on withdrawals in order to preserve the resource may be very difficult to achieve.

In order for an aquifer to be properly governed, data and other information regarding the geological characteristics, recharge and discharge rates, volumetric capacity, and annual extractions must be produced and shared. Unconfined aquifers are particularly vulnerable to contamination from urban runoff and agricultural pollutants, and information about aquifer flow rates and direction would help to direct polluting activities away from sensitive areas. Some nations do not have the financial resources to conduct the studies necessary to produce such information. Some do not have the capacity to know how many bore holes tap into an aquifer and what the rate of withdrawal is. In some cases, nations may consider information about the aquifer to be a matter of national security, to prevent neighbors from becoming aware of the extent of fresh water resources.

Given these social and political challenges, how can effective governance of transboundary aquifers be achieved? As with almost all human endeavors, finding solutions depends on leadership, for without leadership, no group effort can begin or succeed. Leadership in transboundary aquifers can take several forms.

Leadership may begin at the very top echelons of government, where ministers of environment, agriculture or natural resources determine that a shared aquifer should be managed in order to be protected and preserved for future needs. These ministers may become aware of the vulnerability of an aquifer from their constituents, which could be their citizens, their industrial or agricultural sectors, their scientists, their regional or city water managers or some combination of all of them. Alternatively, they might have become aware of the need to manage the

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aquifer from a neighboring country that shares the aquifer, or from outside third parties. When leadership starts at the top, solutions can often be quickly crafted, but they may not always fit the unique needs of a particular region or locality.

Leadership can also start at the local level. Citizens on both sides of a border may realize the importance of an aquifer to their local communities and economies. Community leaders and elected officials may decide to direct their limited resources to gathering and sharing information on the aquifer characteristics and usage. They may also decide to form a commission to act as a receptacle for information, and also as the director of usage and protective actions. When governance is led from the local community, solutions often meet the precise needs of that community and thus will probably be more readily accepted by the populace. The Franco-Genevese aquifer agreement is an example of local communities coming together to manage an aquifer. The Community of the 'Annemassienne' region, the Community of the 'Genevois' Rural Districts, and the Rural District of Viry – all French -- and the Republic and Canton of Geneva in Switzerland crafted an agreement in 2007 that replaced another agreement from 1977. Under the agreement, an aquifer in Switzerland is artificially recharged and the French communities have the right to withdraw water in return for sharing the costs. Another example of local leadership can be found in the cities of Salto, Uruguay, and Concordia, Argentina. These two cities lie across the Rio Uruguay from each other and share the Guarani Aquifer. Although an initial formal program for joint management and data sharing expired, a bi-national commission still meets regularly and works together on outreach programs and management issues.

However, there are several drawbacks to leadership from local communities. First, the adopted solutions and frameworks may be perfectly tailored for that locality, but may not work well in other regions of a large transboundary aquifer. Further, human and financial resources for necessary activities may be minimal and temporary at the local level, whereas involvement of the regional or national government could enhance support. Finally, in a large aquifer and one shared by more than two nations, a local solution achieved by two cross-border localities will not have the broad impact that may be required to preserve the resource.

In addition to top-down national leadership and bottom-up local leadership on transboundary aquifer governance, leadership can also be provided by international bodies such as the Global Environment Facility (GEF), the UN Educational, Scientific and Cultural Organization (UNESCO) and the Observatory of the Sahara and Sahel (OSS). These organizations have played vital roles in funding studies, as GEF did for the Guarani and the Iullemeden transboundary aquifers, and in providing data about global transboundary aquifers, as UNESCO has done through Internationally Shared Aquifer Resources Management (ISARM), a programme jointly led with the International Association of Hydrogeologists (IAH). OSS is a regional organization that has served as a coordinating agency for the North-Western Sahara Aquifer System.

In the end, any project needs a leader, and transboundary aquifer governance initiatives are no different. Whether leadership is found at the national, local and/or international levels, an idea usually starts with one or more similarly-minded and dedicated people and then grows organically and synergistically. With water crises looming and so few governing regimes existing for the many transboundary aquifers, the world needs leadership in transboundary aquifer governance at every level and from every sector.

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For further information:

- Franc-Genevese Aquifer Agreement: Convention relative à la protection, à l'utilisation, à la réalimentation et au suivi de la nappe souterraine franco-suisse du Genevois (hereinafter "2007 Franco-Swiss Aquifer Convention"), EIF 1 January 2008, the Community of the 'Annemassienne' region, the Community of the 'Genevois' Rural Districts, and the Rural District of Viry and the Republic and Canton of Geneva, *available at* http://internationalwaterlaw.org/documents/europe.html#Franco-Swiss%20Genevese%20Aquifer
- GEF: https://www.thegef.org/gef/category/keywords/aquifers
- ISARM: http://isarm.org
- Observatory of the Sahara and Sahel: http://www.oss-online.org/en

## 13. TRANSBOUNDARY GROUNDWATER LAW AND GOVERNANCE IN THE ANTHROPOCENE

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Some of the many challenges that confront sustainable and effective transboundary groundwater governance include:

- groundwater as an object of governance is mostly unobservable and it is difficult to quantify, to describe and to measure;
- this unobservable resource, where it traverses several borders, is subject to diverse legal regimes and governance approaches and jurisdictions, rendering a unified, consistent and focused regulatory response virtually impossible;
- groundwater is increasingly being threatened by a host of expanding anthropogenic impacts, ranging from climate change, industrial and agricultural developments, increased human settlements and other human-induced Earth system changes;
- Compared to other global environmental governance concerns such as climate change and biodiversity, the global normative and institutional framework related to transboundary groundwater resources is relatively underdeveloped and it arguably does not fully respond to the complexities of the resource in question.

These challenges are explicated by and, more worryingly, are set to be considerably exacerbated, in the possible new geological epoch of the Anthropocene. The Anthropocene was introduced by Eugene F. Stoermer and Paul J. Crutzen in 2000 as a term of art expressing the geological significance of anthropogenic change. Emphasising the central role of mankind as a major driving force in modifying the biosphere, the term Anthropocene suggests that the Earth is rapidly moving into a critically unstable state, with Earth systems gradually becoming less predictable, non-stationary and less harmonious as a result of the global human imprint on the biosphere. In the Anthropocene, humanity has become a geological agent in much the same way as a volcano or meteor—able to change the Earth and its systems, and possibly even to cause a mass extinction.

More specifically, in the Anthropocene humans are significantly altering biogeochemical, or element cycles, such as nitrogen, phosphorus and sulphur that are fundamental to life on Earth; as well as causing unprecedented modifications of the water, energy and biological cycles. Virtually all global environmental indicators have been rising exponentially, showing that the Earth system has clearly moved outside the envelope of Holocene variability (still officially the current geological epoch). These indicators suggest major deterioration in all respects, including: an increase in greenhouse gas concentrations; rising ozone depletion; rising Northern hemisphere average surface temperature; an increase in the frequency of

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great floods; depletion of ocean ecosystems including fisheries; a rise in annual shrimp production as a proxy for coastal zone alteration; a rise in nitrogen with respect to coastal zone biogeochemistry; sustained loss of tropical rain forest and woodland; a rise in the amount of domesticated land; increased global biodiversity loss measured as the rate of species extinction; and expanding inter- and intra-species hierarchies and accompanying injustices. While many of the foregoing activities also impact or are related to groundwater resources, the total extent of the human impact on groundwater quantity and quality remains difficult to determine. It has, however, since become clear that Anthropocene activities such as agricultural development, including irrigation and application of chemicals to cropland; urban and industrial development; drainage of the land surface; modifications of river valleys and catchment areas, including construction of levees, reservoirs and removal of natural vegetation; and modifications to the atmosphere, are significantly impacting groundwater resources.

With respect to the diverse local, national, regional and international laws and governance regimes that directly and indirectly focus on groundwater as a crucial component and consideration of the Earth system, the Anthropocene invites a holistic perspective on a globally interconnected and reciprocally related Earth system, Earth system changes, and the connection between the Earth system, its changes and the increasingly globalized human social system and the impact of humans on the Earth system. Part of the imagery that the Anthropocene offers consequently requires an expanded spatial cognition of what the Earth and its systems are, of global Earth system transformations, how Earth systems are connected globally, and how an increasingly integrated global human society is related to, dependent on, and how it impacts the Earth system. This global imperative of the Anthropocene demands not only localized regulatory interventions, but also global ones which transcend borders and which are sensitive to cause-and-effect relationships in the Earth system: the arrival of the Anthropocene arguably requires of us to start thinking about law, politics and social ordering in planetary terms, which necessarily will include the aspect of transboundary groundwater.

One way to think about the law and governance revolving around transboundary groundwater resources in planetary terms is through the lens of Earth system governance. Recognizing the connectivity, nonlinearity and complexity of socio-ecological processes, Earth system science is concerned with the study of the Earth's environment as an integrated system in order to understand how and why it is changing, and to explore the implications of these changes for global and regional sustainability. Fundamentally rooted in Earth system science, Earth systems governance has been developed as a reactive counter-narrative to localized, state-based and narrowly focused regulatory approaches to environmental issues through the trite application of an issue specific environmental governance regime that focuses on pollution control, nature conservation and wildlife, among others, and that predominantly employs formal, state-based law and state institutions. It is a way of thinking about global governance which recognizes that groundwater pollution in Uruguay, for example, is not only a matter of increased industrial activities in that country; it is also a matter of water, climate industry and agricultural governance in the whole of South America; it impacts everyone everywhere in that region and could be addressed by multiple state and non-state actors through a whole range of regulatory interventions of which law is only a small, but crucial, part.

With reference to a more open, holistic, flexible, multi-scalar and multi-actor regulatory approach that is better able to capture and address the many complex global developments that transform the bio-

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geophysical cycles and processes of Earth, the complex relations between global transformations of social and natural systems, and the multi-scale consequences of ecological transformation, Biermann *et al* (see below for references and further reading) define Earth system governance as the interrelated and increasingly integrated system of formal and informal rules, rule-making systems and actor networks at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating and adapting to global and local environmental change and, in particular, earth system transformation.

Because law is particularly adept at steering human behavior, it is a crucial aspect of Earth systems governance. Any Earth system governance-based regulatory response, including its juridical elements, must respond to persistent Earth system uncertainty; nurture new responsibilities and modes of co-operation as a result of inter- and intra-generational, spatial and socio-ecological interdependence between people, countries, species and generations; respond to the functional interdependence of Earth systems and Earth system transformations; respond to the needs of an increasingly integrated globalized society; and respond to extraordinary degrees of socio-ecological harm. It is proposed that any vision of the existing transboundary groundwater governance law and governance regime, including possible future revisions thereof, must fully account for and be sensitive to the imperative of Earth systems governance within the context of the Anthropocene.

Further Reading:

- http://groundwater.sdsu.edu/
- http://pubs.usgs.gov/circ/circ1139/pdf/part2.pdf
- Frank Biermann "'Earth System Governance' as a Cross-cutting Theme of Global Change Research" 2007(17) *Global Environmental Change* 326-337; and more recently, Frank Biermann *Earth System Governance: World Politics in the Anthropocene* (MIT Press, 2014)
- Frank Biermann "The Anthropocene: A Governance Perspective" 2014 1(1) *The Anthropocene Review* 57-61 at 59
- Frank Biermann "'Earth System Governance' as a Cross-cutting Theme of Global Change Research" 2007(17) *Global Environmental Change* 326-337 at 329-330.
- Louis Kotzé "Rethinking Global Environmental Law and Governance in the Anthropocene" 2014 32(2) *Journal of Energy and Natural Resources Law* 121-156.
- Louis Kotzé *Global Environmental Constitutionalism in the Anthropocene* (Hart Publishing/Bloomsbury, Oxford- to appear summer 2016)

## 14. TRANSBOUNDARY GROUNDWATER AND ENVIRONMENTAL JUSTICE

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### INTRODUCTION

Groundwater governance (GWG) can be understood as comprising the overarching formal and informal institutional frameworks that shape decision-making over how groundwater resources are managed and used. *Transboundary* GWG refers to those frameworks that apply to groundwater resources that transcend political boundaries. The way in which these frameworks are constructed creates implications for those impacted by the way groundwater is managed. Since the consequences of these decisions can create winners and losers both sides of a border, establishing a GWG framework is inherently political. Yet, transboundary issues focus primarily on cooperation between political entities without attention to the distribution of benefits and burdens within those entities.

Environmental justice is concerned with the undue imposition of environmental burdens on parties that are not involved in the activities generating such burdens. Thus, the concept of environmental justice

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can draw attention to overlooked political dimensions of governance that impact stakeholders on the ground. In this light, this brief uses Schlosberg's environmental justice framework to explore these patterns in transboundary GWG, based on the Groundwater Governance Project's (GGP) 'Framework for Action' (FFA). Schlosberg's framework emphasises the importance of three overlapping components for environmental justice: *equity* in the distribution of environmental risk, *participation* in political processes for decision-making, and *recognition* of the diversity of the experiences in affected communities. This brief argues that careful attention to these elements is essential for fulfilling the GWG action points, particularly for *building effective institutions.*

## EQUITY

The GGP's FFA describes GWG as comprising the enabling framework and guiding principles for management of groundwater in line with society's goals, which includes the principle of equity, and should be achieved through laws and regulations. In the literature, justice is largely considered a question of equity in the distribution of social goods. In the context of GWG, this refers to the distribution of groundwater, or benefits derived from groundwater use. Indeed, as a question of allocation and distribution, equity is usually determined through various legal regimes from common property systems to private property rights. However, the FFA suggests that the practice of using groundwater as a non-exclusive good is inconsistent with equity, and as such groundwater should be brought into the public domain. Yet, the meaning of equity is not defined in the FFA. As a legal principle, equity is a tool for interpretation on a case-by-case basis. The principle of equitable and reasonable use in the United Nations Watercourses Convention contains a list of factors relevant for its interpretation, as opposed to a fixed definition and criteria.

It is therefore important that there exists a forum for deliberation around the plethora of justice and equity claims, in order to fairly determine distributive outcomes. Accordingly, the question of equity does not ask merely what distribution looks like, but what determines those distributions. In the transboundary context, this determination is usually decided between political entities (e.g. states) based on the interests of those entities, rather than the interests within them. In the international context, trust is placed in states to distribute within their jurisdiction, after the fact of transboundary distribution. As such, a gap exists in the deliberative processes determining equitable distribution between transboundary stakeholders within the structures of groundwater regulation within the public domain. Schlosberg, drawing upon the key works of Iris Young and Nancy Fraser, calls for the procedural approaches of participation and recognition in preventing distributive injustice. The way in which this occurs in transboundary contexts must be considered more closely from an environmental justice perspective.

## PARTICIPATION

The FFA emphasises stakeholder engagement as integral to building effective institutions. Indeed, decisions can become more widely accepted when there is satisfaction with the decision-making process, making participation integral to increasing an institution's perceived legitimacy. However, it is important to recognise that participatory processes can be undertaken ritualistically and through manipulative methods, serving only to uphold the status quo of top-down governance behind the rhetoric and techniques of participation. This 'rubberstamp' application is one of many issues and barriers to the success and value of participatory approaches including the potential to disempower, exclude and oppress participants and the public. Superficially applied forms of participation may merely maintain the *appearance* of community

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involvement as 'tokenism'. The FFA's call for participatory mechanisms is therefore only one step forward from an environmental justice perspective, with potential for the interpretation and implementation of these processes to take two steps back for certain stakeholders.

Schlosberg argues that to achieve environmental justice, participation must take a form of citizen deliberation that is inclusive of interests that are traditionally excluded, including that of the environment. The question of participation is therefore not only 'what participation?' but 'whose participation?' In answer to these questions, Schlosberg's framework emphasises that participation and equity are interrelated and interdependent with the principle of *recognition*.

## RECOGNITION

Recognition is concerned with the inclusion and exclusion of people in society; it prescribes who is entitled to make justice claims. While the FFA recognises the importance of stakeholder engagement for legitimate institutions, there lacks acknowledgment of the diversity and power asymmetries between stakeholders. Stakeholders can be defined as any individual, group, organisation or political entity with an interest or stake in the outcome of a decision. Thus, 'stakeholders' can range from indigenous communities to cities, and from small-scale farmers to large agri-business, all with varying degrees of power and influence in decision-making processes, as well as varying degrees of interest and 'stake' in the resource.

The FFA stresses inclusion of *all* stakeholders, reducing the risk that 'stakeholder engagement' can be satisfied with the engagement of a few to the exclusion of others. In addition, the FFA does recognise certain groups that require broad-based representation within groundwater management associations, including indirect groundwater users, potential polluters, commercial associations and environmental/ecological groups. However, the collective grouping of stakeholders as separate actors from the institutional structures for decision-making fails to recognise the level to which some stakeholders are already included or excluded in society, and their existing influence notwithstanding formal gateways for engagement. Moreover, it fails to appreciate the need to be consciously inclusive of the interests that are typically ignored. The result is likely to lead to continued exclusion of those stakeholders that are marginalised and disenfranchised, under the guise of inclusive decision-making processes.

## CONCLUSION

The GWP's FFA is a necessarily vague document in order to be applicable to the broad range of contexts and scenarios for GWG across the globe. Yet, the FFA provides an influential basis for implementation, carrying implications of injustice that can result through the wide interpretation of vague language and popular 'buzzword' principles. In particular, one must be aware of the nuances that exist in terms such as 'stakeholder engagement', 'participation', and 'equity'. The processes involved in GWG are political, and require placing value on certain uses and users when creating a framework that considers competing claims. This is particularly problematic in the transboundary context that creates jurisdictional frontiers that do not necessarily match the hydrogeological boundaries and social/political arrangements for groundwater use.

Ultimately, if one is concerned about the impacts on the marginalised and disenfranchised as a result of the decisions of the few, an environmental justice perspective can help in promoting the building of effective institutions set out in the GGP's FFA by drawing attention to overlooked political dimensions of governance and their impacts on the ground. This brief analysis shows that environmental justice provides guidance for interpretation of the vague language in the FFA, which can finally help achieve

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greater credibility and legitimacy in its implementation. Future research that applies this framework to specific local cooperation hotspots over groundwater can facilitate the development of institutional frameworks that not only fulfils the goal of addressing GWG gaps, but which does so in a credible way to minimise injustice.

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## 15. HYDROPOLITICAL DYNAMICS AND GROUNDWATER GOVERNANCE IN THE CASE OF THE GUARANI AQUIFER SYSTEM


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### INTRODUCTION

This short paper explores the governance and institutions of the Guarani Aquifer System through the lens of critical hydropolitics and specifically through the framework of hydro-hegemony. This paper argues that it is necessary to consider the power asymmetries, inter-sectorial interests, and the broader geopolitical context in order to understand the current water governance around the Guarani Aquifer System. However, this paper only provides initial analysis that could be further developed in further research.

First, this paper presents the context of the Guarani Aquifer System, discussing the current institutional governance around the aquifer. Second, it presents the framework of hydro-hegemony adopted as a theoretical framework for the analysis of this case. Finally, it discusses the current governance through the lens of the theoretical framework.

### CONTEXT OF THE GUARANI AQUIFER SYSTEM

The Guarani Aquifer System is a transboundary renewable aquifer shared by four countries: Argentina, Brazil, Paraguay, and Uruguay. Current arrangements of governance for the aquifer system include the Guarani Aquifer Agreement, which was signed in 2010 by the governments of Uruguay, Argentina, Paraguay and Brazil, but is not yet in force as it has been ratified only by Argentina and Uruguay. The Guarani Project, co-funded by the four countries and the Global Environmental Facility, was implemented by the Organisation of American States and ran from 2003 till 2009. Among its main achievements were four pilot projects of bilateral commissions at the local level for the monitoring, exchange of data, and promotion of joint projects in four areas. Among those, the bi-national Argentinian-Uruguayan Salto/Concordia Commission on the Guarani Aquifer System is one of the few examples worldwide where the transboundary aspects of groundwater governance are being dealt with by two local communities through an ad-hoc institution. The commission has so far worked mainly on monitoring of the aquifer and data collection. The commission is still functional beyond its term, and works as an informal institution promoting informal transboundary water cooperation between the two cities.

### FRAMEWORK OF HYDRO-HEGEMONY

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Within hydropolitics, which is the study of water politics, a recent body of literature has developed within the last decade known as critical hydropolitics. It is critical, in the sense that it differs from the mainstream hydropolitics by considering cooperation and conflict over water as co-existing and by focusing on the role of power asymmetries by riparian states in order to explain current allocations and institutional arrangements over transboundary water resources.

The Framework of Hydro-Hegemony (FHH) developed by Zeitoun and Warner is a key theory of the critical hydropolitics literature, and it considers three main elements in order to analyse and explain outcomes of water allocation within a basin. The three elements are: geographical position, power asymmetries, and exploitation potential. The framework has been developed and applied to surface water resources, and therefore geographical position and power asymmetries played a major role within the framework. In the case of transboundary aquifers, I argue that geographical position has a relatively less relevant role compared to when the framework is applied to surface water resources. The elements of the geographical position that need to be considered in the analysis of aquifers are: extension of the aquifer, where the recharge and discharge areas are, and the depths in the different areas of the aquifer. Power asymmetries are relevant for both surface and groundwater resources. However, exploitation potential, which is often overlooked in the analysis of surface water resources, is important in the case of deep aquifers. In fact, technology and economic resources are necessary in order to identify and exploit groundwater resources from deep aquifers. In addition, availability of data is also an important element that should be accounted for in the FHH when it comes to aquifers.

## GEOPOLITICAL DYNAMICS

This section provides an incomplete mention of the geopolitical dynamics of the four countries sharing the aquifer. Among the four countries that share the Guarani Aquifer System, Brazil is the most powerful. Brazil appears as a regional leader concerning natural resources, economic growth, military power, and economic-political alliances. Relations between Brazil and Uruguay are solid, the trade relations are strong, and their border is also known as the “peaceful frontier.” There are close relations between Brazil and Uruguay in several sectors, including trade, local commissions for cooperation on sanitation, and a special agreement on free movement of people that live in proximity of the frontier. Relations have been consolidated in the past years because of the current ruling governments with similar ideological values. Uruguay is weaker than Argentina and Brazil, and has always played the role of the ‘buffer’ between Brazil and Argentina. Uruguay has good bilateral relations with them. Paraguay is the weakest of the four countries. Brazilians own about a third of Paraguayan farmed territory, and Paraguay is strongly influenced by Brazilian politics. Paraguay is also a close ally of the US, and the latter has many military bases located in Paraguay, specifically over the recharge area of the aquifer. Finally, Argentina lost power in the region in the past decade due to the economic crisis and its economic protectionist current policies. Nevertheless, after Brazil it remains a powerful geopolitical actor in the region.

## DISCUSSION

The current institutional arrangements for the Guarani Aquifer governance, as seen in the first section, include an agreement, which however has not been ratified by all parties.

Formal cooperation is difficult among all riparian states, but informal cooperation not affecting the interests of the most powerful country is possible and successful for data collection, exchange, and for monitoring. However, Brazil, which is the most powerful actor in the region, emerges as the key state in order to push forward and increase the formal

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cooperative relations over the shared aquifer. This emerged when the agreement was signed after renegotiation and the decision to remove the clause concerning disputes settlements mechanisms, which Brazil strongly opposed.

Nevertheless, as shown in Francesco Sindico's contribution, cooperative arrangements, both informal and formal, can be established either bilaterally or at the municipality scale. At the local scale it is easier to establish institutions and cooperative measures for monitoring of the aquifer and projects of water conservation through educational programmes on raising awareness. In fact, at the local scale it is often about leadership and vision of local individuals rather than state interests (see the contribution from Renee Martin-Nagle). This has happened at the municipal level also along the Jordan River Basin, but as in the case of the Jordan River Basin, it does not mean overcoming power asymmetries and conflictual relations at the state level. Nevertheless, as showed by the Guarani Salto-Concordia Binational Commission, it can have results especially on water conservation and data exchange.

Finally, this short paper has also highlighted the relevance of the exploitation potential pillar in the FHH when considering deep aquifers. In the case of the Guarani Aquifer System, which reaches a depth of over 1,000 meters in regions like Salto/Concordia, having the possibility to identify the groundwater resources, dig a well, and pump the groundwater in order to exploit it is central to explain outcomes of water allocation.

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## 16. LA GOBERNANZA EN AGUAS SUBTERRÁNEAS TRANSFRONTERIZAS: UN CAMINO POSIBLE EN LATINOAMÉRICA


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### GOBERNANZA PARA LAS AGUAS TRANSFRONTERIZAS

¿Cuántos acuíferos transfronterizos existen en América Latina? ¿Cuáles son las características y condiciones de los mismos? ¿Cómo se gestionan? ¿Cuáles son los problemas que enfrentan los países involucrados? ¿Qué mecanismos habilitan la previsión, manejo y resolución de los posibles conflictos?

Las respuestas a estas preguntas requieren completar información ya existente, abordaje multi e interdisciplinario y fundamentalmente mente abierta y espíritu creativo para sondear en los instrumentos legales e institucionales nacidos a nivel nacional e internacional y en las propias experiencias conocidas en Latinoamérica y actuar en consecuencia.

El concepto de gobernanza proveniente de la economía y tomado por la sociología de las organizaciones aludió inicialmente a la gestión de la complejidad territorial, en racionalidad y equidad de los bienes comunes.

La gobernanza refiere a la conciencia de que los asuntos públicos no pueden ser tratados sólo verticalmente; a la presencia de multiplicidad de actores diversos que intervienen en la actividad pública; la necesidad de las instituciones de

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desempeñar otros roles tales como facilitador, estratega, animador, regulador; la necesidad de cooperación amplia entre todos los actores porque nadie posee la totalidad del conocimiento y la necesidad de comprometerlos progresivamente a desarrollar nuevas formas de acción pública y de surgimiento de normativas.

Desde el punto de vista jurídico, la gobernanza ofrece instrumentos procedimentales que colaboran para la concreción de un conjunto de principios directores ya muy conocidos en materia ambiental tales como integración, prevención, precaución, poluidor-pagador. Aún más importante, la gobernanza apunta a paliar en parte las impotencias de los Estados y las instituciones y mejorar la cohesión territorial.

La gobernanza comprende en su núcleo información y participación; incertidumbre científica y jurídica que evidencia la importancia de la expertise in situ; motivación, fundamentación de los actos jurídicos; mediación y modos alternativos de resolver conflictos; evaluación periódica de las políticas públicas, y la concertación para la intervención.

Bajo esta concepción la gobernanza proporciona el adecuado paraguas de actuación en relación a las aguas subterráneas transfronterizas.

En los últimos años con carácter generalizado a nivel de los países en América Latina en cuanto a lo ambiental y en materia de aguas concretamente, se ha producido una inflación normativa que se traduce en multiplicidad de órganos, agencias, institutos variados que a partir de competencias verticales sectoriales intervienen en un mismo territorio y sobre un mismo bien común (aguas), basados en objetivos, intereses, valores o aun culturas disímiles, susceptibles de conllevar a una crisis de autoridad y no credibilidad por parte de los ciudadanos. ¿Cómo superar dicha crisis de confianza?

## EN BÚSQUEDA DE UN CAMINO

La Res. A63/124 del 11/12/08 de la Asamblea General de ONU relativa al derecho de los acuíferos transfronterizos en tanto su carácter de Recomendación, señala los criterios guía para transitar el camino en procura de acuerdos entre países con acuíferos transfronterizos. La resolución basada en el Capítulo IV del Informe de la Comisión de Derecho Internacional invita a los Estados a concertar arreglos bilaterales y regionales para la apropiada gestión de sus acuíferos transfronterizos sobre la base de los principios enunciados en la misma.

Particularmente destaca entre otros, los principios de utilización equitativa y responsable; la obligación de no causar daño sensible y de cooperar; intercambiar datos e información; proteger y preservar los ecosistemas situados en sus acuíferos o dependientes de los mismos; prevenir, reducir y controlar la contaminación; ejercer la vigilancia; elaborar y ejecutar planes para la gestión; notificarse entre los Estados en caso de actividades proyectadas susceptibles de causar efecto negativo sensible en otro Estado y proporcionar los datos técnicos y estudios de impacto ambiental; la cooperación técnica con Estados en desarrollo.

El Acuerdo sobre el Acuífero Guaraní (02/08/10) alcanzado por Argentina, Brasil, Paraguay y Uruguay constituye una demostración de “aterrizaje” de las recomendaciones antes mencionadas. El Acuerdo estuvo precedido y abonado por el trabajo desarrollado entre 2003 y 2009 en el marco del Proyecto para la Protección Ambiental y Desarrollo Sostenible del Sistema Acuífero Guaraní cuyo corazón fue la cooperación entre los países. El Proyecto tuvo siete componentes: Expansión de la base del conocimiento científico y técnico; Instrumentación conjunta de un Marco para la Gestión basado en un Plan Estratégico de Acción; Fomento a la Participación Pública; Evaluación y Seguimiento; Medidas para la Gestión de las aguas subterráneas y para la Mitigación de Daños en áreas críticas; Consideración del potencial para la utilización de energía geotérmica limpia; Coordinación y Gestión. Como productos

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visibles del proyecto se formó el Sistema de Información Georreferenciado del acuífero Guaraní, la Red de Monitoreo y Modelación Matemática en locales específicos, el Grupo de Fomento a la Gestión Local, y la Capacitación y Difusión del conocimiento técnico.

Dos de los cuatro pilotos del Proyecto son de carácter binacional: Rivera en Uruguay - Santana en Brasil y Salto en Uruguay - Concordia en Argentina. El proyecto Salto -Concordia, y en especial el desempeño de su Comisión binacional dan testimonio de productiva cooperación técnica local, habiendo logrado intenso intercambio y acordar y realizar conjuntamente el monitoreo del acuífero. En tal sentido constituye una muestra de cooperación internacional en materia de acuíferos transfronterizos, cimiento de adecuadas bases de gobernanza, como asimismo un llamado a la acción multinivel para el diseño de políticas públicas para la gestión integrada de las aguas.

En América Latina, varios estudios emprendidos desde el Programa Hidrológico Internacional /UNESCO, tales como la Evaluación Preliminar de los Sistemas Acuíferos Transfronterizos en las Américas (2007), los Aspectos legales e institucionales para la Gestión de los Acuíferos Transfronterizos de las Américas (2008), la Estrategia para la Evaluación y Gestión de los Sistemas Acuíferos Transfronterizos(2015) dotan de valiosa información y material para la búsqueda y posterior diseño de acuerdos entre los países.

El camino a transitar en cuanto a la gobernanza de los acuíferos transfronterizos se presenta pleno de desafíos y oportunidades. El ejemplo de lo alcanzado con el Acuerdo sobre el Acuífero Guaraní parece ser una luz para alumbrarlo.

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## 17. INSTITUTIONALISING TRANSBOUNDARY AQUIFER GOVERNANCE: A PROCESS OF DESIGN OR BRICOLAGE?


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This short article points both to the interesting questions transboundary aquifer governance pose to the concept of "institutional bricolage", as well as how the concept itself provides a useful means of better understanding how such arrangements emerge and evolve. Here I highlight how a bricolage lens draws attention to the workings of power, structure, and agency, and their relationship to processes for institutionalising transboundary aquifer governance.


### INTRODUCTION

The idiosyncrasies of groundwater make governing it a particularly complex challenge. A key issue is the hidden nature of the resource, where it is not easy or sometimes even possible to gauge its properties with any real certainty. Yet at the same time, the strategic importance of groundwater has become increasingly apparent given, for example, the large and uncertain threat posed by climate change and the need to supply dispersed rural communities in developing countries with a safe and reliable water supply. However, an added layer of complexity emerges when one considers those aquifers that span international borders or state jurisdictions. In such instances, the already challenging nature of groundwater

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governance takes on a different complexion as a raft of transboundary factors come into play.

Among the factors characteristic of transboundary aquifer governance are the sovereign interests of the different nation states in question, including their claim to manage their portion of the aquifer in accordance with national interests or goals; different legal and administrative systems; different forms of data and levels of scientific understanding of the resource; and distinct, if sometimes overlapping, socio-political, economic, cultural, and natural environments. Only a few examples of transboundary aquifer agreements exist around the world, ranging from more formal mechanisms, through to less formal co-operative arrangements, specific scientific data-sharing initiatives, and informal local efforts undertaken by sub-national political entities. Common to all these endeavours is the need for institutions that allow the parties in question to work together toward the sustainable and equitable management of their shared resource.

## INSTITUTIONALISING TRANSBOUNDARY AQUIFER GOVERNANCE

A recent wide-reaching output on achieving desirable forms of groundwater governance, the "Global Framework for Action", highlights the need to build effective institutions for dealing with transboundary aquifers. Although comparatively little academic attention has been paid to transboundary aquifer governance, the literature that does exist tends to emphasise the legal context. Here a particularly salient question in recent times concerns the relationship between new transboundary agreements and the United Nations International Law Commission (UNILC) Draft Articles on the Law of Transboundary Aquifers, which was adopted in 2008 by the UN General Assembly. Beyond this legal focus, other authors have drawn attention to wider institutional aspects, such as a review of the institutional challenges of groundwater governance by Theesfeld in 2010.

To varying degrees, what much of this literature shares is the notion that institutions for governing aquifers, including transboundary aquifers, can be purposefully designed, crafted, or, as the Global Framework for Action proposes, "built". This conception of how institutions emerge and evolve has a strong intellectual history, deriving in part from neo-institutional approaches to the commons, typified by the work of the late Nobel laureate Elinor Ostrom. Yet this understanding of institutionalisation has been questioned in more recent times by scholars who draw variously from approaches that take into account history, culture, and a "thicker" social-science critique that brings to the fore issues of power, structure, and agency and their relationship to institutions. In the next section I briefly elaborate upon these "mainstream" and "critical" institutional approaches, before concluding by considering what the latter implies for our understanding of transboundary aquifer governance.

## CRITICAL INSTITUTIONALISM AND INSTITUTIONAL BRICOLAGE

Put crudely, mainstream institutionalism - which has been employed widely to analyse natural resource governance, including groundwater governance - puts forward a model of institutions as arrangements of rules that shape individual action, where decision-making typically takes place in formal organisations such as water committees, associations, and authorities acting at different, nested levels of governance. From this perspective, individuals are perceived as "boundedly rational" actors, whose ability to strategically act so as to maximise their own self-interest is limited by access to information about the resource in question and/or the behaviour and character of others they interact with, including the extent to which they are trustworthy. To this end, institutions help to bring assurance and predictability

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through their influence on the behaviour of others. For scholars and decision-makers who subscribe to this view, a core requirement of governance is "getting institutions right" – be it through the design of formal rules, regulations, policies, and the like.

Critical institutionalism, whilst not rejecting some of the important developments made by the mainstream school of thought, nonetheless is sceptical of many of its assumptions and assertions. In particular, it contends that institutions typically perform several functions beyond the one they were intended for. This pluralism implies institutions are inherently dynamic, ambiguous, and only partly amenable to design. Furthermore, individuals are seen as having complex social identities, where their behaviour is not simply strategic and economically oriented, but instead plays out in accordance with emotional and psychological values, states, and desires, and as a result of their position in society. A core concept from a critical institutional perspective is that of "institutional bricolage". This concept attempts to convey the idea that rather than being designed or crafted, institutions are instead formed through a process where people consciously and unconsciously "draw on existing social formulae (styles of thinking, models of cause and effect, social norms and sanctioned roles and relationships) to patch or piece together institutions in response to changing situations".

Institutions are therefore a dynamic hybrid of the modern and traditional, the formal and informal. However, not just any arrangement will do. Rather, new institutional arrangements formed through bricolage must be legitimate and "fit" socially. This depends on such factors as the social status of those involved in their formation, on reference to sources of authority such as dominant discourses and traditions, including the "right way of doing things". Such factors serve to legitimise institutions, helping new arrangements to seem natural or even inevitable. Furthermore, bricolage is not seamless. Instead it is typically a contested process whereby certain individuals, because of their different political, economic, and social standing have varying levels of influence both on the process of institutionalisation as well as on the bending or breaking of rules. Bricolage therefore draws attention to the central role of power in the emergence and persistence of institutions.

## TRANSBOUNDARY AQUIFER GOVERNANCE AND INSTITUTIONAL BRICOLAGE

In a short article such as this it is not possible to do justice to the bodies of scholarship and concepts referred to above. Nonetheless, in the context of thinking about transboundary aquifer governance I have attempted to provide a flavour of a more critical approach to institutions, with special attention paid to the concept of institutional bricolage. The rationale for doing so is twofold. Firstly, much of the research to date that has employed a bricolage approach has focused on local community arrangements for governing natural resources. In contrast, transboundary aquifer governance throws up an array of interesting new questions for researchers who adopt a bricolage perspective. This is because of the range of additional factors involved, some of which were mentioned in the introduction, including different sovereign interests, different forms of data and knowledge, and distinct socio-cultural, political, and economic practices and resources.

Secondly, a bricolage lens helps scholars and practitioners interested in transboundary aquifer governance to better understand the processes whereby particular arrangements emerge, persist, and evolve. It draws attention to the workings of power, to the necessary confluence of different cultural and social milieus, and the contested nature of such processes. Understanding what institutional resources are available in any given context, how they are employed and by whom, the sources of authority invoked to legitimise new arrangements, and the outcomes and effects of such processes for different

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countries, communities, groups, as well as the environment, are crucial aspects of transboundary aquifer governance. Here I propose that a better understanding of these dynamics can be obtained through a critical institutional approach that views institutionalisation as a process of bricolage.

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## 18. FROM SEPARATION TO PROXIMITY: THE BORDER AS A MEETING PLACE


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I'm standing in the *Represa de Salto Grande*, a hydroelectric dam on the Uruguay River, which supplies electricity to Uruguay and Argentina and at the same time serves as a bridge to connect the two countries, specifically the city of Salto (Uruguay) and Concordia (Argentina). But I'm not standing on either side of the dam, I am in the place where it passes the line of the border. Moreover, this imaginary line crosses me, so that one half of my body is in Argentina and the other half in Uruguay. But I have doubts on the part of my body that is exactly the place where it passes the line. My belly button is in neutral territory? What part of my body is exactly in Uruguay and what part is in Argentina? How thick is the line?

Returning to Salto, where we held the workshop, I was able to identify some practices that are generated by the fact of being a border town and the possibilities offered through it. The *bagashopping* is a place where smuggled goods bought in Argentina are sold in Salto. Smuggling is illegal but the *bagashopping* is a widely known retail location with a great visibility. In a taxi trip I asked the driver why this illegal practice is allowed and he said that "there the police cannot enter," without further explanation. Therefore, I see that, in addition to complex situations, the border may have a de-facto situation where unlawful activities are simply tolerated, unlike non-border areas

Some of these situations that arose in less than one week on the border, marked an illustrative picture of the institutional and legal complexity surrounding the definition of what a border is. Several of these questions led me to think about the need to discuss the concept of border and transboundary and try to think in a different way, concerning the subject of the workshop, exploring some possibilities to think of them as places of proximity and not separation. Thought this way the border can lead us to new ways of thinking about ways of knowing, legislate or manage transboundary groundwater. We can then perceive it not only as elements of nature that are present in different countries, but as elements of the world of nature that are part of cultural life, which are shared but beyond that generate culture and identity. The border emerges as a way to separate countries, to organize the territories and institutions, but it also generates places with common practices, interrelated natural and cultural histories and neighbors who are not only separated by a border, but united by an imaginary line. On these issues I will address the next words.

As we can see, the border is not only a concept that explains reality, but is a concept that generates reality. Rethinking this concept is to rethink the ways to build realities and in that sense a means to influence the possibilities of generating pragmatic

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conceptual alternatives with important implications on the life of nature and people. The utility of the border is usually associated with the need to limit its crossing. However, it is actually the moving of goods and people from one country to another that probably justifies the existence of the border. In fact, crossing the border generates handover practice, a practice that was previously only movement.

From a territorial point of view, borders change the dynamics of cultural practices and the world of nature that existed prior to the construction of the border. Two places arbitrarily separated by a border is likely to limit the amount of movement of that place, but it also reconfigures its quality (not in a judgmental sense but rather descriptive). In those places crossed by these types of lines, the "places of border" are characterized by a shared history, shared environmental matrix and present life in which the existence of the border plays a fundamental role. In those places the movement has always existed and historically formed a space whose characteristics the border reconfigures. Therefore, we see that the configuration of the practices of "places of border" are strongly determined by the existence of the border. These practices have specificities on both sides, but above all they have many things in common that are given by the proximity and contiguity of a common natural and cultural history in which new practices around the possibility of crossing the border are also included.

More generally, when we think about borders usually we think of a line that separates things. However, those things that can be separated by borders can be be very close. They are probably the closest things possible within the possibilities of proximity. Thinking of borders as the ultimate expression of proximity creates new possibilities of considering the border and transboundary issues. Understanding the border as a particular place characterized by the proximity (not forgetting the differences) allows us to focus on the aspects that the bordering parties have in common. This leads us to prioritize common interests and synergies in detriment of differences and oppositions.

Nevertheless, this proposal has a great difficulty. The problem of conceiving the "place of border" as a new object is that it requires to establish new limits, increasing the number of limits. This problem is mainly due to the way we represent boundaries, taking a cartographical approach as lines that divides the space. However, in the maps often the lines that separates also coexist with connecting lines (roads, routes, etc.).

A possible solution to the multiplication of objects generated by this proposed new "places of border" approach is to change the way we consider the concept of limit that is usually associated with the border: a line. Maybe we can start thinking about the limit as a dilution of what is intended to be limited. However, we need to be open to "think" outside the box if we want to develop new ways of thinking. We will have to seek new perspectives focused on proximity to other sciences (and arts?) and for that we must discuss the ontology of the border as (re) construction constantly changing.

These reflections were inspired by the following references:


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## PART III – GROUNDWATER GOVERNANCE: PRINCIPLES, TOOLS AND MANAGEMENT



## 19. GOVERNING GROUNDWATER SYSTEMS AS GOVERNANCE – A FRAMEWORK FOR ASSESSING GOVERNANCE NEEDS AND CAPACITY


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Effective governance of groundwater resources is challenging. Groundwater resources are at risk of depletion through over-extraction, pollution and degradation due to a number of human activities. Their governance suffers from inadequate leadership from governments, limited awareness of long-term risks, lack of monitoring, non-performing legal systems, conflicting interests amongst stakeholders, etc.

The GEF initiative "Groundwater Governance: A Global Framework for Action" implemented by the FAO, jointly with UNESCO-IHP, IAH and World Bank, provided important insights on how to address these challenges. It developed a clear definition of the goal of governing groundwater - *ensure control, protection and socially-sustainable utilisation of groundwater resources and aquifer systems for the benefit of humankind and dependent ecosystems*, and a governance diagnosis tool to assess the state of groundwater systems, including challenges and opportunities.

In this context, the aim of this brief paper is to present an analytical framework which can be used to conduct a governance diagnosis in a structured way. It uses the case of the Guarani Aquifer in Salto/Concordia between Uruguay and Argentina to illustrate key features of the framework and its practical application.

### GOVERNANCE?

Any project seeking to improve the governance of groundwater systems must define what governance means. This paper does not review the large and

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multidisciplinary literature of governance. It simply provides a working definition of the concept to be employed by the analytical framework.

The term governance is better understood in contrast to government. Traditionally, governance referred to governments and their actions, but in more recent interpretations within social theory the term governance has been employed with a broader meaning which refers as *the totality of instruments and mechanisms available to collectively steer social systems*. According to this interpretation, both the state and societal actors are involved in the activity of governing, which becomes a collective process involving a broad range of actors.

## WHAT IS A GOVERNANCE SYSTEM?

Knowledge about the boundaries, structure and functioning of a groundwater governance system is a *sine qua non* condition for attempting to change it. Here again this paper does not review the scientific literature of system studies in the field of governance. The goal here is simply to suggest an approach that can be used to define the system. It does that drawing largely from the literature of interactive governance.

Interactive governance theory suggests that a governance system is composed of a Governing System (GS), which includes all actors who participate in the governing process; a System to be Governed (SG) made of environmental and socio-economic components; and a set of Governing Interactions (GI), which link the two subsystems (Fig.1). Overall system governance is then determined by the capacity of the GS to respond to the needs of the SG in the presence of GI.

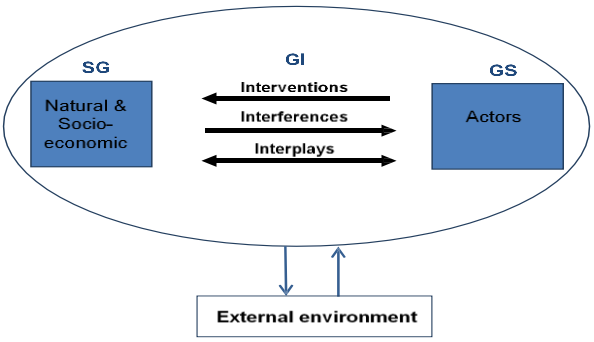


Fig.1. Components of a governance system

Four qualities characterize the SG and GS subsystems. *Diversity* points to the nature and degree to which the entities that form the system differ. Systems with high diversity require large amounts of data of high resolution and are therefore expected to be less governable. *Complexity* is an indicator of the architecture of the relations among the components of a system. More complex systems require more in depth analysis and can be expected to be less governable. *Dynamics* is about systems going from one state to another due to natural, technical or social forces. Systems that are highly dynamic are likely to be more difficult to govern. *Scale* pertains to the spatial dimension of the system, the size, range and boundaries of the system components. Large-scale systems are likely to be less governable.

GI can be of three types. *Interventions* are the most formalised, hierarchical kind of interactions, going one-way, top-down from the governors to those governed to bring about, or avoid, societal changes. *Interferences* travel upwards from the governed to the governors and reflect how socio-political entities (individuals, groups and movements) participate in the governing process. *Interplays* have a typical horizontal character where no formal authority or subordination exists, but goals are reached by engaging in collective actions such as partnerships, collaborations and communication.

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## THE GOVERNANCE SYSTEM IN SALTO/CONCORDIA

Before applying the framework illustrated above to the case of the Guarani Aquifer in Salto/Concordia, we need to be aware that the definition of boundaries and components of a governance system is, to a large extent, a subjective interpretation of reality, not necessarily reflecting physical or objective features of the system.

The first step of the assessment addresses the qualities of the SG, which entails a natural component – the aquifer system, and a socio-economic component – the stakeholders.

In the case at hand, the natural component is one unitary aquifer system. Due to the slow water flow in the Guarani Aquifer, the component covers only a small area of the larger aquifer corresponding to the area of the municipalities of Salto and Concordia. The natural component has been studied comprehensively and its physical features are well understood. Groundwater quantity and quality are subject to slow natural processes. However, over extraction can cause rapid, localized lowering of the water table. Human activities in the area are considered to have limited impact on groundwater quality.

The socio-economic component of the governance system refers to all stakeholders involved in the use and extraction of groundwater from natural component. In Salto/Concordia, there are few types of stakeholders including thermal baths, hotels, well developers and city governments. The local population at large has only an indirect stake in the resource, primarily for ecosystems well-being and entertainment. The scale of the component is local and corresponds to the area of the two municipalities – Salto and Concordia, where water extraction and use occur. The complexity of the system is low since stakeholders do not hold conflicting views, but agree about the need to sustainably mange groundwater. At the same time, some categories have an economic incentive towards overexploitation.

The second step of the analysis evaluates the qualities of the GS. In Salto/Concordia the categories of actors playing an important role in the governing process include the national government of Uruguay, Provincial Government of Entre Rios, city governments of Salto and Concordia, the Binational Commission, specialized agencies in the two countries and a handful of hotels and thermal baths. International GOs, environmental NGOs, farmers and local communities play today no, or a limited role. Governing actors hold views and positions that are largely consistent and stable over time. The geographical scale of the system is national/provincial, inherently linked to the jurisdictional boundaries of Uruguay and the Province of Entre Rios.

Table 1. Qualities of the SG and GS – summary results

| | **System to be Governed** | | **Governing System** |
|---|---|---|---|
| | **Natural** | **Socio-economic** | |
| **Complexity** | Low | Medium | Low |
| **Diversity** | Low | Low | Medium |
| **Dynamics** | Medium | Low | Low |
| **Scale** | Low | Low | Medium |

The third step of the analysis assesses the GI to evaluate how conducive they are for governance. A primary form of GI in the case of Salto/Concordia is through interventions. Public actors – national/provincial governments and specialized agencies in the two countries, adopt regulations - groundwater quality and quantity standards, and grant licences. Another important form of interactions is interplays, in particular the activities (monitoring, communication and education) of the Binational Commission. Finally, interferences in the form of e.g. public consultations, expert forums, focus groups and social movements are not significantly developed.

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## OVERALL GOVERNANCE

The governance of a specific system is then determined by the capacity of the GS to steer the system in the face of the specific needs of the SG and qualities of the GI.

In the case of Salto/Concordia, the SG shows low levels of diversity, complexity and dynamics, while its scale is local. The GS appear appropriate to deal with these challenges. Future governance challenges might develop from stakeholders' potentially conflicting interests (complexity) and rapid changes in the water table caused by over extraction (dynamics). For what concerns GI, interventions lack a comprehensive scope due to the transboundary nature of the system, while interplays - consisting primarily in the activities of the Bilateral Commission, are appropriately conducted over the entire system.

The rapid assessment of the case of Salto/ Concordia carried out in this paper shows that the system has low governance needs for which the governing system appears largely appropriate. Further improvements should see the development of governing actors and/or governing interactions (especially interventions) applicable comprehensively to the entire SG.

Further reading:


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# 20. TOOLS TO INCREASE THE EFFECTIVENESS OF THE GOVERNANCE OF TRANSBOUNDARY AQUIFERS


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The accessibility to safe freshwater is a human right but also a matter of national security, and as such, of key importance for the maintenance of global peace. However, further improvement of both legal and institutional aspects should be implemented, in order to deal with the challenges imposed by the often competing issues over the water use, such as an increasing world population implying the requirement for more food and energy, but exposed to scarcity and pollution and climate change, and the maintenance of the environment. A good institutional architecture is crucial to deal with these underlying political, social, economic and ecological drivers as well as to prevent disputes over the use of the shared resources, such as transboundary aquifers.

This piece presents some of the current trends in the application of information and communication technologies as a tool to help governance, with reference to the case of the Guarani Aquifer System, within the La Plata River Basin.

## JOINT ASSESSMENT

A consensus way to implement the shared governance could be through a joint multiple disciplinary team of experts belonging to the countries holding the use of the aquifer and, if necessary, one from a neutral one. An approach such as the Drivers, State, Pressures, Responses and Vulnerabilities Analysis, could be taken, in dialogue with stakeholders, aiming at identifying the most influential human activities and natural stressors, to then assess and manage their risks, and communicate the results at the policy level.

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The process should ideally end up in treaties, including addenda comprising this information, with a set of agreed parameters and their limits. This is because not always the freshwater regulations are similar between different countries.

## DECISION SUPPORT SYSTEMS

The application of decision support systems (DSS) for sustainable watercourse management is a recommended tool. It integrates georeferenced systems, remote sensing, and simulation models with electronic government to give transparent accessibility of data to all stakeholders. In the case of transboundary aquifers, buffer zones can be identified at the recharge and discharge areas, and hot spots set where valuable assets are to be protected or are exposed to extreme vulnerability. There are several experiences for integrated catchment model using DSS, such as the Elbe, the Nile, the Baltic and the Danube Basin. This method helps to evaluate the effectiveness of management options, the identification of local inputs in sub-catchments and their impact on the overall water quality, and prioritise management actions in terms of spatial distribution and effectiveness, while offering data in a visually simple, transparent and participatory way.

## RISK AND VULNERABILITY MAPS

Data should be easily collectable, and deemed as vulnerability indicators, to then, use methods such as Multi Criteria Analysis (MCA) to estimate the risks of contaminants in porous aquifers or to saline intrusion in coastal aquifers under different climate change scenarios. Mapping vulnerability of aquifers, along with land use, drilling operations, existing bore holes and wells, springs, geological formations, population, industries, agricultural uses of the land, and other data, should be introduced using information and communication technologies, with maps composed of layers that every stakeholder would be able to see, allowing for the transparency of big data to the public from schools children, to academic uses, and to politicians and decision makers.

In the case of aquifers, this approach has not yet been applied, but the trend should be towards a more holistic point of view, as water is interconnected in the water cycle, and groundwater depends on recharge zones prone of contamination from surface water and land use, thrusting towards the management of both, bearing in mind the implications of the human activities and the vulnerability areas to rivers, streams, lagoons and aquifers.

## THE GUARANI AQUIFER SYSTEM AND THE LA PLATA BASIN CASE

In 1969, the La Plata Basin Treaty was signed as a framework agreement that might be good to update to include groundwater resources. The infrastructure could use existing basin committees and others (such as Administrative Commission of the Uruguay River (CARU), Binational Commission for the Guarani Aquifer). As tools to make them more effective, a joint meeting of representatives at the La Plata Basin plenary could be gathered, and decision support systems developed at national and regional levels, with transparency in relevant water quality parameters agreed by the teams, that allow screening the status of freshwater resources and identify them clearly in dynamic maps of vulnerability and risks to bring awareness and transparency to the system.

## FURTHER RESEARCH

More allocation of funds should be devoted to research to identify more specific institutional architectures for transboundary waters governance, and to populate databases and systems. The tools should be available to every stakeholder to tackle the modernisation of the integrated water resources management and governance. The ideal scenario would be that through international cooperation an

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equitable access to these tools should be harmonized and fostered.

For further information:


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## 21. THE ROLE OF REGULATORY SAFEGUARDS IN THE DESIGN AND OPERATION OF MARKETS FOR GROUNDWATER ECOSYSTEMS SERVICES


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### INTRODUCTION

Regulatory frameworks for groundwater management have to deal with balancing the exploitation of a complex resource with the increasing demands of water and land users. These user communities may pose a risk to the availability and quality of the resource, especially if their access is unregulated or only poorly regulated. Unfortunately, experience shows that calls for groundwater management do not usually arise until a decline in well yields and/or quality affects one of the stakeholder groups. If further uncontrolled pumping is allowed, a vicious circle may develop and irreparable damage to the resource may result including serious groundwater level decline, and in some cases aquifer saline intrusion or even land subsidence.

To transform this 'vicious circle' into a 'virtuous circle', it is essential to recognize that managing groundwater is as much about managing people (water and land users) as it is about managing water (aquifer resources). In other words, the relationship between the resource and user communities maybe considered a market relationship where the tradeable commodity is an environmental or ecosystem resource. Consequently, it is critical for the well-functioning of the market that that the socio-economic dimension (demand-side management) of the markets is balanced against the hydrogeological dimension (supply-side management); and, further that integration of both is always required. An ecosystems market approach to groundwater management is one method of ensuring that risks are properly mediated and costs internalized.

### DESIGNING MARKETS FOR GROUNDWATER ECOSYSTEM SERVICES

A well-functioning market in groundwater ecosystem services depends on attributes required for any viable environmental market. These include a stable political environment, a clear assignment of property rights to foster confidence in the security of credit transactions and to avoid conflicting claims to rights to accrue the value of credits, clear allocation of authority to administer the trading programme to public entities, and the provision of adequate financial resources to the agencies responsible for those who manage the programme. However, in addition to these institutional prerequisites, I argue that the foundation of a reliable market that is capable of achieving efficient and effective protection of ecosystem services must rest on five pillars of accountability: financial safeguards, verifiable performance standards, transparency and public

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participation standards, regulatory oversight mechanisms, and rule of law safeguards.

I derive these standards from three sources. First, these accountability tools emerge from identification of the flaws that are responsible for the abuses of market-based approaches to environmental protection in other payments for ecosystems services programmes. Second, drawing on from the experience from market-based programs that appear to have worked well or that include mechanisms that promise to effectively curb abuses of environmental markets, such as the EU's Common Agricultural Policy and the US Clean Water Act wetlands protection program. Third, reliance is made upon on important principles of international law, such as the obligations to provide transparency and opportunities for public participation that the Aarhus Convention imposes on signatory nations. Each of these regulatory safeguards play a fundamental in creating an accountable market in groundwater ecosystem services that minimizes opportunities for fraud and abuse and could help in the design of effective regulatory framework.

## THE LIMITS OF MARKETS IN GROUNDWATER MANAGEMENT

The use of market-based methods of environmental protection in legal efforts to protect the flow of ecosystem services represents the interface between an entrenched methodology for structuring environmental law and policy, and enhanced appreciation by scientists and policymakers of the importance of the natural environmental in providing social benefits that have not always been fully appreciated. The promise of achieving efficient protection of groundwater ecosystem services through a trading regime is an enticing one. At the same time, that combination is potentially incendiary. Notwithstanding great leaps forward in scientific knowledge of how groundwater ecosystems function and identification of the valuable services they provide, there is much that neither scientists nor resource managers understand about these matters. Scientific uncertainty, the backdrop against which much of environmental law has been adopted, remains considerable in this area. These knowledge gaps create risks that participants in trading regimes of the kind proposed in this note will engage in abuses that are difficult to detect. It may not always be clear, for example, whether those claiming credits for protective measures have actually taken the necessary steps to protect ecosystem services to a degree that offsets resource impairment authorized by a trading regime. The need for the accountability mechanisms suggested in this note is therefore perhaps even more acute than it is in the context of regulatory programs that involve better understood cause-and-effect relationships between pollutants that have been regulated for decades and the environmental resources the law seeks to protect. In short, the use of trading in groundwater ecosystem services protection is a work in progress. Markets for ecosystems services hold a certain promise for greater and more efficient environmental protection. However, that potential may be easily derailed by poor regulatory oversight, which enables market abuses to occur, highlighting the need for consolidated regulatory frameworks designed to ensure the integrity of the markets. It is crucial that market mechanisms to protect groundwater ecosystem services integrate the five components of operational accountability identified here, including financial safeguards, verifiable performance standards, transparency and public participation mechanisms, regulatory oversight, and rule of law safeguards. Unless effective safeguards are implemented and embedded into the design of markets for groundwater ecosystems services, the legitimacy of these interventions will remain questionable.

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For further information:

- T Kaime & R Glicksman 'A comparative analysis of accountability mechanisms for ecosystem services markets in the United States and the European Union' 2 (2013) Transnational Environmental Law 259-283.
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## 22. BREAKING THE BOUNDARIES: CO-OPERATIVE PROTECTION AND REGULATION OF GROUNDWATER

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### INTRODUCTION

Administrative/political boundaries are important challenges for groundwater governance. This is mainly because these boundaries need not always be in alignment with the boundaries of the aquifer system (including the recharge and discharge zones). The boundaries pose crucial governance challenges at the domestic as well as at the international level. While international boundaries constitute a serious obstacle to the governance of transboundary aquifers, different administrative/boundaries at the domestic level pose challenges for groundwater governance at the domestic level. A governance regime limited by the constraints of boundaries is unlikely to be effective from the points of view of regulation and protection. At the same time, boundaries are such a reality that the governance regime has to engage with it and work with it. This complex scenario places the principle of co-operation as one of the cardinal principles of groundwater governance both at the domestic and international level. This paper dwells upon the principle of co-operation in the context of groundwater governance in the light of two examples – one in the transboundary context (the Guarani Aquifer System) and the other in the domestic context in India.

### MAKING CO-OPERATION WORK

There are a number of preconditions and factors that are necessary to make the principle of co-co-operation work. First, a proper mapping of aquifer system is an essential precondition to trigger co-operation. A governance framework based on administrative boundaries is, by default, the only option in the absence of the aquifer data. This is, for example, the case in India. Even though groundwater is the major source of freshwater for almost all uses, there is no consolidated data of aquifers. The Government of India has recently initiated the aquifer mapping process. Therefore, it is not surprising that the governance of groundwater in India currently focuses on limited aspects, for example the regulation of use based upon the information available on quality and quantity. An aquifer based governance regime is still far from the reality.

Second, while the scientific mapping could confirm the hydrological boundary of an aquifer system, the availability of information does not per se facilitate co-operation. This needs to be oiled through leadership from the side of the political community and the technical community. In a scenario where administrative units have a long history of co-operation, it might not be a difficult task. However, water is such a strong political issue that different administrative units tend to hold positions motivated by self-interests. Therefore, depending upon the local scenario, different groups can trigger the co-operation initiatives individually and collectively. For example, in a scenario of a hostile relationship between different administrative units, probably the technical community could start the process of co-operation because the political leadership would be constrained by the pressure from their respective constituencies. Examples from India and the Guarani Aquifer System demonstrate how important is the

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history of relationship insofar as the co-operative governance system for groundwater in concerned. The bi-national informal mechanism between Concordia (Argentina) and Salto (Uruguay) tells the story that co-operation is possible even between two provincial units from two neighbouring countries where there is a long history of co-operation. At the same time, in India, different state governments are involved in never-ending conflicts on water sharing although they are units within a country. This also makes it clear that the nature of relationship and initiatives from all involved units and stakeholders are the most important determining factor, not the domestic or international nature of the boundaries.

Third, from a strategic point of view, co-operative governance framework does not have to be an all-encompassing framework at the beginning. It could follow incrementalism as a strategy and start with less controversial steps, for example a joint effort to take stock of the groundwater scenario. The functional co-operation on less controversial issues could eventually pave the way for co-operation on more controversial aspects of governance such as regulation and protection.

## TWO TALES OF FORMALISM AND INFORMALISM

There could be a number of permutations and combinations insofar as co-operative groundwater governance is concerned. However, a major debate in this context is on the method of co-operation, that is, on the comparative advantages/disadvantages of a formal or informal mechanism. While there cannot be a blind generalisation on these two methods, this part of the paper simply highlights two examples wherein these methods are being used or planned.

The bi-national informal mechanism between Concordia (Argentina) and Salto (Uruguay) is an interesting example of co-operation at an informal level. The bi-national commission has been working for last several years although its focus is on limited aspects, for example joint monitoring and exchange of information. This example projects the possibilities of co-operation even without a legal basis between two sub-national entities. This could be an important lesson in a lot of other contexts where provincial or even more local administrative units can adopt this strategy until and unless a formal framework is in place. The Concordia- Salto example also shows that there could be a number of issues where local level co-operation could work such as monitoring of groundwater scenario and control of use. This could lead to the building up of trust and opens up the possibility of a co-operative framework at the proper scale.

Unlike the Concordia-Salto example, the scenario in India shows a calculated move towards a formal framework. This makes sense because one of the major impediments for groundwater governance in India is the common law right that recognises the uncontrolled right of landowners over groundwater. Any effort to govern groundwater, therefore, requires the abolition of the common law right through a law. Further, India follows a decentralised governance system in general and therefore, a framework law to facilitate co-operation among different administrative units (from the federal government to the most local government at the village level). In this context, the Government of India has drafted a model groundwater bill to persuade the state governments to adopt a progressive groundwater law with regulation and protection based on hydrological boundaries. The federal government in India can only come up with a model law because the power to make law on water in vested with the state governments. One of the most important changes the model groundwater bill seeks to introduce is the aquifer based governance framework and thereby it seeks to break the administrative/political boundaries insofar as groundwater governance is considered. This is to be achieved through an institutional mechanism with representation from relevant administrative units by respecting the hydrological boundaries. This marks a

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significant deviation from the erstwhile approach limited by administrative boundaries.

## CONCLUSION

The governance of groundwater can be effective only if it takes aquifer as a unit, not the existing administrative units. This scenario makes co-operation between all relevant administrative/political units extremely important for groundwater governance. While there is no single approach towards operationalising the principle of co-operation in groundwater governance, it could be different in terms of nature and scale in different contexts. Nevertheless, every single step operationalising the principle of co-operation could significantly strengthen the legal and institutional framework for groundwater governance.

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# 23. GROUNDWATER GOVERNANCE REFORMS: A POSSIBLE LICENSING FRAMEWORK FOR GROUNDWATER ABSTRACTION AND USE


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## WHAT IS GOVERNANCE?

For some, governance is about setting rules in relation to the conduct of certain activities and enforcing their proper implementation thereafter. In its broadest sense, governance captures even more than that. Governance, whether of a state or a corporation, may be achieved without resource to rules of any kind. Indeed, empirical studies have revealed that much governance is secured by setting economic incentives or dis-incentives which promote compliance behaviours. In overall, governance means designing sound institutions which can influence the flow of events to the desired direction. For example, environmental governance does not only seek to prevent or mitigate adverse impacts on the environment. It also seeks to promote sustainable development by enhancing the population of protected species, planted trees, regulating the number of available fish stocks etc. Indeed, whereas rules are generally used to specify minimum standards of performance, governance is also oriented to continuous improvement and monitoring.

## GROUNDWATER GOVERNANCE: STRIKING BALANCES

Over the past decades, incidents of extensive water level decline, contamination of groundwater aquifers and extraction of poor quality water have become more intense. The rapidly decreasing availability of groundwater water resources globally, combined with increasing population growth and enhanced urbanization, has led to competitive and unregulated

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extractive practices which have detrimental effects on the economic development and ecosystem integrity in many regions across the globe. Both overexploitation and pollution of groundwater systems are largely a result of human activities on the surface. These may include agriculture, urbanisation, domestic and public use, industrial use, energy etc. All these economy sectors are inherently linked: they all vitally depend on groundwater but at the same time represent the most immediate threats to its sustainable management and conservation. That being the case, it is apparent that any governance system for the management and conservation of this valuable resource must be able to accommodate the interests of each sector while ensuring its sustainable qualitative and quantitative use.

The 2014 Groundwater Global Framework of Action has explicitly recognised this need by stating that 'An adequate institutional set-up is a critical prerequisite for satisfactory groundwater governance and for promoting effective groundwater management and protection'. This should be able to 'balance the roles of the public administration and of private stakeholders to promote socially responsible use and protection of the resource base'. The Framework points out that any groundwater regulatory regime needs to be developed based on perfect knowledge of the characteristics of the resource and regulate rights by licensing, setting levels for groundwater extraction and limitations on number of wells drilled.
Having regard to the above, this short paper explores possible types of groundwater governance reforms and provides an example of what a successful framework for groundwater abstraction and use might look like.

## INTRODUCING GROUNDWATER GOVERNANCE REFORMS: POSSIBLE OPTIONS

When it comes to introducing regulatory reforms, governments and policy makers must walk a fine line in balancing competing or conflicting interests among stakeholders, and in the case of groundwater, coordinating with urban and rural land uses and the management of the entire subsurface space.

The first policy option could be to introduce these changes in the form of retrospective regulations relating to water use and/or licence re-assignment. However, experience shows that taking away vested rights under existing laws or imposing new obligations and duties for activities that are already underway, may give rise to fierce public opposition and is likely to discourage future investments.

Another possible option could be a non-institutionalised, i.e. non-formalised, framework to which groundwater users voluntarily adhere. However, traditional theories or regulation suggest that regulatees will only comply with a rule to the extent that it is in their immediate interest to do so. In fact, some studies have found that compliance is the outcome of measuring the benefits of non-compliance versus the probability of being discovered and punished, with the severity of the penalty being the most decisive factor. In other words, the assumption is that adherence to a rule is prompted by the potential cost of non-compliance. These may include direct financial costs such as penalties and fines but also indirect effects such as licence revocation and bad publicity on the interested party's reputation. In the absence of clear-cut incentives for stakeholders concerned, this option is unlikely to achieve a long-term solution.

A further policy option could be a goal-setting and participatory regulatory system that leaves it to the interested parties to comply but is underpinned by the licensing powers of the state. Such system would place the most substantial degree of responsibility on the well head owners to meet certain goals: to gather all the necessary hydrological data, to identify risks to

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the environment and the water and propose mitigation mechanisms. In other words, a licensing system designed to ensure that water users are implementing good practice and that regulatory intervention only comes into play where problems exist in this regard.

## PROPOSED LICENSING SYSTEM

The proposed system (see diagram below) is based on the assumption that ownership of water resources is vested in the state and that anyone wishing to abstract and make use of this resource must apply for a licence. A licence is an administratively granted permission authorising an activity that would otherwise be unlawful. This system has no retrospective effective, hence applies only to new licences. Nonetheless, existing licences will come under its scope once they reach their renewal phase (see Phase C below).

### *PHASE A – APPLICATION AND ROYALTIES FOR WATER ABSTRACTION*

The authorising department would require from anyone wishing to abstract and make use of groundwater to provide information, including, inter alia, detailed hydrological reports about the area in question, agrochemicals used, waste management, environmental impact assessments, envisaged number of wells drilled etc. Licence fees and royalties in respect of the water used could also be included as an annexation to the licence. Royalties for using high volumes of groundwater could potentially form a powerful disincentive to over-abstraction and aquifer systems degradation. Also, higher charges may be applicable in cases where aquifers are considered to be more vulnerable in terms of contamination and depletion.

### *PHASE B – REVIEW OF APPLICATION*

Once the application is submitted, the authorising department, which would be composed by a multidisciplinary group of experts, would audit the application in an integrated manner by taking into account the potential impact on other related sectors, such as agriculture and energy. The department will then invite the applicant to a discussion with a view to arriving at a technically desired, economically efficient and environmentally sustainable solution. If the audits, technical reports and discussions lead to alignment between the authorising department and the applicant, then everything agreed upon will be incorporated in the licence in the form of conditions, the breach or non-observance of which may result in the licence being revoked. Grounds for rejecting an application may include, for example, non-alignment over the number or specification of wells drilled and failure to propose adequate impact mitigation mechanisms.

### *PHASE C – MONITORING AND VERIFICATION*

The efficacy of the proposed system largely depends upon the existence of a punitive sanction in the event that a licence, if granted, is not complied with. Therefore, after a licence has been granted, it is proposed that an annual monitoring process will be enacted, which, in broad terms, will be designed to ensure that licence holders adhere to the terms of the licence and, if not, force them to relinquish the licence back to the state. Licence holders would be directed to submit annual reports to the authorising department including inter alia hydrogeological data, level of water abstractions, number and specification of wells drilled. Once reports have been submitted these with be screened by the department to identify possible impacts on the environment and the resource itself. Should all conditions be met, the licence can be renewed. If not, a notice to improve performance may be served upon the licensee. Once again, as noted above, if the department is not satisfied that the licence holder has taken steps to raise its standards, then the former will be able to

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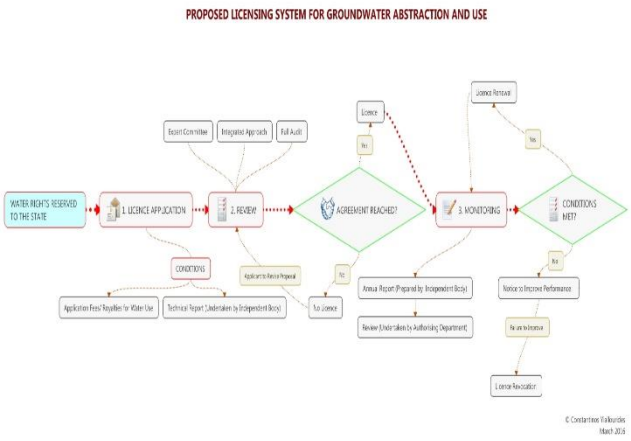
initiate the required process to have the licence been relinquished back to the state.

## CONCLUSION

The idea of the proposed system is that licence holders are consistently doing the right thing and that licences are only granted to those with the technical and financial ability to manage, conserve and protect the water and the surrounding environment at large. The assumption is that the well head owner, not the state, initiates the permitting process for water abstraction and use. While this scheme is essentially voluntary in nature, it is strongly underpinned by the licensing prerogative of the state. The proposed system coincides in many respects with the basic principles of groundwater governance as identified by the Groundwater Shared Global Vision for 2030. First, it takes into account the peculiarities and interests of each sector, such as urban and industrial development and the environment, by implementing an integrated licensing approach. Second, it has the capacity to prioritise. For example, aquifers lying on recharge zones, which are more vulnerable to contamination, may require further environmental studies whereas others can be fast tracked. Last but not least, this system has the capacity to be proportionate and legitimate in the eyes of the stakeholders and to lead to credible and verifiable commitments.




For further information:

- Global Framework for Action (Special Edition for WWF7, 6 March 2015)
- Groundwater Governance: A Shared Global Vision for 2030 (Special Edition for WWF7, 6 March 2015).
- Insa Theesfeld, 'Institutional Challenges for National Groundwater Governance: Policies and Issues' 48(1) (2010) Ground Water 131.

# 24. ACHIEVING GROUNDWATER GOVERNANCE: THE ECOSYSTEM APPROACH AND THE ROLE OF MARKET-BASED INSTRUMENTS

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Groundwater is an elusive and largely unseen common pool resource. Yet driven by strong economic incentives, whether or not encouraged by existing policies, groundwater users think of it as a 'private good' that benefits them as any other good or service might, and in so doing, they are competing with each other to extract as much as possible and as quickly as possible with devastating consequences for its sustainability. Like many common pool resources, it effective management and governance therefore require a set rules, norms and values that should underpin its development in a manner that is consistent with the ecosystem approach. The challenges faced for sustainably managing such a common resource, on which people have established de facto individual rights are manifold. But creating a market for trades of some kind in ecosystem services associated with groundwater could actually enhance the protection of a critical resource such as groundwater on the basis that protection can benefit individual groundwater users economically as well as provide a broader public good. This piece examines the meaning governance in the *Global Framework for*

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*Action to achieve the vision on Groundwater Governance* document and the potential and challenges of using market-based approaches in its implementation, with a focus on developments in conservation policy and law.

## WHAT DO WE MEAN BY GOVERNANCE?

The term governance is as elusive as groundwater itself. It can mean different things to different people but would generally be concerned with how decisions are taken and implemented. Generally, good governance is seen as promoting equity, participation, pluralism, transparency, accountability and the rule of law, in a manner that is effective, efficient and enduring. Such a characterisation suggests that good governance is not only concerned with governmental activity but also private sector and non-governmental actors. Which of these characteristics is seen as most important, and how issues will be resolved will vary greatly, depending on the broader governmental and legal context, but at the minimum, there must be a means of ensuring that groundwater management schemes are widely accepted as having the legitimacy to enable them to continue, and especially to justify any financial advantages granted to participants. Good governance helps to build trust and confidence among the various stakeholders, which is central to the success of any market-based mechanism. However, the principles of groundwater governance outlined in the *Global Framework for Action to achieve the vision on Groundwater Governance* document would appear to go beyond those regarded above as the basic principles of good governance, to include consideration of wider principles such as the ecosystem approach which is evident in almost all the principles of groundwater governance, as the following analysis suggests.

## DEVELOPMENTS IN CONSERVATION POLICY AND LAW - ECOSYSTEM APPROACH

Since the 1990s, there has been a shift in focus from the narrow species or habitats approach in conservation efforts towards an ecosystems approach. According to the Convention on Biological Diversity (CBD) COP 5 Decision V/6 (2000), this new approach involves 'a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way'.

Central to this is the emphasis on the conservation of ecosystem structure and functioning, in order to maintain ecosystem services. This not only requires adopting a new way of thinking and working but also a shift in focus of policy-making and delivery towards a more holistic or integrated approach based on the entire ecosystem and its functioning. This is based on the increased recognition of the role of the 'natural' environment in providing a range of services, either directly or indirectly.

The more holistic approach encouraged requires a shift in the both the mind-set and practices of many of those who manage and use land. For example, farmers who depend on groundwater ecosystem services are now going to see themselves as 'integrated land managers' who produce food and provide ecosystem services rather than merely 'food producers'. This will require adaptive management to produce the ecosystem services that groundwater underpins but there are particular challenges as to how such adaptive management practices will be reconciled with established agricultural and other uses on specific lands where multifunctionality is yet to be recognised and the costs associated with such changes.

A starting point in the shift in our policies and practices to reflect the value of land (and groundwater) in providing ecosystem services is to calculate in economic terms the value of such services and to ensure that this is properly taken into account

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when decisions that affect the state of undeveloped land are being taken. Such an approach would fit the groundwater governance themes, by ensuring that the provision of groundwater ecosystem services is integrated with other land uses and that there is coordination with other water sources. This is important because available evidence shows that the spatial layout of ecosystems is important for the interactions that give rise to ecosystem services. For example, linkages between ground water, surface water and rainfall within in the area of a river catchment mean that impacts on any one of these can affect hydrological processes within the catchment and the ecosystem services linked to these processes, such as clean water provision. Equally, the social value of ecosystem services (e.g. the thermal springs in Salto, Uruguay) relates spatially to where they are consumed, hence the emphasis on context-specific groundwater management.

## LESSONS FROM BIODIVERSITY CONSERVATION POLICIES

The need to establish linkages to other water resources and to other sectors in groundwater governance requires not just better scientific understanding of these linkages but also provides an opportunity to look at the potential lessons from approaches already adopted in the management of other resources. Along these lines, developments in conservation policy and law are creating opportunities to look at habitats and their management in a new way, based on identifying and valuing in economic terms the ecosystem benefits that undeveloped land can provide.

Traditionally conservation law has been based on prohibiting direct harm to species and designating areas of habitat that have to be protected. Now there is interest in new approaches, in particular:

- biodiversity offsetting, whereby harmful development in one place is permitted if provision is made for compensating enhancements elsewhere, so that there is no net loss to nature overall;
- payment for ecosystem services, whereby there is recognition that "natural" land provides benefits to neighbours and the wider community (e.g. flood protection or recreational or aesthetic value) and payment is provided to ensure the maintenance of these services.

These approaches mean that there are opportunities for wetlands and aquifers to be re-evaluated. For example land where groundwater-related ecosystem services can be enhanced or established might be valuable as potential offset sites for developments elsewhere (e.g. building infiltration wells along the head area of one aquifer in order to store surpluses of water in the wet periods to offset for overexploitation of a nearby aquifer), whilst identifying the actual and potential ecosystem services that the groundwater can deliver might provide an income stream for land which is currently unproductive, thereby encouraging balance (rather than competing) of use from sources that allows hydraulic equilibrium to be established in the aquifer. Although there is acceptance that groundwater should be under public stewardship and that the role of the private sector should be supplementary, the possibility of extending such approaches to groundwater has not yet been fully explored but may be a significant issue as our understanding of the inter-linkages between groundwater and various ecosystems and ecosystem services, and the vulnerability and resilience of groundwater-dependent systems improves.

There are significant challenges in the adoption of the new approaches. For offsetting, for example, this will include devising legal mechanisms to provide long-term guarantees for the protected land, whilst allowing some flexibility. For payment of ecosystem services, an important challenge will be determining whether payment should be based on "inputs" (e.g.

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work done to maintain or enhance groundwater levels) or "outputs" (e.g. the actual benefits delivered, such as the quantity and quality of groundwater benefited), noting that these may be separated in time by many years.

In addition to resolving the legal issues in creating appropriate mechanisms to implement such ideas, a fundamental requirement is sound science that identifies the actual and potential value of aquifers from this new perspective. Knowing what ecosystem benefits groundwater is currently providing, and could provide (and their value), is an essential building block in operating any offsetting or payment scheme and may call for a shift in emphasis in scientific research.

For further information:

- Global Framework for Action to achieve the vision on Groundwater Governance available at: http://www.groundwatergovernance.org/fileadmin/user_upload/groundwatergovernance/docs/general/GWG_FRAMEWORK.pdf
- For more information on applying the ecosystem approach to groundwater governance and management, see CGIAR Research Program on Water, Land and Ecosystems (WLE) 2015 report on Groundwater and ecosystem services: a framework for managing smallholder groundwater dependent agrarian socio-ecologies - applying an ecosystem services and resilience approach, available at: http://www.iwmi.cgiar.org/Publications/wle/corporate/groundwater_and_ecosystem_services_framework.pdf
- More information on developments in conservation law and policy can be found at CT Reid, 'The Privatisation of Biodiversity? Possible New Approaches to Nature Conservation Law in the United Kingdom' (2011) 23(2) Journal of Environmental Law 203-232.

## 25. GROUNDWATER ECONOMICS FROM A NATURAL CAPITAL VALUATION PERSPECTIVE

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Sustainability is not only an ethical or a corporate responsibility issue but also a financial one for core business and government operations. Thus neglecting conservation of nature has financial implications by increasing exposure to risk of ecosystem failures which has already been exacerbated by climate change. By investing in nature conservation, organisations can reduce their exposure to ecosystem related risks. Freshwater related risks (in terms of both quality and quantity) are among the most threatening ecosystem related risk, if not the most.

Any sustainable approach to freshwater governance has to take groundwater and surface water simultaneously into account and inform the need for identifying and promoting best practices in groundwater governance as a way to achieve the sustainable management of water resources to offset global water crisis. Groundwater governance can be the way to address the water supply-demand imbalances in many parts of the world. We propose that natural capital discourse can assist the governance efforts by improving valuation and protection of groundwater by redirecting finances for effective groundwater management as required in the Global Groundwater Governance Framework for Action (2015).

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## WHAT DOES NATURAL CAPITAL MEAN?

Appropriate economic valuation of natural assets and services provided (in stocks and flows supported by the stocks) can facilitate funding nature protection by including true value of ecosystem services to our wellbeing and economy in social benefit–cost analyses and social progress accounts.

Although it is a new concept by the science and policy community, the consideration of nature as a form of capital is a long-standing approach in theoretical economics narrative. Natural capital is a powerful metaphor to translate value of undisrupted services provided nature to the language of finance and business which is based on metrics, numbers and robust decision tools rather than complicated terminology. More than a mere market valuation or inter-sectorial communication tool, the concept of natural capital helps underlining the unaccounted contribution of nature to economy and how environmental assets should be considered in the combination with other stocks required for production. Understanding of the value of nature both in economic and non-economic terms, and incorporating its value in financial accounts (and decision making processes), will help fill investment gap in nature and resource protection.

## RELEVANCE OF GROUNDWATER IN THE NATURAL CAPITAL DEBATE

Groundwater is the only dependable source of freshwater in many parts of the world. Thus, it can offer resilience and supply security as a strategic reserve throughout the years against fluctuating supply and escalating frequency of extreme weather conditions that are exacerbated with climate change. Issues with surface water extraction also adds to the significance of groundwater. The water supply risk has already been accepted as a major risk that affects business operations and thus impacts the financial valuation of companies. A similar risk is also present in the governmental planning. Groundwater is interconnected not only to safe securing water supply, but also a wider set of dividends for (agricultural an industrial) production and society in a system dynamics approach. Groundwater has a very important role in the food-water-energy nexus due to energy demand for pumping and reliance from agricultural and drinking water supply. On the other hand, land management heavily impacts groundwater quality and water tables as well as related ecosystems which provide a bundle of services essential to human livelihoods. Some of the countries with high climate change related water risk such as Pakistan, Iran and India, are reported to have the most extreme groundwater abstraction. It is also the largest source of groundwater supply in UK, providing up to 80% of the public drinking water supply in southern and eastern England (Environmental Agency, 2007). Global recognition and implementation of good groundwater governance can be a real game changer for achieving sustainable ecosystem management and future water security in especially the vulnerable countries.

Measurement of natural capital value is first step to diagnose the initial state of depletion in (ground)water wealth and to inform the ongoing investments in natural assets. International organisations such as the United Nations Environment Programme, World Bank, and FAO have already called for inclusion of the value of natural capital in sustainability metrics, such as inclusive wealth in their Global Groundwater Governance Framework for Action. For instance, measuring the vulnerability of a groundwater-dependent agricultural system requires measuring the wealth held in the aquifers. According to the recent study of Fenichel et al. (2016), Kansas lost approximately $110 million worth of capital value annually through over-abstraction of aquifers in the period between 1996 and 2005. In such cases natural wealth loss in terms

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of groundwater should be replaced via better governance and additional investment in restoration of natural and improvement of conventional assets (such as technological improvement) to reduce water-related risks the community is exposed to today and in the future as a result of former withdrawals beyond recharge rate.

In conclusion, better valuation of any stock or flow of natural resources is necessary to incentivise its users for its protection and to realise regional and intergenerational equity in the allocation of resources. A standard approach is required to quantify the vulnerability to water scarcity and to develop investment programs in support for groundwater resource protection required for climate change resilience at a broader context. Natural capital asset pricing can facilitate incorporation of water related vulnerability in the accounts of companies and companies and can be used as an economic tool for shifting funding necessary for better groundwater management.

For further information:


- Fenichel, E. P., Abbott, J. K., Bayham, J., Boone, W., Haacker, E. M. K., and Pfeiffer, L. (2016). Measuring the value of groundwater and other forms of natural capital. PNAS 2016 113 (9) 2382-2387 www.pnas.org/cgi/doi/10.1073/pnas.1513779113
- Environmental Agency, (2007). Assessing the Value of Groundwater. Science Report – SC040016/SR1 www.gov.uk/government/uploads/system/uploads/attachment_data/file/291073/scho0207bmbd-e-e.pdf
- Groundwater Governance Framework for Action (2015). http://www.groundwatergovernance.org/about-the-project/en/


## PART IV – LINKAGES



## 26. GROUNDWATER AND ENERGY GOVERNANCE: CAN WE FIND COMMON GROUND FOR SUSTAINABLE POLICY DEVELOPMENT?


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### MAKING ESSENTIAL LINKAGES: WHAT ARE THE CONNECTIONS BETWEEN GROUNDWATER AND ENERGY?

Groundwater, as explained in Working Principle 1 of the *Global Framework for Action to achieve the vision on Groundwater Governance,* needs to be managed and understood within its wider system of water resources. *Working Principle 5* of the *Groundwater 2030 Vision*, points to the importance of managing the interactions, and competition with other sectors. It is thus important to understand what links there are between water and other sectors in order to use resources more efficiently, and avoid negative trade-offs. There are intricate interdependencies between water and energy resources that make it essential to consider them in unison. The production and generation of energy requires water at most of its

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stages, and the provision of water requires energy in pumping and treatment.

The extraction of groundwater in particular accounts for a significant portion of energy use in water resources. Groundwater requires extensive pumping to be made available at the surface, as well as for treatment when contamination may be an issue. There is also significant pumping required for conveying groundwater from the source where it is pumped upwards to where it may be needed. Globally, groundwater use is intensifying due to pressures from changing populations, decreasing water quality from pollution, climate change, irrigation, industry, and sometimes for the extraction of fossil fuels, such as shale gas, or electrical power generation (Scott, 2013).

A deeper understanding of how these changes are influencing and affecting the availability of groundwater resources - as well as how groundwater resources can be used sustainably to meet some of society's challenges - is essential in order to ascertain how water may be sustainably used and shared in the future.

Overall, the role that effective groundwater management, regulation, and governance plays in being able to provide water without having an increasing impact on the environment is essential. Furthermore, the collective understanding of how changing groundwater resources affect the whole water use cycle today, but also in the uncertain future, will contribute to making sound decisions towards a sustainable future.

## WHAT ARE THE CONFLICTS AND SYNERGIES?

### *AGRICULTURE*

Groundwater irrigation is widespread around the world. However, agricultural sector energy use is highly subsidized in many areas of the world. This can lead to inefficient water use, and can be considered to be one of the main reasons for overexploitation of groundwater resources in some regions of the world. At the same time, extensive well development and the use of high energy consuming pumps (e.g. diesel pumps), leads to high energy use and greenhouse gas emissions. Cross-sectoral policy-making could help alleviate some of these burdens of groundwater pumping for agriculture, for example through specific pricing policies for pump irrigation. This would be an effective direction for groundwater management, as well as energy use (and associated greenhouse gas emissions), to move in. Regionally specific policies need to be developed in understanding of local cultural needs and prices.

The energy and water sectors can (and have to) work in conjunction with regional governments and stakeholders, in developing suitable supply and demand side policies for groundwater management. Supply side measures include actions such as artificial recharge of aquifers, conjunctive use of groundwater and surface water resources, the regulation of supply through registration of wells and boreholes, managing power supply to pumping areas or raising energy prices. Demand side interventions can involve the development of more efficient pumps, both through water efficiency and energy efficiency, improving irrigation practices or shifting from water-intensive crops (Singh, 2008). It is thus obvious, that the effective governance of groundwater resources requires a significant effort across sectors, not only water and energy, but also agriculture, and the inclusion of relevant stakeholders from the start.

### *ENERGY GENERATION*

A similarly complex issue is presented in the use of water for the extraction, production and exploitation of fossil fuels and the generation of electricity. The exploitation of traditional fossil fuels such as oil and gas can require the use of large amounts of groundwater, as well as pose threats to the quality of such waters. These activities require full policy cross-sectoral attention, and appropriate environmental

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regulation, as some groundwater sources may be used for public supply, and severe pollution incidents are not uncommon around the world.

Likewise, energy can also be generated from groundwater resources. Geothermal energy can be obtained from deep groundwater hydrothermal reservoirs. In these, groundwater is usually pumped and energy extracted from the heat. There are however, issues with the use of groundwater for such generation. For example, when an open-loop system is used, it can lead to the depletion of the groundwater source. Thus, cross-sectoral policy can also help in addressing some of the potential issues arising from such sources; for example, through incentivizing re-injection of the water and testing for quality when it is reinjected.

### *PUBLIC SUPPLY*

Energy used by water utilities is starting to be considered a major issue, due to rising energy use in the sector, particularly for pumping. As surface water resources become more over-exploited in regions of the world, the reliance on groundwater resources for the supply of water may increase. This has significant energy implications as it is more energy intensive to abstract water from groundwater resources than directly from surface sources. With increasing pollution, it may also lead to higher treatment needs. In the long term, this may have implications for the greenhouse gas emissions of the sector, which should be reduced. Thus, there is potential for cross-sectoral policy across climate change, water and energy to minimize some of these trade-offs and promote technological development, and the joint development of demand-side policies to reduce the growing demand for water and associated energy.

## CONCLUSIONS

The role of groundwater in the provision of fundamental resources for human development, including energy, food and clean water, needs to be emphasized. The issues presented here will have to see policy-makers, as well as groundwater scientists, engineers and the private sector, finding common ground to apply their skills to new conflict and potentially synergistic areas, and to interact with each other to assess impacts and optimize the use of natural resources. This is necessary if we are to meet our growing needs sustainably.

For more information:


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# 27. HYDRO-SCHIZOPHRENIA AND WATER SCARCITY INDICATORS: GROUNDWATER GOVERNANCE PRINCIPLES AS TOOLS TO BREAK OLD TENDENCIES


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## INTRODUCTION

Safeguarding an adequate amount of water to fulfil current and future needs of people and ecosystems alike is one of the biggest challenges the world is currently facing and poses the biggest threat to global prosperity. The role that groundwater plays in contributing to meeting these competing demands is inadequately addressed in the indicators applied to measure global water scarcity, yet these metrics have been mainstream to inform international development policy-making. This section of the

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working paper discusses the current approaches that inform water scarcity indicators in order to show the lack of consideration of groundwater contributions to global water availability. The implications of this neglect have led to a state hydro-schizophrenia (failure to link surface-ground water interactions within the global water community). It will be proposed that the Global Framework of Action for Achieving Groundwater Governance may be a suitable starting point to address the current state of affairs.

## MEASURING GLOBAL WATER SCARCITY: MEAN ANNUAL RIVER RUNOFF

Water scarcity can be conceptualised as a lack of available water relative to demand. More than 150 indicators that measure water scarcity exist but common to them all is that two dominant approaches to measure water scarcity underlie them all. The first approach holds that water scarcity occurs when annual water availability per capita is below 1,000 cubic metres per capita per year whereas the second contends that conditions of water scarcity occur when the ratio of annual freshwater withdrawal to availability (wta) exceeds a ratio of 0.4.

Both approaches commonly characterise freshwater resources as derived from observations and simulations of Mean Annual River Runoff (MARR) (i.e. river "runoff"). The use of MARR to define freshwater resources is problematic for several reasons. As a measure, MARR assumes that it adequately represents renewable blue water resources as the difference between mean precipitation and actual evapotranspiration). However, MARR does not represent the proportion of river flow that derive from steady baseflow (e.g. groundwater discharges, meltwater flows) and episodically from stormflow (i.e. subsurface flow). Thus, groundwater with a long residence time is not considered as contributing to renewable freshwater availability nor is the contribution of green water (soil moisture) or surface water storage (man-made dams, ponds, rainwater harvesting). MARR uses discharge data from gauging stations in river and simulations computed at an annual average scale. Thereby, the temporal inter and intra-annual variability is masked in measurements of freshwater availability as the approach assumes a state of global hydrological stationarity which considers changes in terrestrial storage negligible. The lack of consideration for these temporal variations is particularly crucial for low-income tropical and semi-arid regions where the consequences of water scarcity are projected to be the most severe.

## THE GLOBAL FRAMEWORK OF ACTION FOR ACHIEVING GROUNDWATER GOVERNANCE AS A VEHICLE TO COMBAT HYDRO-SCHIZOPHRENIA

Indicators that attempt to measure global water scarcity have been applied globally for more than three decades with little regard for the role that groundwater plays in contributing to global water demands, yet they are used as a basis for international development policy formulation. The adoption of the Sustainable Development Goals (SDGs) on 25th September, 2015, was heralded as a big step towards fighting global poverty and inequality, but measuring progress towards these goals still remains problematic. SDG 6.4 aims "[…to] substantially reduce the number of people suffering from water scarcity" by 2030 but the proposed indicator to measure this reduction derives freshwater availability from MARR and shows no acknowledgment to the importance of correctly incorporating groundwater. Groundwater has an unprecedented ability to act as a buffer to climatic changes and although not a silver-bullet, the future of how we deal with shifting variability in rainfall may ultimately lay with how well we govern and manage our sub-surface stores.

Establishing with certainty the amount of global groundwater availability is a challenge but

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progressive attempts have been made. The amount of groundwater volume for Sub-Saharan Africa has been estimated to about a hundred times that derived from surface water across the entire continent. More recently, the importance of distinguishing between modern and old groundwater in terms of the time of recharge was highlighted and a subsequent study found that global "modern" groundwater, defined as that replenished over 50 years, is three times larger than global surface water volume. This groundwater is readily available in quantities much higher than surface waters alone, but is also much more vulnerable to contamination on account of the strong links with surface land-use than "older" groundwater. Groundwater has contributed to meeting water demands for decades but this has been overlooked by the wider water community, yet the effects of increased pumping on global groundwater reservoirs are real and visible. In order to better understand the role that groundwater plays requires the termination of the long-standing hydro-schizophrenic tendencies of the field. Hydro-schizophrenia is not just found within the water scarcity indicator community, but also within the domain of water law. It was only in 2008 that the full hydrological cycle was adequately addressed when the International Law Commission's Draft Articles on Transboundary Aquifers was drafted, albeit more than a decade after the adoption of the 1997 UN Watercourses Convention.

The tools to do away with the current hydro-schizophrenic paradigm and its dependence on MARR may lay within the working principles of the Global Groundwater Governance Framework (G3F). The first issue relates to the challenges surrounding data and knowledge-sharing. The increased ability to quantify with higher degrees of certainty the changes in both groundwater fluxes and stores requires more robust mechanisms for transboundary data-sharing. The historical tendency to focus on surface waters is reflected in the way in which river gauges have better time-series data than groundwater levels, the latter often coarse and inconsistent. This in part may be attributed to the level to which it is more practical and easier to measure surface water discharge through river gauges as opposed to groundwater levels through monitoring wells. Therefore, any historical data with regards to groundwater monitoring is precious and the G3F supports the crucial issue of data-sharing as part of groundwater governance through principle one, in which "[…] elements that contribute to the foundations of good governance are provisions for […] management of data and information". Like-wise, the starting point for moving beyond the inability of the global water community to think of water as three-dimensional is found in principle three of G3F which recognises that "Groundwater is part of a continuous cycle […] and groundwater and surface water […] supplement and feed each other". Through the application of these principles the future of good groundwater governance has the ability to do away with the old tendencies which are continuously validated through the application of global-scale water balance modelling that are not associated with governance purposes.

More information:


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## 28. THE ROLE OF THE PRIVATE SECTOR/FOOD INDUSTRY AND GROUNDWATER GOVERNANCE

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Groundwater is a public shared resource interlinked with many areas in the society such as food, energy, water supply, industry and the environment. There is more freshwater underground than on the surface of the planet and it is a critical resource for societies worldwide, and yet its understanding, governance and management have often been overlooked. The Groundwater Governance Global Framework for Action in its third theme identifies that connections with other sectors, such as the private sector, need to be systematically made. Effective groundwater governance is essential for groundwater management and it is only achievable with stakeholder participation. The private sector, and especially the food industry, constitutes a key stakeholder in this process as agriculture accounts for 70% of the global water withdrawals and industry for 20%. This short paper discusses the role of this sector by first outlining the reasons why they should work towards a better groundwater management. Furthermore, it suggests ways in which businesses can contribute to an improved groundwater management and governance. In addition, it argues the reasons why an emphasis should be made on the food sector and finalises with suggestions for future avenues for research and practice.

### WHY SHOULD THE PRIVATE SECTOR BE CONCERNED ABOUT GROUNDWATER?

Groundwater and its sustainability should be in the interest of the private sector as it poses a risk to their businesses in different ways. Water is a physical risk as its scarcity or pollution can have an impact on the production of their goods. In addition, it is a reputational risk because the company's image can be affected when the public poses questions about their sustainable policies around water. It is also a regulatory risk as it is expected that governments' policies in the water and groundwater areas will increase. Finally, it is a financial risk as all of the aforementioned risks can impact on businesses' revenues.

Water specialists have mainly focused their efforts on research and analysis of public institutions and are less familiar with the private sector. There is therefore a need for evaluating ways in which businesses can contribute to a better water and groundwater management.

### HOW CAN BUSINESSES CONTRIBUTE TO A BETTER GROUNDWATER MANAGEMENT AND GOVERNANCE?

The concept of Corporate Social Responsibility (CSR) is not recent and yet there is still not an agreement on what does it actually mean and let alone its significance to water or groundwater management. CSR is broadly defined it as the responsibility companies hold for their impacts on the society and the environment. As a result, when businesses mention sustainability there is little certainty on whether everyone is referring to the same thing. In addition, all CSR activities remain voluntary, which highlights the importance for developing a common language and a framework of action for promoting a sustainable water management in the private sector. It is worth noting that transparency, monitoring, accountability and reporting should be at the core of this process.

In an effort for doing so, the WWF proposes water stewardship for businesses as the evolution of increased improvement of water use and the reduction of impacts of internal and value chain

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operations on water resources. They broadly propose five steps for water stewardship for business water strategies:

1. Water awareness: companies need to have an awareness of water sustainability issues and their responsibility in this area. All levels in the company (from CEOs to plant managers and suppliers) should have an awareness of the water situation.

2. Knowledge of impact: this refers to the understanding of where the companies' impact on water resources and ecosystems are.

3. Internal action: refers to the actions to help tackle technical fixes, water efficiency, pollution reduction, measuring and reporting. This means an engagement with employees, buyers and suppliers to establish potential opportunities and risks for the company.

4. Collective action: is an engagement with external stakeholders such as customers, communities, NGOs and other companies. The forms of water stewardship partnerships can vary from place to place which will depend on the presence of appropriate partners, the degree of development and the willingness to engage.

5. Influence on water governance: A successful engagement needs businesses to be aligned with the broader public interest. This can be done with the collaboration with NGOs, business coalitions and also acting as individuals.

Up to date, the WWF has carried out work on water stewardship on 15 river basins around the world. However, there is no evidence of work being carried out in any aquifer or groundwater system. This highlights the urgent need for including groundwater in all the initiatives that aim for a better water governance and management.

## WHY SPECIAL EMPHASIS SHOULD BE MADE ON THE FOOD SECTOR?

Groundwater is estimated to provide 42% of water for irrigated agriculture and 24% of industrial supply, and these figures are expected to rise. Food relies on agriculture, and hence on water, for its production. Food demands are estimated to double in the next 50 years due to population growth and changing diets. Much of the water used for food production comes from groundwater resources and thus there is an urgent need on finding ways that promote an effective groundwater governance and management.

## AVENUES FOR FUTURE RESEARCH AND PRACTICE

Effective groundwater governance is only achievable with effective stakeholder engagement. In this process, the private sector, and especially the food sector, plays a key role, as it is a major user of groundwater resources. The private sector needs to pay special attention to water as it poses a series of risks to their businesses, all of which translate into financial risks. A better groundwater management in the private sector can be achieved through improved CSR strategies. However, there is a lack of standardisation and development of a common language and framework of action for water, and let alone groundwater, management in the private sector. Initiatives such as water stewardship for businesses have aimed for an improved water use and management, but they lack of the consideration of the groundwater dimension. In conclusion, future groundwater governance research and practice should focus on effective mechanisms for participation and engagement with the private sector, with emphasis on the food sector.

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For further information:


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## CEREGAS (Regional Centre for the Management of Groundwater in Latin America and the Caribbean)

CeReGAS was officialised and signed off as a Category II Centre of UNESCO in 2014 with the aims of providing facilities and opportunities for advanced research on aquifer systems and groundwater resources management for scientists from Latin America and Caribbean countries. The purpose of the Centre is two-fold: to strengthen national capacity in support of the sustainable management of aquifers in the country, and to address the needs and requirements jointly identified with other countries of the region by working in mutual cooperation. The objectives and programmes of the proposed Centre would contribute to fulfilling the objectives of the UNESCO International Hydrological Programme.

## SCELG (Strathclyde Centre for Environmental Law and Governance)

SCELG operates as a centre of academic excellence in environmental law and governance within the University of Strathclyde. The goal of the Centre is to foster multidisciplinary and policy relevant research in international, European and national (both Scottish and English) environmental law and governance. The Centre is also a hub for excellence in PhD and postgraduate teaching programmes in environmental law and governance within the Law School. It hosts a Visiting Researcher Programme and welcomes consultancy collaborations with public and private policy makers and stakeholders.

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