Geo-hydrology of Transboundary Aquifers and International Water Law

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Abstract

Aquifer systems undoubtedly present the world's most predominant freshwater reservoirs; and also serve as the most dependable alternative in water stressed areas. However, aquifers are at risk of over-exploitation, especially in cases where these systems cross one or more political borders. Thus, In order to promote equitable use and encourage cooperation, states rely on principles of customary international law to guide and govern the use of transboundary water resources. This article reviews the three main legal instruments governing transboundary waters, with the aim of substantiating the need for a separate regulatory instrument for transboundary aquifers.

I. Introduction

Groundwater is found under the surface of the earth, accumulating and filling up the spaces (not filled by solid mineral matter) between rocks, sediment, or soil (Conti and Gupta, 2015). When water infiltrates the surface of the earth, it inundates pores of permeable strata (fig 1.1), ultimately collecting above non-permeable layers of geological formation, creating an underground reservoir. These inundated permeable strata together with the water contained within the strata, are known as aquifers (Morris *et a*l., 2003).

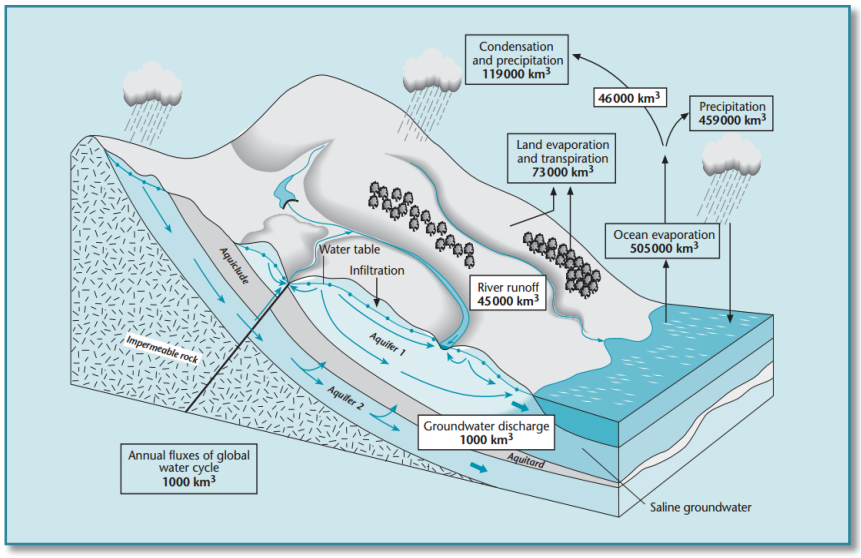

Figure 1.1 Schematic representation of groundwater within the global hydrological cycle (Morris *et al*., 2003).

The single most important function of an aquifer is its groundwater storage capability (Morris *et al*., 2003). Although aquifers hold volumes of fresh potable water that can be beneficial in domestic, as well as in agricultural and industrial activities, the assessment, regulation, management as well as compliance monitoring of aquifer systems is largely non-existent, especially in Africa (Pietersen *et al*., 2012), furthermore, the issue becomes even more challenging where these aquifers cross one or more international borders.

II. Transboundary Aquifers

There are currently approximately 608 transboundary aquifers worldwide (IGRAC, 2015). Although they are located beneath the earth's surface, such systems (similar to surface waters) are quantitatively and qualitatively strongly affected by human development. Moreover, on a global scale, the sustainable development of transboundary aquifers is disadvantaged by distinct policies, institutional frameworks, level of expertise, and different rules of good governance on either side of an international boundary (Varady, 2010).

The sustainability of groundwater abstraction depends on the cooperation of states on the utilisation, protection and development of transboundary aquifers (Blomquist and Ingram, 2003). Although there is a plethora of examples on the management of international rivers, the same cannot be said for the management of transboundary aquifers (Eckstein and Eckstein, 2003), most of which have only recently been identified.

Since governance is different in each state, aquifer states must find rules of good governance acceptable to all. These rules are usually found in treaties and agreements among states. Although such rules have been comprehensively developed for the management of transboundary surface waters, the rules on the good governance of transboundary aquifers are still in draft form. Moreover, states are trying to come up with legal instruments that will create institutional frameworks that will promote and regulate the sustainable use and socio-economic development of transboundary aquifers without overlooking environmental protection in each state (Llamas and Martínez-Santos, 2005).

III. International Water Law

The advancement of international water law represents the progressive development of the international regulation of surface waters, with that of transboundary aquifers gravely lagging behind. With the increasing dependence on groundwater abstraction, states are now facing challenges relating to the use, access, protection, and development of transboundary aquifers. Furthermore, because of the nature of aquifers, states are faced with contradicting ideologies regarding the ownership of transboundary aquifers (Eckstein and Eckstein, 2003). Therefore, in order to avoid disputes with regards to the beneficial use and sustainable development of transboundary aquifers, the rights and obligations of aquifer states *vis-à-vis* transboundary aquifers must be elucidated in accordance to the progressive development of international law (Eckstein and Eckstein, 2003 and Llamas and Martínez-Santos, 2005).

The objective of this article is to analyse, and review, the three international legal instruments for the regulation of international waters, with the aim of ascertaining the need for a separate regulatory instrument for transboundary aquifers. This article reviews the 1992 United Nations Economic Commission for Europe Convention on the Protection and Use of Transboundary Watercourses and International Lakes (the Water Convention); the 1997 Convention on the Law of the Non-navigational uses of International Watercourses (the Watercourses Convention); as well as the 2008 Draft Articles on the Law of Transboundary Aquifers.

a) The 1992 United Nations Economic Commission for Europe Convention on the Protection and Use of Transboundary Watercourses and International Lakes

The UNECE Water Convention aims to protect and ensure the quantity, quality and sustainable use of transboundary water resources by facilitating cooperation, and providing an intergovernmental platform for the day-to-day development and advancement of transboundary cooperation (UNECE water convention, 1992). The convention is applicable to transboundary aquifers as reflected in its definition of transboundary waters which states that *"Transboundary waters" means any surface or ground waters which mark, cross or are located on boundaries between two or more States;…."* (UNECE water convention, 1992).

The Water Convention requires state parties to use transboundary waters in a reasonable and equitable manner which ensures their sustainable management. Furthermore, member states must take the responsibility to prevent, control and reduce transboundary impact as well as to cooperate by establishing joint bodies and entering into specific agreements with neighbouring watercourses states (UNECE water convention, 1992).

The Water Convention covers all surface and groundwaters, however, the provisions of the convention are primarily focused on the efficiency of measures taken by states to reduce, control and prevent pollution and other transboundary impacts, the monitoring and assessment of transboundary waters, the exchange of information between riparian states as well as the availability and accessibility of water quality data and information to the public (UNECE water convention, 1992). The convention follows a holistic approach and does not differentiate between transboundary surface and groundwaters.

The convention which entered into force in 1996 was first established as a legally binding regional agreement for member states within the Economic Commission for Europe (ECE), to regulate and manage the water quality issues affecting international waters. However, the convention became a universally applicable legal framework for transboundary cooperation, following its amendment in 2003, and the subsequent entry into force of amendments in February 2013 (UNECE, 2016). The convention is now open to all UN Member States and as of the 1st of March 2016, UN Member States outside the ECE region can accede to the Convention (UNECE, 2016).

b) The 1997 Convention on the Law of the Non-navigational uses of International Watercourses.

The Watercourses Convention was developed with the aim of establishing a legal instrument in order to govern the utilisation of international watercourses, as well as to provide watercourses states with a framework to follow in applying key principles and rules of international water law. The convention was adopted in 1997 and entered into force in 2014 when Vietnam ratified as the 35th state.

The general principles embodied in the Convention are equitable and reasonable utilization of international watercourses, and the obligation of watercourses states to take all appropriate measures within their territories to prevent significant transboundary harm (Watercourses Convention, 1997). Thus, in order to achieve equitable and reasonable utilisation as well as to prevent significant harm, watercourses states are to cooperate with each other through the exchange of relevant information, notification of planned activities, as well as by entering into consultations and negotiations as necessary; in order to prevent disputes (Watercourses Convention, 1997).

Similar to the UNECE Water Convention, the Watercourses Convention also stipulates that states have the responsibility to prevent, reduce and manage pollution in order to preserve and protect ecosystems of international watercourses. Likewise, the Watercourses Convention is applicable to transboundary surface waters and groundwaters; however, unlike the UNECE Water Convention, the applicability of the Watercourses Convention is limited to "*systems of groundwaters hydraulically connected to international surface waters*" (Watercourses Convention, 1997).

Both conventions are applicable to transboundary groundwaters, however their applicability is limited. Although the UNECE Water Convention covers all transboundary surface and groundwaters; it's holistic approach to regulating transboundary waters results in the lack of appreciation for the different characteristics between surface and groundwaters. On the other hand, the Watercourses Convention's limited applicability to "*groundwaters hydraulically connected to international surface waters*" results in the exclusion of groundwaters not hydraulically connected to international surface waters.

This gap is addressed by the current draft articles on the law of transboundary aquifers, although the articles are non-binding, the draft articles were created with the aim of establishing a foundation to the development of a convention on the law of transboundary aquifers.

c) The 2008 Draft Articles on the Law of Transboundary Aquifers

The regulation of transboundary aquifers is still in its infancy; this is evident from the six international agreements signed on the 608 transboundary aquifers worldwide, compared to over 3600 agreements signed on the 279 transboundary surface waters. Nevertheless; groundwater is usually mentioned or addressed in most bilateral, multilateral as well as regional agreements over surface waters such as in the Inco-maputo agreement, the Danube, the Mekong, and the SADC Protocol.
The development of transboundary aquifer law is therefore very pertinent, considering the importance of these systems to global water security. Following the adoption of the watercourses convention, at its fifty-sixth session in 2001, the General Assembly invited states to identify and propose topics in areas that needed clarification of the

law. The International Law Commission (ILC) at its fifty-fourth session in 2002, decided to include work on the clarification and codification of the law on shared natural resources, as one of the topics that delegations in the Assembly expressed as “ripe for codification” (Yamada, 2003b).

The newly appointed Special Rapporteur, Mr Chusei Yamada, during the second part of the commission’s fifty-fourth session, indicated that since the commission had already dealt with the topic of transboundary watercourses, and produced a resolution on Confined Transboundary Groundwater, he intends to follow on the syllabus prepared by Mr. Rosenstock for the Watercourses Convention and the resolution on confined transboundary groundwater (Yamada, 2003b). The resolution, which formed the basis of the draft articles on the law of transboundary aquifers, was therefore developed as a platform to establish rules pertaining to transboundary aquifers (ILC, 1994).

The commission established a working group on transboundary groundwater, and over a period of six years, worked with groundwater experts from the Economic Commission for Europe (ECE), the International Hydrological Programme of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Food and Agriculture Organization (FAO) as well as the International Association of Hydrogeologists (IAH). The commission; through the assistance of the Secretary General, and in consultation with the governments of member states, adapted on first reading, draft articles on the law of transboundary aquifers in 2006 (ILC, 2006). Following observation and comments received from member states, the draft articles on the law of transboundary aquifers were concluded in 2008 in response to the need for an instrument to regulate the exploitation of transboundary aquifers (ILC, 2016).

Based on the inclusion of groundwater related to surface waters in the Watercourses convention, the scope of the draft articles on the law of transboundary aquifers therefore, addresses transboundary aquifers shared by more than two states, and are not covered by article 2 (*a*) of the Watercourses Convention. However, the special rapporteur suggested the broadening of the scope of the draft articles to include aquifer systems made up of aquifers hydraulically connected to surface waters, as well as confined aquifers. Yamada argued that in such instances, both the Watercourses Convention as well as the draft articles can be applied by states sharing transboundary waters (Yamada, 2003a).

These draft articles were submitted to the General Assembly (GA) with the recommendation that the assembly expand on a convention on the basis of the draft articles. Although not legally binding, the draft articles were adopted by the assembly with the intention of encouraging States to take appropriate measures in establishing bilateral, multilateral or regional agreements for the conservation, protection and successful management of transboundary aquifers.

It has been over eight years since the initial adoption of the draft articles in 2008. Over the course of the eight years, the topic on the law of transboundary aquifers made it to the agenda of three GA sessions, the 66th session in 2011; the 68th session in 2013 and most recently in the current 71st session in December 2016. At each of the three sessions mentioned above, the General Assembly reminded states of its previous resolutions on the law of transboundary aquifers, emphasised the importance of the

subject of the law of transboundary aquifers in the relations of States, encouraged UNESCO-IHP to continue its valuable work on the topic, and postponed further consideration of the law of transboundary aquifers to a predetermined GA sessions in the future.

In its 2008 and 2011 resolutions, the GA encouraged States to 'take into account' the provisions of the draft articles when entering into bilateral or regional arrangements for the appropriate management of their transboundary aquifers. Furthermore, these two resolutions (2008 and 2011) close by recommending the addition of the topic to future sessions with the "view of examining, inter-alia, the question of the final form that might be given to the draft articles." In its 2013 and 2016 resolutions however, the Assembly has moved from encouraging states to '*take into account'*, to "commending the draft articles as *guidance* for bilateral and regional agreements…" and has also left out from its closing statement the aim of adding the topic of the law of transboundary aquifers on the agenda of future sessions.

Even though the last two resolutions do not make mention of "*examining*" the form that the draft articles should take, the movement from taking the draft articles '*into account'* when developing bilateral and regional agreements, to using them as '*guidance*' is a significant step in the development of the law of transboundary aquifers (Eckstein and Sindico, 2014).

Although the draft articles are straight forward and easy to understand, two articles (article 2a and article 3) present potentially controversial concepts. Article 2 (a), defines an aquifer as '*a permeable water-bearing geological formation underlain by a less permeable layer and the water contained in the saturated zone of the formation*.' This definition on its own explicitly excludes 'confined aquifers' from the scope of the draft articles. Aquifers can be categorised in into three, unconfined, semi-confined and confined aquifers (Meinzer, 1923; Sophocleous, 2000 and Eckstein and Eckstein, 2003). Unconfined aquifers are hydraulically linked to surface waters and serve as base flow for all springs and most groundwater-fed rivers and lakes (Sophocleous, 2000 and Eckstein and Eckstein, 2003).

Semi-confined aquifers are partially closed from above, below or laterally, thus being partially impermeable, and confined aquifers are completely confined within aquicludes (impermeable rock) from above and below, enclosing water that percolated the aquifer during its formation, such a completely confined aquifer, is also known as a fossil aquifer (Sophocleous, 2000 and Eckstein and Eckstein, 2003). Thus from article 2(a), the '*permeable water-bearing geological formation underlain by a less permeable layer'* refers to unconfined and semi-confined aquifers.

Another potentially controversial concept is presented in article 3, the 'sovereignty of aquifer states' which stipulates that '*each Aquifer State has sovereignty over the portion of a transboundary aquifer or aquifer system located within its territory, and thus shall exercise its sovereignty in accordance with international law and the present draft articles'*.

IV. Discussion

Without water; food security is threatened and economic development ceases, water is first and foremost a source of life; but also represents a source of power. The hydro-politics of shared water resources observed throughout the globe represent the power aspect of water. Thus in successfully managing and regulating shared water resources, the politics surrounding water resources must be acknowledged. To prevent conflict among states, the regulation of transboundary groundwaters requires cooperation, joint management, sustainable use of transboundary aquifers, as well as the protection, preservation and conservation of these finite resources.

Although states have permanent sovereignty over their natural resources, in order to promote cooperation and equitable sharing of transboundary natural resources, states have relied on principles of customary international law to guide and govern the use of shared natural resources. Thus, to avoid one state's policy impacting on another state's water security (Vlachos, 1998); transboundary water governance must be implemented at all levels, from the catchment level, through to the international level (Darnault, 2008).

In order to achieve all these aspirations, states need to formulate water policies that recognise the unique characteristics of groundwater, namely, its slow movement, low recharge rates, its connection to surface waters, vulnerability to contamination, and its subsequent difficulty to mitigate existing pollution.

Thus the non-renewable nature of confined aquifers by virtue of its extensive slow flow rate (when compared to unconfined aquifers) warrants transboundary aquifers a distinct regulatory instrument. However, with the coming into force of the UN Watercourses Convention (which is applicable to unconfined aquifers), as well as the opening up of the UNECE Water Convention (which is applicable to all transboundary surface and groundwaters), the development of a legally binding Aquifer Convention will leave states more perplexed with regards to which of the three conventions to accede to. Furthermore, the fact that the international community is currently sitting with the same draft articles proposed in 2008, and that there draft articles have never had any proposed amendments, may indicate the reluctance of states in developing a distinct convention on the law of transboundary aquifers. Moreover, the UNGA's silence on examining the final form of the draft articles in its last two resolutions further affirms this perception.

The draft articles on the law of transboundary aquifers were developed with the aim of providing a legal framework for the regulation of transboundary aquifers, thus, since the UNECE Water Convention was only open to ratification by ECE states, the draft articles on the Law of Transboundary Aquifers were therefore aimed at complementing the Watercourses Convention, and addressing the management, conservation and protection of transboundary aquifers (McCaffrey, 2009).

It is important to eliminate ambiguity in the selection of words used in the draft articles. Such ambiguity in the use of terms as well as article 3 of the draft articles can result in a lot of confusion with regards to the scope of the draft articles, as well as the application of other provisions by aquifer states. Although in his second report, the Special Rapporteur, Mr Yamada explains that the definition of an aquifer is not meant to be reflective of hydrological conditions, but was rather selected for simplicity

(Yamada, 2008a), in order to minimise ambiguity, article 2a of the draft articles should cover all aquifers (unconfined, semi-confined as well as confined aquifers) in its definition. For example, the article can define an aquifer as '*a permeable, semi-permeable or impermeable water-bearing geological formation and the water contained in the saturated zone of the formation*.' The definition is all inclusive and self-explanatory.

Even though the provision of article 3 on the sovereignty of aquifer states, goes on to say that …'*each state shall exercise its sovereignty in accordance with international law…*' that part of the provision is in a way superseded by the first part advocating the sovereignty of states, this is evident in article 3 of the Guarani agreement which states that 'all aquifer states are sole owners of the transboundary aquifer' and that 'each state has territorial control over parts of the aquifer within its respective borders'. The Guarani aquifer agreement was developed after the establishment of the draft articles on the law of transboundary aquifers, and makes reference to the ILC draft articles in its preamble. Although article 3 of the draft articles is in accordance with international law, by not explicitly stipulating that *each 'Aquifer State has **limited sovereignty**….' over the portion of a transboundary aquifer or aquifer system located within its territory,* the provision was misinterpreted by the Guarani aquifer states.

Expanding the scope of the draft articles to include unconfined aquifers (covered by the Watercourses Convention) needs harmonising of the two instruments (the UNWC and the draft articles), so as to eliminate regulatory problems as to which of the contradicting provisions of the two instruments would be applicable in states sharing a transboundary river (or other surface waters) as well as a transboundary unconfined aquifer. In such cases, as in the case of Brazil, Argentina, and Uruguay, which share the Uruguay River and are underlain by parts of the Guarani aquifer system, there would be irregularities and lack of cooperation in cases where the three countries are not parties to the same agreement. Lastly, the application and interpretation of the contradicting provisions of the two instruments might result in disputes among watercourses states sharing a transboundary aquifer.

There are only six international agreements on transboundary aquifers, two of which (the Iullemeden and the Guarani aquifer agreements) are the most comprehensive, and were developed after the establishment of the draft articles one the law of transboundary aquifers in 2008, however, only the Guarani aquifer agreement makes reference to the draft articles on the law of transboundary aquifers.

The Iullemeden is silent on the draft articles. The provisions of the agreement in accord with the draft articles are those that are shared by the Watercourses Convention and the draft articles. The analysis of the Iullemeden as well as the Guarani agreements indicates a strong accordance with the provisions of the Watercourses Convention.

V. Summary, Conclusions and Recommendations

Recent trends in Integrated Water Resources Management (IWRM) identifies cohesive planning and management of all water resources (including groundwater), as the most dependable method in which water resources can be utilised in a manner that promotes their protection, conservation and sustainable development. Therefore, extending the concept of IWRM to the legal framework of international water law would provide watercourses states with a holistic overview of their shared resources,

providing a platform where true equitable, reasonable and sustainable use of shared water resources can be achieved.

Limiting the number of conventions with a similar scope, further allows for uniformity in the interpretation and application of the applicable convention, and enhances cooperation among watercourses states, while increasing collaboration, as well as conservation initiatives by states.

The review and analysis of the above-mentioned international regulatory instruments demonstrated that the UN Watercourses Convention does not cover confined aquifers within its scope, and that even though confined aquifers are covered within the scope of the UNECE Water Convention, the conventions' holistic approach is limited. Although the scope of the draft articles was meant to cover both confined and unconfined transboundary aquifers, the draft articles' definition of an aquifer explicitly defines an unconfined aquifer, and totally excludes confined aquifers from the scope of the draft articles. Thus it is a recommendation of this study that the draft articles should not be developed into an independent legal instrument, and that the current Watercourses Convention be revised to include the management, regulation, protection and conservation of transboundary confined aquifers within the scope of the convention.

It is therefore, a recommendation of this article that the ILC may extend the concept of integrated management of all water resources to the legal framework of international waters, developing one comprehensive regulatory instrument, which applies to all surface and all groundwater resources. Therefore, the revision of the current UN watercourses convention to include the management, regulation, protection and conservation of transboundary confined aquifers in the scope of the convention would be in accord with current water management practices.

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