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Managing buried treasure across frontiers: the international Law of Transboundary Aquifers

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In recent years, transboundary aquifers have received growing attention in numerous policy-making and negotiating circles. This development suggests an evolution in customary international law for transboundary aquifers. This article examines recent international arrangements and pronouncements related to the assessment, use, allocation and protection of transboundary groundwater resources and identifies the legal trends emerging from these instruments. The article also considers gaps and shortcomings in the emerging regulatory regime and offers recommendations for the further development of the law.

Keywords: international water law; groundwater; international groundwater law; transboundary aquifers; water dispute

Introduction

Until quite recently, transboundary groundwater resources were treated as the neglected stepchild of international water law.[1] Transboundary aquifers were habitually ignored in projects with international implications, consistently omitted from treaties and cursorily misunderstood in much of legal discourse. To a large extent, these resources were "out of sight, out of mind", largely because few realized that the resource they pumped was shared with another county. This neglect now appears to be on the wane.

Over the past few decades, transboundary aquifers have received increasing attention at all levels of civil society in the context of policy and law-making initiatives, academic exercises and a number of significant negotiations. A highly detailed management and allocation scheme was implemented on the Genevese Aquifer situated along the French–Swiss border (Convention Genevois 2008), while more rudimentary consultative and data-sharing agreements were applied to the Nubian Sandstone and Northwestern Sahara aquifers in North Africa (NSAS 2002, SASS 2002); a comprehensive cooperative arrangement was drafted for the Iullemeden Aquifer System in West Africa (Iullemeden MoU 2009), while a less-specific agreement was formulated for the nations overlying the Guarani Aquifer in South America (Guarani Acuerdo 2010); and a model transboundary-aquifer agreement was developed by a multidisciplinary group of experts meeting in Bellagio, Italy, for the Mexico–United States border (Hayton and Utton 1989). Furthermore, transboundary groundwater resources have featured prominently in the 1992

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United Nations Economic Commission for Europe Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UN/ECE 1992), the 1997 UN Convention on the Non-Navigational Uses of International Watercourses (UN 1997), the 2000 Revised Protocol on Shared Watercourses in the Southern African Development Community (SADC 2000) and the International Law Association's 2004 Berlin Rules on Water Resources Law (ILA 2004). In addition, unofficial arrangements have been forged by sub-national political entities for the Hueco Bolson Aquifer underlying the cities of El Paso and Juárez on the Mexico–United States border (Juárez–El Paso MoU 1999), and for the Abbotsford–Sumas Aquifer between the US State of Washington and Canadian province of British Columbia (Abbotsford–Sumas MoA 1996). And in late 2008, the UN International Law Commission (UNILC) formulated 19 draft articles on the law of transboundary aquifers (Draft Articles) thereby focusing global attention on the legal status of aquifers that traverse international political boundaries (UNGA Resolution 2008). While this catalogue is not comprehensive, the breadth of this list indicates that concerns about aquifers shared by multiple nations are no longer secondary to those of surface-water resources. Transboundary aquifers have come into their own and are now legitimate topics of international law, policy and relations.

The escalating interest in transboundary groundwater resources is largely a reflection of the growing importance that aquifers, especially those traversing international boundaries, are having in meeting nations' development needs and objectives. This is particularly evident in the Middle East where the use and allocation of transboundary aquifers, such as the Qa Disi Aquifer shared by Jordanians and Saudi Arabians and the Mountain Aquifer shared by Israelis and Palestinians, continue to be a source of friction among overlying riparians. The growing interest in shared groundwater resources, however, is also a response to the realization that few concrete rules exist in international law to govern relations over these buried treasures. As nations around the world begin to extract (or intensify their withdrawals of) groundwater from aquifers traversing international political boundaries, they are raising important questions related to the rights and obligations that riparian states can claim to these shared resources.

State practice and experience pertaining to the utilization of transboundary aquifers are slowly becoming more prevalent, and nations and scholars are now giving more thought to the formulation of rules and regulations for the management of these critical resources. While the law of transboundary aquifers is in an early stage of development, it is already possible to identify a number of trends, based on the practices of states, which are relevant to this nascent body of law. In an effort to identify and characterize these trends, this study reviews some of the activities and procedures states have pursued in the coordination, management and allocation of transboundary groundwater resources as evinced by formal and informal arrangements that they have entered into in relation to those resources. It also considers the work-product of international organizations relevant to the topic.

The study begins by addressing the importance of transboundary aquifers as a source of fresh water for people and the environment. It then examines a number of specific legal arrangements developed by nations for the assessment, use, allocation and protection of transboundary groundwater resources. By studying these regimes and the practices of states, this article attempts to identify trends that implicate the emergence of generally accepted international legal norms applicable to transboundary aquifers. This study concludes that while the law of transboundary aquifers is in an early stage of development, there is, nonetheless, a growing body of experience and practice indicating the emergence of accepted legal standards. Lastly, the article considers the gaps and shortcomings in the emerging international regulatory system and offers recommendations for the further development of the law.

The importance of transboundary aquifers

In places like North Africa, the Middle East and the Mexico–United States border, transboundary aquifers often serve as the primary or sole source of fresh water for human and environmental sustenance. Libya, for example, which has no meaningful surface-water resources, obtains the majority of its fresh water – some 6.5 million cubic metres of water daily – from the Nubian Sandstone Aquifer, a vast underground reservoir that also underlies sections of Libya's neighbours (Chad, Egypt and Sudan) (Watkins 2006). Similarly, Palestinians in the West Bank and Gaza obtain the great majority of their water from aquifers shared with Israel: the Mountain Aquifer underlying the West Bank and eastern Israel and the Coastal Aquifer underlying Gaza's and Israel's Mediterranean coast (World Bank 2009). In addition, transboundary aquifers serve as the sole source of fresh water for many of the communities along the Mexico–United States border, including the Mexican cities of Puerto Palomas, Naco, Nogales, Sonoyta and Tecate, and their respective American sister cities of Columbus, Bisbee, Nogales, Lukeville and Tecate (Eckstein 2011).

Although the exact number of aquifers traversing international political boundaries around the world is still unknown, transboundary aquifers underlie the territory of nearly every non-island nation (Puri and Aureli 2009). An ongoing study has, to date, catalogued 273 transboundary aquifers globally (UNESCOPRESS 2008), including more than 155 on the European continent, 38 in Africa, 68 in the Americas and 12 in Asia (Stephan 2009). In comparison, there are 263 watercourses crossing national boundaries (UNEP 2002). Additionally, while the extent to which states and peoples around the world rely on groundwater resources traversing sovereign borders has yet to be precisely quantified, groundwater today is the most extracted natural resource in the world. Groundwater provides more than half of humanity's freshwater for everyday uses such as drinking, cooking and hygiene, as well as 20% of irrigated agriculture (UNESCO and World Water Assessment Programme 2003). In Europe, between 60% and 99% of drinking water comes from groundwater (Almássy and Busás 1999); in the United States, that figure is between 50% and 97% (Burchi 1999). Accordingly, it is now quite evident that groundwater resources generally, and transboundary aquifers specifically, are a crucially important source of fresh water globally, and that the sound management and regulation of these shared resources are critical for ensuring the sustainability of human communities and the environment.

Examples of regulatory mechanisms for transboundary aquifers

Historically, groundwater resources were omitted from or neglected under international law and cursorily misunderstood within the legal community (Eckstein 2003). This, in turn, resulted in a blatant disregard for subsurface waters in projects with transboundary implications. Over the past few decades, though, largely in response to growing populations and expanding economies, interest in groundwaters traversing international borders has increased considerably, especially as nations intensified withdrawals from known aquifers and expanded their search for new sources of fresh water. As a result, there is now a growing international concern with the use, allocation, management and protection of transboundary aquifers. In a number of cases, this interest has spawned coordinated efforts and mechanisms, of which the most notable were identified in the Introduction. Given space limitations, only four of these efforts are examined in more detail.

The best known, and still the only treaty managing and specifically allocating the waters of a transboundary aquifer, is the Convention relative a la protection, a l'utilisation, a la realimentation et au suivi de la Nappe Souterraine Franco-Suisse du Genevois (Genevese

Agreement), commenced in 1978 and revised in 2008 (Convention Genevois 2008). This singular arrangement addresses groundwater quality, quantity, abstraction and recharge largely through the creation of a joint Genevese Aquifer Management Commission. While the Commission has only consultative status, its recommendations and technical opinions carry considerable weight in the modification of existing and development of new water-extraction works. The regime also recognizes the Swiss artificial-recharge obligations created in the original 1978 agreement, allocates expenses between the countries for the Swiss recharge efforts, and places strict withdrawals limits on the French side (see Preamble, Arts. 2.3, 8, 11–14, and Annex to the Convention on the Inventory of the recharge equipment and existing extraction works). The Genevese Agreement is particularly significant because it strikes a balance between state sovereignty and state responsibility in its management scheme, which is based almost exclusively on principles of transparency, good faith and cooperation. Moreover, the agreement is unique in proffering a purely technical mechanism that is devoid of any provisions directly related to nations' sovereign rights to the underlying aquifer or its waters.

Another fascinating arrangement, albeit one still undergoing development, is the 2009 Memorandum of Understanding Relating to the Setting up of a Consultative Mechanism for the Management of the Iullemeden Aquifer System (Iullemeden MoU) entered into by Mali, Niger and the Republic of Nigeria (Iullemeden MoU 2009). While not a binding instrument, the details and language used in the Iullemeden MoU reflect an intention by the parties to comply with the terms of the resulting agreement once it comes into force. As noted by its title, the focus of this arrangement is the creation of a Consultative Mechanism tasked with promoting cooperation over the management of the Iullemeden. More specifically, the Mechanism is responsible for, inter alia, formulating opinions related to water-management and utilization operations, coordinating Iullemeden-related activities and harmonizing procedures and policies, and developing action plans for implementing its recommendations (see Art. 5). In contrast to the purely consultative status of the Genevese Aquifer Management Commission, the Consultative Mechanism would have legal personality and authority to contract, acquire and dispose of property, seek and obtain loans, gifts and technical assistance, and be a party in legal proceedings (see Art. 6). In addition, and in stark contrast to the Genevese Agreement, the Iullemeden Memorandum explicitly relies on the well-known international water-law and environmental-law principles of equitable and reasonable utilization, no harm, exchange of data and information, prior notification, protection of the environment, public participation, precautionary approach, and polluter and user pays (see Arts. 13–17, 19–22 and 24). Nonetheless, like the Genevese Agreement, the Iullemeden Memorandum focuses more on balancing state sovereignty and state responsibility, yet avoids any explicit mention of sovereignty in its formulation.

The memorandum of understanding (Juárez-El Paso MoU) entered into by the municipal water utilities of the City of Juárez in Mexico and the City of El Paso in Texas, United States (Juárez–El Paso MoU 1999) is an especially unique transboundary aquifer arrangement. This mechanism is distinctive in that it was entered into by sub-national political entities without the oversight of the respective federal governments. While legally unofficial and unenforceable, the purpose of the arrangement is to encourage cooperation over the management and exploitation of the Hueco Bolson Aquifer, which as a result of population growth and development in the overlying region has been overexploited, raising concerns for the aquifer's viability as an ongoing source of fresh water for the area (Eckstein and Hardberger 2008). The Juárez-El Paso MoU "seeks to identify the mechanisms between the parties to increase communications, cooperation, and implementation of transboundary projects of common interest". Moreover, in its "general objectives", the arrangement

alludes to data and information sharing related to transboundary natural resources, and cooperation in the management, use and protection of natural resources that traverse an international boundary (see final paragraph of Recitals). Furthermore, the MoU obligates the sister cities to develop and coordinate a compatible plan "to secure water supplies and extend the life of the Hueco Bolson" (see para. 3[a]). Given its parochial origin and perspective, it is understandable that the Juárez–El Paso MoU makes no reference to principles of international law or notions of sovereignty.

Possibly the most profound effort to develop an international regulatory system for transboundary aquifers is that undertaken by the UN International Law Commission (UNILC). In late 2008, following six years of intense work, the UN General Assembly (UNGA) adopted a resolution containing 19 draft articles on transboundary aquifers that were prepared by the UNILC (UNGA Resolution 2008). Modelled largely on the 1997 Watercourses Convention, the chief substantive state obligations are the well-respected rules of equitable and reasonable utilization and no significant harm. Those principles, however, are tailored to the unique qualities that differentiate surface waters from groundwater resources. For example, the list of factors for assessing what constitutes equitable and reasonable utilization includes "the natural characteristics of the aquifer or aquifer system", "the contribution to the formation and recharge of the aquifer or aquifer system", and "the role of the aquifer or aquifer system in the related ecosystem" (see Arts. 5[1][c], [d] and [i]). Likewise, the no significant harm rule obligates aquifer states not to cause significant harm through "activities other than utilization of a transboundary aquifer . . . that have, or are likely to have, an impact upon that transboundary aquifer" (see Art. 6). This latter modification specifically relates to the distinct likelihood that non-aquifer utilization activities undertaken above or around aquifers could detrimentally affect those aquifers, such as industrial and agricultural operations in the recharge zone, mining activities in the aquifer matrix, and construction, forestry and other activities that might affect the normal recharge process (Eckstein 2007). Other notions found in the Resolution include obligations to regularly exchange data and information, safeguard ecosystems, protect recharge and discharge zones, prevent pollution, monitor the aquifer and prior notification of planned activities (see Arts. 8, 10, 11, 12, 13 and 15). The future form (that is, convention or guidance document) of the 19 articles has been scheduled for consideration by the UN General Assembly at its 66th session in autumn of 2011 (UNGA Resolution 2008).

Developing international law for transboundary groundwater resources

The international law for managing and allocating transboundary groundwater resources is still in a nascent state. Nevertheless, the increasing number of agreements and related activities, as well as the growing international interest in the subject, suggests the evolution of customary international law in this area. Customary international law refers to international law that is based on accepted practice rather than codified rules. It emerges from the broad and consistent conduct of states that is undertaken by a belief that such behaviour is both legally appropriate and mandated (Brownlie 1998). While the extent of the practice relating to the management of a transboundary aquifer is still somewhat limited, a review of the arrangements discussed above nevertheless indicates a number of emerging trends in customary law applicable to transboundary aquifers. In particular, three procedural and two substantive norms can be identified.

Possibly the most palpable customary obligation to emerge from the evolving state practice is the procedural duty to regularly exchange data and information about a transboundary aquifer. Appearing in all of the arrangements discussed in this study, the duty

is fundamental to the cooperation over and sound management and protection of transboundary aquifers. Without the sharing of such information, aquifer states' activities will be hampered by an inability to fully project and mitigate any deleterious consequences that might result from the utilization of a particular transboundary aquifer (Eckstein 2007). Accordingly, the duty requires aquifer states to share collected information on the aquifer and its functioning on a continuing basis. While the precise types of data and information that must be shared is not always spelled out, it is obvious that they should relate to the character, use and functioning of the aquifer. Draft Article 8 of the UNGA Resolution on the law of transboundary aquifers provides that it should include material of a "geological, hydrogeological, hydrological, meteorological and ecological nature and related to the hydrochemistry of the aquifers or aquifer systems, as well as related forecasts" (UNGA Resolution 2008).

A corollary procedural obligation to the duty to regularly exchange data and information is the requirement to generate supplemental data and information on an ongoing basis through monitoring and related activities. Found in a majority of the arrangements considered in this study, this obligation is indispensible to fulfilling the duty to exchange data and information. The obligation also acknowledges the need to maintain vigilance in managing a transboundary aquifer and the need to continuously check on activities related to the aquifer's utilization and the possible impact they may have on people and the environment. Under the UNGA Resolution on the Law of Transboundary Aquifers, aquifer atates "shall, wherever possible, carry out these monitoring activities jointly with other aquifer States concerned and, where appropriate, in collaboration with competent international organizations" (see Art. 13). Implementing this approach in some detail, the Genevese Agreement mandates, inter alia, that all quantitative and qualitative monitoring activities "shall be performed jointly by Swiss and French authorities on their respective territories", and water pollution analyses "shall be made at regular intervals" (see Arts. 10 and 16).

The obligation to monitor and continuously generate additional data accords with the comparable duties imposed on riparians of transboundary surfacewaters. In his separate opinion in the *Case Concerning the Gabčikovo-Nagymaros Project* before the International Court of Justice (ICJ), Judge Christopher Weeramantry argued for the emergence of a principle of continuing environmental-impact assessment. In that opinion, Judge Weeramantry opined that: "As long as a project of some magnitude is in operation, [an environmental-impact assessment] must continue, for every such project can have unexpected consequences; and considerations of prudence would point to the need for continuous monitoring" (ICJ 1997, p. 111). More recently, in the *Case Concerning the Pulp Mills on the River Uruguay*, the ICJ asserted that: "Once operations have started and, where necessary, throughout the life of the project, continuous monitoring of its effects on the environment shall be undertaken" (ICJ 2010, p. 205). While both cases applied this recurring obligation in the context of the use and development of a transboundary watercourse, the logic applied is equally and undeniably applicable to transboundary groundwater resources.

Another related procedural obligation found in a majority of the above-noted instruments is the duty of prior notification of planned activities. In essence, where a planned project has the potential to adversely affect either the territory of another aquifer state or the transboundary aquifer itself, the acting state must notify other aquifer states of its plans. This obligation is designed to allow potentially affected states to evaluate the possible consequences and to seek an understanding or compromise with the acting state (Eckstein 2007). While the precise procedures required under this principle vary among the instruments, the basic notions of advance notification are well accepted in international water

law. Under the UNGA Resolution on the Law of Transboundary Aquifers, aquifer states would be obligated to provide "timely" notification "accompanied by available technical data and information . . . to enable the notified State to evaluate the possible effects of the planned activities" (see Art. 15). In contrast, the Iullemeden MoU proffers a more rigorous process of notification that includes: provisions relating to a time period during which the acting state must refrain from proceeding with the planned activity while the Consultative Mechanisms and the informed state review the information; authorization to proceed with the planned activity in the absence of a response from the Consultative Mechanism; consultation and negotiations in good faith where the acting and notified states disagree about the expected consequences of the planned activity; measures in the absence of prior notification; and an emergency exception to these obligations (see Arts. 24–28).

Among the substantive obligations found in the various arrangements discussed in this article, two well-known rules appear in a majority of instruments; those of equitable and reasonable utilization and of no significant harm. Recognized broadly as the cornerstones of transboundary surface water law, these two principles now appear to have been extended to transboundary aquifers through various academic and legalistic pronouncements. According to the first doctrine, aquifer states must ensure that their utilization of transboundary aquifers is both equitable, in terms of the benefits derived from the use of the aquifer, and reasonable with regard to the use itself. A non-exhaustive list of factors is typically provided in these instruments to aid in determining whether a particular use confirms to these criteria. Similarly, aquifer states are bound to ensure that their activities related to shared groundwater resources do not result in significant harm to other aquifer states. Like their application in the context of surface waters, none of the transboundary aquifer arrangements elaborate on the implementation of these principles. Nonetheless, they represent the nascent state of the law of transboundary aquifers.

Although the instruments discussed in this article present other rules and procedures for transboundary aquifers, the lack of their consistent appearance across the various instruments and arrangements suggest that these additional concepts do not yet represent a trend in the development of customary international law for transboundary aquifers. Nonetheless, the presence of these additional rules and procedures – such as obligations to safeguard aquifer-dependent ecosystems, protect the recharge and discharge zones of aquifers and prevent aquifer pollution – should not be discounted. Rather, their use and effectiveness as regulatory and management mechanisms should be reviewed and assessed periodically, as should their applicability for other transboundary-aquifer agreements.

Considerations for the continued development of international law for transboundary groundwater resources

While surface and groundwater resources share numerous similarities, groundwater possesses a number of unique characteristics that must be considered carefully when contemplating regulatory tools for managing these resources. For example, groundwater is typically more vulnerable than surface water to agricultural, industrial and municipal pollution as well as other forms of contamination. This is so because water in aquifers generally flows at much slower rates than in rivers and lakes, typically measured in distances of centimetres or metres per day (Hamblin and Christiansen 2001). This slower flow rate greatly diminishes the natural filtering capacities of aquifers and, thereby, their ability to reclaim and cleanse themselves. In addition, because of the geographic extent of most aquifers and the difficulties associated with monitoring and working with underground

formations, the artificial reclamation of a polluted aquifer can be prohibitively complex and expensive. The result is that once contaminated, an aquifer may be rendered unusable for years, decades or longer (Eckstein 2007).

Accordingly, these unique aspects must be taken into account in order to formulate appropriate regulatory mechanisms for the sound management of transboundary aquifers. For example, special attention must be paid to the "functioning" of an aquifer, which refers to how particular aquifers work or behave as aquifers. Aquifers typically store and transport water, dilute wastes and other contaminants, provide a habitat for aquatic biota and serve as a source of fresh water and nutrients to aquifer-dependent ecosystems. Some aquifers even provide geothermal heat. Each of these characteristics comprises a function of the aquifer that is dependent on the particular aquifer's hydrostatic pressure, hydraulic conductivity, and mineralogical, biological and chemical attributes, all of which may be interdependent with each other to the extent that the aquifer's sustained operation as a dynamic hydrogeologic system depends on the continuation of a particular function or series of functions (Heath 2004). If any component related to an aquifer's natural behaviour is impaired or destroyed, it could result in serious consequences for the viability and integrity of the aquifer as a whole, as well as to communities and ecosystems dependent on that aquifer. Accordingly, regulatory mechanisms must be developed to ensure the identification, maintenance and protection of the functioning of transboundary aquifers that incorporate functional characteristics on both sides of a border, tasks that can best be achieved in a coordinated and cooperative process.

Highly related to the functioning of aquifers, recharge and discharge zones of aquifers also require special attention since, with the exception of some deep, non-recharging, aquifers, these zones are integral components of aquifers. Recharge and discharge zones regulate the flow and quality of water moving into and out of aquifers and, thereby, the functioning of aquifers themselves. Hence, the recharge and discharge process, as well as the geographical area in which they operate, must be maintained and protected. In the case of recharge zones, this consists of ensuring both the quantity and quality of water flowing through the recharge zone and entering the aquifer. Thus, recharge-zone protection might include limitations on industrial and municipal development projects in the recharge area that could diminish the amount or affect the quality of water percolating through the zone into the aquifer. It also might include restrictions on industrial and agricultural activities that might pollute the recharge area and thereby pollute the water flowing into the aquifer. In the case of discharge zones, protective action could include restrictions on construction and other activities that could detrimentally affect the discharge process, water flow within the aquifer, the location of the water table or the aquifer's natural cleansing abilities. In both zones, it could also include constraints on mining activities that remove or modify strata within the recharge and discharge areas. Moreover, limitations in the two zones should be pursued regardless of whether or not the targeted activities are related to the use of the aquifer itself.

Finally, a conceptual notion that is inherently tied to the transboundary characteristic of these aquifers pertains to the perception, held by some nations, that they have unqualified or near-absolute sovereignty over the portion of an aquifer that lies within their jurisdiction. The belief, which harkens back to the long-discredited Harmon Doctrine, suggested that states are free to exploit resources within their jurisdiction without regard to the extraterritorial effects of such action (McCaffrey 2007). While a number of the instruments reviewed here appear to subscribe to this notion, the suggestion that a liquid resource – which is in a near-constant state of motion moving within the hydrologic cycle in surface waters, subsurface strata and the atmosphere, transforming between gaseous, liquid

and solid states, and traversing local and international political borders – can be subject to a state's sovereignty defies logic. Moreover, the idea is contrary to the basic tenets of international water law, including those of equitable and reasonable utilization and of no significant harm, which clearly espouse a more limited conception of sovereign rights over transboundary freshwater resources (McCaffrey 2011).

While the Draft Articles on Transboundary Aquifers adopts the notion of sovereignty in Draft Article 3, it also includes a provision in the same article that could temper states' claims and obligate them to exercise their sovereign rights "in accordance with international law and the present articles" (UNGA 2008). In essence, states that agree to the terms of the Draft Articles would relinquish some measure of sovereignty to the extent that they give up their right to act contrary to other provisions and obligations contained in the Draft Articles. This is because the principles contained in the Draft Articles – such as equitable and reasonable utilization, no significant harm, exchange of data, monitoring and others – clearly place considerable restrictions and obligations on what aquifer states can do with regard to the utilization of a transboundary aquifer (Eckstein 2007). While this saving grace may be unsatisfactory for some (McCaffrey 2011), others suggest that it reflects an unavoidable compromise between nations seeking to preserve sovereignty over resources found within their territory, and those who argued for a more collaborative approach to resources that traverse international boundaries (Yamada 2011).

Conclusion

Until quite recently, concerns over aquifers traversing international boundaries were rarely raised in international fora. With the advent of drilling technology and the growing global need for additional sources of fresh water, transboundary aquifers are now the focus of considerable international attention, including scrutiny by the UN General Assembly. As such, they are also becoming the focus of new treaties and other arrangements and, thereby, the development of international standards. While this evolutionary legal process is still in its infancy, a number of trends can be identified from the practices of states (as reflected in instruments formulated to manage specific transboundary aquifers) that indicate the emergence of customary international norms. One of the purposes of this study was to identify these nascent trends.

As the number of such arrangements grows, as is certain to happen, many of these trends will become more evident and will lead to the development of a regime for the management of transboundary groundwater resources. In the meantime, numerous gaps and shortcomings exist in the absence of such a regime that must be considered, as states formulate new agreements for other transboundary aquifers. Hence, the second purpose of this article was to develop recommendations for the further development of the law.

The recommendations offered here, however, do not cover the gamut of issues and aquifer characteristics that require attention within an international regulatory and legal context. Others concerns and topics that should be considered include, inter alia: the threshold of harm necessary to trigger a violation of the no significant harm standard as it applies to transboundary aquifers; the aspects of an aquifer, in terms of functions and geographic scope, that should be covered by a regulatory or cooperative transboundary regime; harmonization of metadata and methodologies among aquifer riparians for generating information about shared aquifers; and the rules that should govern the exploitation of non-recharging aquifers. Nevertheless, this article provides a starting point from which to further the conversation about the characteristics of transboundary aquifers that must be considered, as well as the regulatory and legal mechanisms that might develop.

Note

1. This article expands on a prior paper that appears in UNESCO (2010).

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