

SYMPOSIUM ON INTERSTATE DISPUTES OVER WATER RIGHTS

INTERNATIONAL LAW FOR TRANSBOUNDARY AQUIFERS: A CHALLENGE FOR OUR TIMES

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Quarrels between states sharing a transboundary aquifer (TBA) have been relatively minor in comparison with the more boisterous disputes seen in many of the world's shared river basins. Yet, transboundary groundwater can easily serve as the basis for cross-border disagreements. Twice as many TBAs and shared groundwater bodies have been identified globally as compared to transboundary rivers and lakes,¹ and the volume of accessible groundwater exceeds all surface waters by a factor of one hundred.² Yet, the number of treaties in force for TBAs is miniscule in comparison with those for transboundary rivers and lakes. Moreover, dozens of nations exploit groundwater from a TBA, often unilaterally and without knowing the cross-border implications, or even that the aquifer is transboundary. The lack of prioritization of groundwater in international practice and law, coupled with the reality that groundwater is "out of sight," and thereby "out of mind," has relegated shared aquifers as the neglected stepchildren of international water law. But, with many of the world's nations experiencing growing water scarcity and stress, this situation undoubtedly will change. This essay highlights the growing pains of international groundwater law and the challenges for its identification and articulation. Specific hydrogeologic characteristics of various TBAs are presented and, where relevant, placed in the context of water scarcity and security and recognized international legal norms.

Today, only a handful of treaties in force apply to TBAs, and few nations have directly engaged with their neighbors over their shared groundwater. Thus, there is little settled law in this area. Although the law for cross-border surface water is relatively well-established and might serve as a basis for TBAs, it is unlikely to transfer directly without adjustment. Questions about the relevance, efficacy, and implications of surface water norms for TBAs remain unaddressed. Moreover, because certain aquifer types have characteristics that are distinct from other aquifers and surface waters, it remains unclear whether all freshwater resources can be governed under one legal regime, or whether fragmentation in the law will result. The challenge is whether we can conceptualize a rational and effective legal regime for TBAs before significant disputes arise.

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¹ GABRIEL ECKSTEIN, [THE INTERNATIONAL LAW OF TRANSBOUNDARY GROUNDWATER RESOURCES](#) 3 (2017).

² See Stephen McCaffrey, [Seventh Report on the Law of the Non-Navigational Uses of International Watercourses](#), UN Doc. A/CN.4/436 at 52, para. 17 (1991).

Reliance on Transboundary Aquifers

Approximately six hundred aquifers and aquifer bodies have been identified traversing international frontiers.³ While the global human, environmental, and economic significance of these shared subsurface resources escapes precise quantification, extrapolation indicates that it is substantial. Groundwater is the most extracted natural resource on Earth with more than 1,000 km³ pumped every year to meet agricultural, industrial, and human needs.⁴ 45 percent of humanity's everyday domestic freshwater requirements, such as for cooking and hygiene, are met by groundwater,⁵ and more than half of all drinking water originates from aquifers.⁶ Moreover, given that around 40 percent of the world's population resides in transboundary river basins⁷ and most transboundary rivers have a hydraulically connected aquifer, and given that numerous cross-border non-recharging aquifers underlie many communities around the world, we can infer that a comparable if not larger number of people reside within the basins of TBAs.

Furthermore, in the arid, semi-arid, and temperate regions of the world, including Central Asia, the Middle East, North Africa, and the Mexico-U.S. border, TBAs serve as the primary or sole source of water for human and environmental sustenance. Libya, for example, obtains nearly all of its freshwater from the Nubian Sandstone Aquifer, a vast underground reservoir that also underlies portions of Chad, Egypt, and Sudan.⁸ Similarly, Palestinians obtain much of their freshwater (either via Israeli transfers or from their own extractions) in the West Bank and Gaza from aquifers shared with Israel—the Mountain Aquifer underlying the West Bank and Israel, and the Coastal Aquifer underlying Gaza's and Israel's Mediterranean coast.⁹ Furthermore, numerous communities along the arid Mexico-U.S. frontier have for decades extracted mostly unmetered groundwater from the region's TBAs to meet most or all of their domestic, agricultural, and industrial needs.¹⁰

Relevance of Existing International Law

The 1997 UN Convention on the Non-Navigational Uses of International Watercourses (Watercourses Convention),¹¹ often portrayed as codifying the main customary tenets of international water law (IWL), suggests that TBAs are subject to the norms articulated in that instrument. Under Article 2(a) of the Convention, a *watercourse* comprises “a system of surface waters and groundwaters constituting by virtue of their physical relationship a unitary whole and normally flowing into a common terminus.” However, because the definition excludes aquifers that are not part of a “system” or do not typically flow toward a “common terminus” with interrelated surface

³ INT'L GROUNDWATER RESOURCES ASSESSMENT CTR., [TRANSBOUNDARY AQUIFERS OF THE WORLD – SPECIAL EDITION FOR THE 7TH WORLD WATER FORUM 2015](#).

⁴ JEAN MARGAT & JAC VAN DER GUN, [GROUNDWATER AROUND THE WORLD: A GEOGRAPHIC SYNOPSIS](#) 125 (2013); James Famiglietti, *The Global Groundwater Crisis*, 4 NATURE CLIM. CHANGE 945, 945–46 (2014).

⁵ MARGAT & VAN DER GUN, *supra* note 4, at 149.

⁶ Abhijit Mukherjee et al., *Global Groundwater: From Scarcity to Security Through Sustainability and Solutions*, in GLOBAL GROUNDWATER: SOURCE, SCARCITY, SUSTAINABILITY, SECURITY, AND SOLUTIONS 3 (Abhijit Mukherjee, et al. eds., 2021).

⁷ UN Envtl. Programme, [Atlas of International Freshwater Agreements](#) 2 (2002).

⁸ John Watkins, *Libya's Thirst for 'Fossil Water'*, BBC News (Mar. 18, 2006).

⁹ World Bank, [Securing Water for Development in West Bank and Gaza](#) 2 (Table 1) (2018).

¹⁰ Gabriel Eckstein, *Rethinking Transboundary Ground Water Resources Management: A Local Approach Along the Mexico-U.S. Border*, 25 GEO. INT'L ENV'T'L. L. REV. 95, 99–100 (2012).

¹¹ [G.A. Res. 51/229](#) (1997).

waters, it excludes a significant number of TBAs from the Convention's scope.¹² Moreover, none of the existing TBA agreements and arrangements reference the Convention, and while most do refer to various principles appearing in that document, interpretation and implementation of those obligations vary considerably. Lastly, questions about whether the Convention actually represents the current status of customary IWL appear to be diminishing its appeal.¹³

A basic challenge for applying IWL to TBAs, at least as articulated in the Watercourses Convention, is the complexity of groundwater. Water flows very differently in an aquifer as compared to a river or lake. In most cases, groundwater flows at a fraction of the speed that water flows down a river. In addition, groundwater flows in three dimensions in relation to gravity, porosity, permeability, hydrostatic pressure, and other natural factors, while the primary influence on surface flows is gravity. Accordingly, notions of due diligence, harm, precaution, responsibility, and other legal concepts in IWL may need reassessment in light of these considerations. This does not necessarily negate the possibility that aspects of IWL could apply to TBAs with appropriate alterations. Yet, it does suggest that further exploration and even experimentation is necessary before applying IWL wholesale to all TBAs. Three examples support the need for prudence.

First, anthropogenic contamination of groundwater is relatively common today, making large volumes of subsurface freshwater unusable or necessitating expensive treatment. It is unclear whether the customary IWL threshold for actionable harm, including pollution of cross-border surface water bodies qualified as "significant," should be the same for TBAs. For example, a spill on the surface one-half kilometer from a transboundary river may not rise to the level of *significant* harm because of geography, topography, and climatic conditions, as well as technological and financial capacities; it is easily seen and evaluated, and may be readily prevented from contaminating the transboundary river. In contrast, a spill over a TBA's recharge zone located a similar distance from the aquifer's saturated zone could be deemed a greater threat because of challenges associated with halting or removing the contamination within the formation. The fact that the spill's flow and the threatened waterbody are underground requires more complicated assessments and scientific, technical, and financial resources. Ultimately, this could affect the calculus for what constitutes *significant* harm, and whether the threshold should be modified or the types of actions or scenarios that are actionable should be broadened.¹⁴

A second reason for caution pertains to the geographic scope subject to IWL. For rivers and lakes, that scope is determined by the geographic extent of the physical watercourse. For groundwater, it remains unclear whether the scope should encompass solely the saturated section of the formation, the entire formation, or the formation plus the surface recharge area. Thus, in the case of the Mountain Aquifer, whose storage is found primarily underneath Israel proper while 90 percent of its recharge area is located in the Palestinian West Bank, it is unclear what norms should apply for the allocation and protection of the aquifer's groundwater. Assuming the "two-state solution" is achieved, Palestine would have control over the vast majority of the recharge area and, thereby, control the quantity and quality of water infiltrating and supplying the aquifer, but little access to the subsurface reserves. In contrast, Israel would have the exact reverse situation. Since IWL principles only apply to water within a shared water body, this leaves uncertain the legal status of diffused water in the recharge area and infiltrating surface flows.

Third, the applicability of IWL norms to non-recharging aquifers is unsettled. These aquifers are groundwater-bearing formations with insignificant or no source of contemporary recharge, and are particularly common in arid regions like the Middle East, Northern Africa, and the Mexico-U.S. border. By definition, these aquifers cannot be utilized sustainably, at least not in terms of perpetuity, since any withdrawal will deplete the resource. Moreover,

¹² Gabriel Eckstein, *A Hydrogeological Perspective of the Status of Ground Water Resources Under the UN Watercourse Convention*, 30 COLUM. J. ENVTL. L., 525, 547–61 (2005).

¹³ Gabriel Eckstein, *The Status of the UN Watercourses Convention: Does it Still Hold Water?*, 36 INT'L J. WATER RESOUR. DEVEL. 429 (2020).

¹⁴ ECKSTEIN, *supra* note 1, at 137–38.

because of the stagnant character of non-recharging aquifers, which constrains their natural cleansing abilities to dilute and eliminate pollutants, these resources are uniquely susceptible to pollution and extremely difficult to reclaim. Hence, it remains unclear whether norms applicable to rivers and lakes could equally apply to these unique aquifers, or whether a more rigorous, distinct, or tailored regime is necessary. For example, should the threshold for actionable harm to non-recharging TBAs be the same as for recharging TBAs, or for transboundary rivers? Is it possible to equitably and reasonably utilize a non-recharging aquifer given that any use eventually will exhaust the resource? It is noteworthy that three of the five TBA treaties presently in force address non-recharging aquifers: the Al-Sag/Al-Disi Aquifer shared by Jordan and Saudi Arabia,¹⁵ the Northwestern Sahara Aquifer System shared by Algeria, Libya, and Tunisia,¹⁶ and the Nubian Sandstone Aquifer.¹⁷

Searching for Relevant Law

Despite the relevance of TBAs to human existence, economic development, and environmental sustainability, policy and legal attention to these subsurface resources are relatively recent. While over 3,600 treaties relating to the use of transboundary surface waters have been catalogued since 805 AD, and over 400 since 1820 AD,¹⁸ the handful of those that reference interrelated groundwater do so as a secondary or tertiary matter. It wasn't until the late 1970s that the first agreement to focus exclusively on managing a TBA appeared. Today, six treaties targeting specific TBAs have been ratified; informal arrangements cover another five TBAs.

Two additional sources for legal principles must be highlighted: Draft Articles on the Law of Transboundary Aquifers prepared by the UN International Law Commission and now before the UN General Assembly;¹⁹ and the Model Provisions on Transboundary Groundwaters adopted by the Parties to the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes.²⁰ While neither document is binding, both are proffered as guidelines for states when engaging over TBAs with their neighbors.

While this assemblage of instruments hardly suffices as evidence for established customary practice, a review of the provisions they contain does offer some insight into potential trends. From among these agreements, arrangements, and guidelines, the most consistent obligation is the procedural conduct of regularly exchanging data and information over shared aquifers. Not only logical in concept, the practice is fundamental to the sound management and protection of TBAs. Thus, the four nations overlying the Nubian Sandstone Aquifer in North Africa established a cooperative mechanism designed to collect and compile information on the aquifer, as well as an Internet data portal to share available material. In contrast, though, some states remain reticent to share their knowledge, especially over resources for which they have scant or unfavorable data. Nations like China²¹

¹⁵ [Agreement Between the Government of the Hashemite Kingdom of Jordan and the Government of the Kingdom of Saudi Arabia for the Management and Utilization of the Ground Waters in the Al-Sag/Al-Disi Layer](#), Apr. 30, 2015.

¹⁶ [Establishment of a Consultation Mechanism for the Northwestern Sahara Aquifer System \(SASS\)](#), Dec. 19–20, 2002, in *GROUNDWATER IN INTERNATIONAL LAW: COMPILATION OF TREATIES AND OTHER LEGAL INSTRUMENTS*, 6, (Stefano Burchi & Kerstin Mechlem eds., 2005).

¹⁷ [Constitution of the Joint Authority for the Study and Development of the Nubian Sandstone Aquifer Waters](#), 1992.

¹⁸ [UN Env'tl. Programme](#), *supra* note 7, at 6.

¹⁹ [The Law of Transboundary Aquifers](#), G.A. Res. 63/124 (Jan. 15, 2009).

²⁰ UN Econ. Comm'n for Europe, [Decision VI/2, Model Provisions on Transboundary Groundwaters](#), in *REPORT OF THE MEETING OF THE PARTIES ON ITS SIXTH SESSION – ADDENDUM: DECISIONS AND VISION FOR THE FUTURE OF THE CONVENTION*, UN Doc. ECE/MP.WAT/37/Add.2, 19 September 2013.

²¹ Brian Eyster, [Science Shows Chinese Dams are Devastating the Mekong; New Data Demonstrates a Devastating Effect on Downstream Water Supplies That Feed Millions of People](#), *FOREIGN POL'Y* (Apr. 22, 2020).

(whose TBAs have yet to be fully mapped), Iraq²² (which shares TBAs with Iran, Kuwait, Saudi Arabia, Syria, and Turkey in the highly parched Middle East), and Uzbekistan²³ (which shares TBAs with Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan in arid Central Asia) all maintain a tight lid on information related to their freshwater resources, suggesting this trend is not universal.

A second common feature is the practice of generating supplemental data and information on an on-going basis through monitoring-related activities. Again, a logical step, the practice acknowledges the need to maintain vigilance in managing TBAs, which is indispensable to fulfilling the obligation to exchange data and information. The Genevese Aquifer Convention, for example, was developed largely around monitoring and further developing information about the aquifer, and incorporates the term “monitoring” in the agreement’s title.²⁴ Moreover, the practice comports with the ICJ’s *Pulp Mills* case in which the Court 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.”²⁵

Another procedural obligation supported by most of the TBA-related instruments is a duty to provide prior notification where planned activities have the potential to adversely affect a neighboring aquifer state or the TBA itself. The purpose of this commitment is to allow potentially affected states to evaluate the possible consequences of planned measures and to seek an understanding with the acting state. Thus, the Memorandum of Understanding drafted for the Iullemeden, Taoudeni/Tanezrouft Aquifer System (ITAS) articulates a rigorous series of procedures detailing when such notification should be provided, the type of information that should accompany notification, the response obligations, and possibilities to proceed without notifications in emergency situations.²⁶

The final procedural practice common to the vast majority of the instruments is the creation of a joint institutional mechanism to carry out the regime’s objectives. While the structures and levels of authority assigned to these TBA-focused entities vary considerably, those few nations that have engaged over shared aquifers appear to recognize the value of and need for institutionalized cooperation to facilitate the sound management of these subsurface resources. For example, arrangements established for the ITAS, Nubian Sandstone Aquifer, and Northwestern Sahara Aquifer System, by their very titles and purposes, were formulated intentionally to create joint cooperative mechanisms.

Substantive Versus Procedural Obligations

While the TBA-related agreements, arrangements, and guidelines noted here do offer evidence of trends in the development of procedural obligations, the same is not true of substantive responsibilities. A number of the instruments articulate substantive principles, such as equitable and reasonable utilization, non-damaging use, sustainable development, ecosystem protection, precaution, and polluter pays. Nevertheless, the obligations

²² Jon D. Unruh, *The Geography of Water and Oil Resource Governance in Post-Conflict Iraq*, 21 ARAB WORLD GEOGRAPHER 261, 266 (2018).

²³ Ainur Kokimova, *Developing a Transboundary Groundwater Model in the Water Scarce Region of Central Asia: A Case Study of the Pretashkent Transboundary Aquifer* (MSc Thesis WSE-GW.19-03, Aug. 1, 2019 / updated Nov. 30, 2019).

²⁴ [Convention relative à la protection, à l'utilisation, à la réalimentation et au suivi de la Nappe Souterraine Franco-Suisse du Genevois, entre la Communauté de Communes du Genevois, la Commune de Viry d'une part, et au la République et canton de Genève d'autre part](#), Dec. 18, 2007 (entered into force Jan. 1, 2008).

²⁵ *Case Concerning the Pulp Mills on the River Uruguay* (Arg. v. Uru.), Judgment, 2010 ICJ REP 14, para. 205 (Apr. 20).

²⁶ [Memorandum of Understanding for the Establishment of a Consultation Mechanism for the Integrated Management of the Water Resources of the Iullemeden, Taoudeni/Tanezrouft Aquifer Systems \(ITAS\)](#), Mar. 28, 2014.

presented vary considerably among the instruments, and standards and criteria are often left out. Hence, it is not possible to point to any particular trends toward the development of substantive international law for TBAs.

Conclusion

State practice in the management, allocation, and protection of cross-border aquifers is, as yet, too sparse to identify customary international norms. Given the dearth of direct cross-border experience, this is understandable. Yet, a lack of cooperation over TBAs does not mean that states are not utilizing these resources. On the contrary, many nations pump from aquifers traversing their frontiers. With ever-growing demands for freshwater from communities and economies, the consequences of a changing climate, and the continuing needs of the environment, TBAs are likely to emerge as sources of cross-border tension.

In 2022, the theme for the UN's World Water Day will be *Groundwater: Making the Invisible Visible*. This will be a welcome development given the historical obscurity accorded to this critical resource. Hopefully, it will also spur greater understanding of TBAs, as well as mechanisms and norms to minimize tension and enhance international cooperation.