

Title

From Fragmentation to Mutualization: Which Path for the Cooperation of Transboundary Aquifers?

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Introduction

Transboundary aquifers represent a vital resource, yet their management remains fragmented, oscillating between national sovereignty and limited cooperation. Faced with the challenges of climate change, demographic pressure and competing uses, current governance struggles to ensure sustainable and equitable management.

This presentation proposes to explore an innovative pathway: the mutualization of transboundary aquifers as a lever for more effective and resilient cooperation.

The current international legal framework relies on a juxtaposition of bilateral agreements and non-binding principles, often insufficient to guarantee integrated management of these strategic resources.

Although certain instruments such as the 1997 *UN Watercourses Convention* or the 2008 *Draft Articles on the Law of Transboundary Aquifer* provide important foundations, their implementation remains limited.

States, eager to preserve their sovereignty, favor segmented approaches, hindering the emergence of genuinely collective management.

1. A Fragmented Management of Transboundary Aquifers

International law applicable to transboundary aquifers remains fragmented both in its sources and in its approaches. While groundwater constitutes vital and increasingly strategic reserves, its legal regime remains scattered, incomplete and non-harmonized.

This section addresses:

- A limited and fragmented international legal framework
- Obstacles to integrated management
- The limits of the current approach

1.1. A Limited and Fragmented International Legal Framework

This fragmentation appears historically through the dispersion of non-binding precursor texts, conventions with differing scopes, and incomplete codification attempts.

Early soft-law instruments illustrate this fragmentation:

- 1989 Charter on Groundwater Management
- 1966 Helsinki Rules on the Uses of Waters of International Rivers
- 1986 Seoul Rules on International Groundwater
- 1989 Bellagio Draft Treaty on Transboundary Groundwaters

These instruments address groundwater only partially, often in connection with surface water, and without offering a legally binding framework. For example, the 1989 Charter recommends qualitative protection but establishes no binding obligations. The Helsinki (1966) and Seoul (1986) Rules set integrated principles but remain doctrinal: they fill a gap while maintaining institutional fragmentation. The 1989 Bellagio Draft Treaty proposes advanced mechanisms but, lacking formal status, adds an additional reference point without harmonizing existing instruments.

Binding international conventions also contribute to fragmentation, though differently, as they do not cover the same hydrological scope:

- 1992 Helsinki Water Convention
- 1997 New York Convention on International Watercourses
- 2003 African Convention on the Conservation of Nature and Natural Resources

The 1992 Helsinki Convention adopts a comprehensive approach by including both surface and groundwater, whether connected or not, partially **reducing fragmentation**. Conversely, the 1997 New York Convention restricts its scope to groundwater connected to international watercourses, reinforcing **hydrological fragmentation**. The 2003 Maputo Convention, not specific to aquifers, contributes to **thematic fragmentation** by treating water as one resource among others.

The 2008 Draft Articles on the Law of Transboundary Aquifers, although the most advanced text, paradoxically generates a new form of fragmentation. On the one hand, it unifies the approach by defining the aquifer (water + geological formation), offering an integrated and consistent vision. On the other hand, it creates a conflicting overlap with the New York Convention:

- Aquifers connected to watercourses are covered by two separate regimes, the principles of which are not entirely compatible.
- Unconnected aquifers are covered only by Draft Articles, creating a duality of regimes.

Doctrinal debates surrounding the Draft Articles (definition of aquifers, role of sovereignty, final legal status) also reflect **conceptual fragmentation**. Some authors favor hydrological integration. Others defend state sovereignty. Still others wish to limit or broaden the scope of application. The lack of State consensus on its transformation into a convention accentuates this **political fragmentation**.

In sum, the international law of transboundary aquifers remains a heterogeneous mosaic:

- soft-law instruments with varied approaches

- two general conventions with divergent scopes
- an advanced but unfinished codification project

Despite this fragmentation, these instruments share common principles (equitable utilization, prevention of harm, cooperation, data exchange) forming a useful basis for a mutualized approach to aquifer governance.

1.2. Obstacles to Integrated Management

Doctrinal analyses highlight a fundamental obstacle: the **absence of a shared understanding** of what constitutes the “resource,” its status and its legal regime.

The notion of natural resource remains polysemic (material, ecological or anthropocentric) creating an **epistemic fragmentation** that complicates the legal framing of transboundary groundwater.

Additionally, States hold structurally divergent perceptions:

- Some view aquifers primarily as fixed geological formations under exclusive territorial competence.
- Others see them as mobile hydrological resources generating interdependencies.

This duality (immobile substrate vs. mobile water) creates **legal ambiguity**.

The 2008 Draft Articles attempt to overcome this by emphasizing the “water–formation” unity, but this vision remains weakly internalized by States.

A deeper obstacle lies in **the primacy of territorial sovereignty** over integrated or cooperative management.

The absolutist theories of the 19th century (absolute territorial sovereignty, absolute territorial integrity), although outdated in law, continue to permeate contemporary practices.

They sustain a nationalized reading of the resource: each State seeks to exercise exclusive control over the portion of the aquifer located beneath its territory, viewed as an essential attribute of its sovereignty and its permanent sovereignty over natural resources.

Even the more nuanced approaches (limited sovereignty, qualified territorial integrity, community of interest) have not succeeded in fully shifting States toward a dynamic of shared management.

Sovereignty remains the dominant lens, leading to several difficulties:

- resistance to the full exchange of data.
- mistrust toward joint monitoring mechanisms.

- refusal of legally binding commitments.
- prioritization of national uses over collective imperatives.

This tension is visible in the 1997 UN International Watercourses Convention, which excluded unconnected aquifers due to their perceived territorial sensitivity, forcing the ILC to produce a separate set of rules (2002–2008) and increasing **normative fragmentation**.

Hydrogeological characteristics (slow flows, heterogeneity, vulnerability) also heighten state concerns over losing control of a vital and strategic resource.

The combination of conceptual plurality, legal ambiguity, sovereignty concerns, absolutist legacies and international normative fragmentation explains the difficulty in establishing integrated management and highlights the need for a paradigm shift toward mutualized cooperation.

It also highlights the need for a paradigm shift towards mutualized cooperation, which alone would enable us to overcome these competing sovereignties and ensure sustainable and equitable management.

2. Mutualization: An Alternative Paradigm for Shared Management

Faced with persistent fragmentation, competing sovereignties and insufficient normative integration, mutualization offers an alternative capable of reorienting cooperative dynamics around transboundary aquifers.

It proposes to move beyond strict territoriality and to frame the resources within a common horizon grounded in hydrological interdependence, risk prevention and mutual benefits.

This perspective unfolds around three axes:

- Definition and conceptual foundations
- Mechanisms of mutualized management
- Tools supporting mutualization

Together, these dimensions aim to transform aquifers from potential conflict sources into drivers of sustainable, equitable cooperation.

2.1. Definition and Conceptual Foundations

Mutualization, as applied to transboundary aquifers, refers to a cooperative approach whereby several states deliberately choose to manage a **common resource** together by pooling their resources, expertise, and capacity for action.

The concept is not well developed in legal doctrine, but it is based on common definitions of the term “mutual,” which evoke reciprocity, sharing, solidarity, and compromise. In this context,

mutualization means not only sharing risks and costs, but also organizing a conscious interdependence based on shared responsibility.

Mutualization therefore involves a consensual commitment between states to pool their material, technical, financial, and human resources to ensure the sustainable management of a shared aquifer.

The “risk” (understood as threats of overexploitation, pollution, scarcity, or social conflict) becomes a collective issue that is addressed jointly.

The objective is therefore to create synergy based on transparency, fairness, participation, and solidarity, enabling competitive approaches to be transformed into cooperative dynamic.

Two forms exist in public administration:

- **Institutional mutualization:** creating a common body with transferred functions
- **Functional mutualization:** sharing means while retaining original competences

For transboundary aquifers, institutional mutualization is most relevant, as it enables genuine joint management rather than mere coordination.

In this way, mutualization goes beyond the simple principle of solidarity: it establishes a structured interdependent relationship in which states consider the aquifer to **be a common interest, involving the sharing of risks and benefits.**

It enables the development of binding mechanisms and shared services for the sustainable management of the aquifer system.

This approach aims to strengthen collective capacities, reduce vulnerabilities, and prevent tensions related to the competing exercise of territorial sovereignty.

2.2. Mechanisms of Mutualized Management

Mutualized management rests on three interlinked principles:

- recognizing the aquifer as a **resource of common interest**
- asserting the role of **States as guardians responsible for this resource**
- establishing a **permanent joint commission**

Recognizing the Aquifer System as a Common-Interest Resource

This concept moves away from a strict territorial view and considers the aquifer as an interdependent resource whose preservation requires the pooling of capacities. Classifying the aquifer system as a common interest has several functional consequences:

- no exclusive appropriation
- shared risks
- pooled means (technical, financial, human)
- protection for future generations
- harmonized national practices

This recognition makes it possible to transform the aquifer into a common planning object, rather than a fragmented space regulated separately by each state.

➤ **States as Guardians of the Resource**

Drawing from the public trust doctrine and African collective traditions, States must:

- prevent risks and degradation
- act with diligence and impartiality
- ensure essential needs
- guarantee transparency and participation
- protect the resource for future generations

This guardian role goes beyond diplomatic cooperation alone: it places states in a situation of acknowledged interdependence, where each remains responsible not only for its own territory, but also for the stability of the entire aquifer system.

➤ **A Permanent International Joint Commission (PIJC)**

To make this shared management work, the best way would be to set up a joint international commission based on the tried-and-tested model of the Canada-United States International Joint Commission (IJC).

To this end, it should be established as:

- an independent body with real powers
- a mechanism for dispute settlement
- a platform for participation and transparency
- an institution building inter-state trust

➤ **An independent body with real powers**

The PIJC would be an autonomous institution, composed of independent commissioners supported by scientific and technical committees. It would have the power to:

- approving or rejecting projects affecting the aquifer
- setting common rules on withdrawals, quality, risks
- monitoring the resource
- harmonizing legal and technical frameworks
- conducting joint studies and impact assessments

Such a structure would overcome the current fragmentation of the law applicable to aquifer system.

➤ **A mechanism for dispute settlement**

The Commission would act as the preferred framework for preventing and resolving disputes through:

- consultation and negotiation.
- mediation and conciliation.
- the formulation of independent technical opinions.
- referral to arbitration in the event of deadlock.

By formalizing dialogue, it would contribute to defusing tensions in a region where conflicts over water and natural resources are recurrent.

➤ **A platform for participation and transparency**

PIJC would strengthen the democratic legitimacy of shared management by:

- disseminating information to the public and local communities.
- organizing public hearings.
- translating documents into local languages.
- guaranteeing local stakeholders, the right to participate.
- providing access to justice in cases of environmental damage.

➤ **An institution building inter-state trust**

Through transparency, institutional stability, and the creation of common rules, the PIJC would play a central role in building inter-state trust. It would make it possible to:

- balance power asymmetries between states.
- reduce strategic uncertainties.

- prevent opportunistic behavior.
- structure a space for sustainable and credible cooperation.

By combining recognition of the aquifer system as a common interest, the role of states as responsible guardians, and the establishment of a permanent joint international commission, mutualized management mechanisms offer a robust framework for overcoming the current fragmentation.

These principles of mutual management make it possible to transform the resource, a potential source of tension, into a real lever for sustainable, solidarity-based, and technically sound cooperation.

2.3. Tools Supporting Mutualization

The implementation of a mutualized cooperation framework for the aquifer system relies on a set of concrete instruments designed to move beyond the fragmented and sectoral management that currently characterizes aquifer States.

In a context shaped by ecosystem vulnerability, institutional dispersion, limited financial resources and increasing pressure on groundwater, these tools aim to pool capacities, harmonize practices and structure collective action.

They are organized around two pillars:

- common protection measures to secure the aquifer, and
- harmonized regional planning, led by a Permanent International Joint Commission (PIJC).

➤ Common Protection Measures to Secure the Aquifer

These measures form the first set of tools designed to establish a shared foundation for protecting the aquifer system. They rely on three complementary mechanisms:

- the ecosystem-based management approach
- the aquifer information and monitoring system
- the water education program

➤ The Ecosystem-Based Management Approach

This tool requires a holistic vision of groundwater, understood as an integral part of terrestrial and aquatic ecosystems. Rooted in the Convention on Biological Diversity (1992) and the “Malawi Principles,” the ecosystem approach:

- emphasizes interactions among water, soil, biodiversity and human societies.
- requires prevention and adaptation measures in response to ecosystem complexity.

- integrates ecosystem needs into the prioritization of water uses.
- promotes integrated (IWRM), participatory and intersectoral management.

It is recognized by multiple international instruments that enshrine the obligation to protect ecosystems dependent on transboundary waters.

➤ **The Aquifer Information and Monitoring System**

This tool is essential to ensure transparency, scientific knowledge and informed decision-making. Its objectives include:

- collecting, harmonizing and continuously updating hydrogeological, climatic and socioeconomic data.
- jointly monitoring water quality, withdrawals and vulnerabilities.
- harmonizing methods and standards in line with international good practices (Helsinki 1992, WFD 2000, MEDWIS).

The system must be centralized within the PIJC, accessible to stakeholders and interoperable, to reduce information asymmetries and strengthen cooperation.

➤ **The Water Education Program**

This tool aims to build social and cognitive capital for mutualized cooperation. It includes:

- training for professionals, technicians and decision-makers (UNESCO, Agenda 21, Draft Articles 2008).
- awareness-raising among local actors and populations, including through informal programs.
- integrating traditional and customary knowledge from local communities.
- promoting a shared ethic of the resource and a common understanding of the challenges.

The objective is to create a generation of actors capable of supporting the sustainable management of the aquifer and actively participating in decision-making processes.

Harmonized Regional Planning: Tools to Guide Collective Action

Planning constitutes the second pillar of mutualization. It helps structure a common long-term vision based on tools for projection, coordination and investment, such as:

- water resources assessment
- the master plan for the protection, management and enhancement of the aquifer
- regional planning for equitable access to water

➤ **Water Resources Assessment**

As a preliminary and essential tool, it enables:

- determining the quantity, quality, availability and dynamics of groundwater.
- identifying current uses, pressures and risks.
- building a reliable database for decision-making.

Inspired by the recommendations of Dublin (1992), Helsinki (1992) and the work of the OSS, this assessment must be continuous and carried out by the PIJC.

➤ **The Master Plan for the Protection, Management and Enhancement of the Aquifer**

This is the key strategic tool. It defines general orientations, priorities and long-term objectives. It identifies protection, restoration and development measures and harmonizes national policies within a transnational vision.

It relies on public consultations and stakeholder participation and aligns with the frameworks of Mar del Plata (1977), Agenda 21 (1992) and the Draft Articles (2008).

The master plan must be iterative, flexible, legally binding, and adapted to local realities as well as climatic and socioeconomic constraints.

➤ **Regional Planning for Equitable Access to Water**

This tool aims to reduce structural inequalities in access to water and to address the hydric vulnerability of regions. It includes:

- analyzing existing infrastructure and future needs.
- designing solutions adapted to each context (urban/rural).
- developing progressive and economically realistic investments.
- establishing mechanisms for equitable sharing of benefits.

Planning thus becomes an **instrument of hydric justice**, aligning national approaches so they become coherent, solidaristic and effective.

The tools supporting mutualization form a coherent toolbox enabling the PIJC and aquifer States to:

- overcome fragmentation.
- harmonize practices.
- secure and enhance the resource.
- guarantee equitable access for populations.
- and anchor inter-state cooperation on a long-term basis.

They give concrete, operational and context-appropriate expressions to the mutualization of transboundary aquifer systems.

Conclusion

Ultimately, the conclusion remains clear: the management of transboundary aquifers is still overly fragmented, divided among heterogeneous norms, weak institutions and isolated initiatives.

Faced with these limitations, mutualization emerges as a credible and fruitful prospect: it combines solidarity, sustainability and equity by offering States a common framework for jointly managing what cannot be managed separately.

This is therefore a call for genuine shared responsibility, for an assumed co-management capable of overcoming strictly national reflexes and acknowledging the deeply interconnected nature of aquifers.

A decisive question nevertheless remains open: **which regional alliances and legal instruments will, in the coming decades, give institutional reality to this mutualized approach?**

I would have liked to illustrate this presentation with a concrete case applied to the lullemeden Taoudéni-Tanezrouft Aquifer System, but the time available does not allow it. You may, however, find this case study developed in detail in my book: **International Law of Transboundary Aquifers: Perspectives and Opportunities for the Mutualized Cooperation of the lullemeden and Taoudéni-Tanezrouft Aquifer System.**

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