



How best to incorporate conjunctive water management into international water law: legal amendment, instrument coupling, or new protocol adoption?

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Abstract

International water conventions—e.g., the *1997 United Nations Convention on the Non-Navigational Uses of International Watercourses*—include positive but insufficient focus on groundwater and its interaction with surface water. As such, a growing body of literature has proposed modifications to existing frameworks to enable consideration to surface and groundwater and their interactions. While this literature places considerable focus on coupling and amending existing legal frameworks, elaboration and evaluation of a new protocol on conjunctive water management comprises a key gap. To fill this gap, this paper seeks to answer the following question: does formulation and adoption of a *new* “conjunctive” protocol provide more value than existing proposals centered around modifications to *existing* law? This paper seeks to compare benefits associated with current proposals to strengthen the international legal framework for management of surface–groundwater interaction, *vis-a-vis* adoption of a new protocol on conjunctive management of transboundary freshwaters. To do so, the authors use doctrinal legal methods to analyze the existing main instruments globally assessing the degree to which they consider key interlinkages between surface water and groundwater. Then, the paper examines the concept of conjunctive water management and deduces tenets that should be pursued in shared waters to achieve this objective. To identify the preferred option to support conjunctive water management in international water law, the paper explores the degree to which existing proposals *vs* a new protocol enable an embrace of these tenets of conjunctive water management. The paper finds that while a new protocol may add greater value in advancing conjunctive water management, multiple options can and should be concurrently pursued. In particular, the authors argue that new protocols to the existing treaties must be adopted in combination with the amendment of the Draft Articles on the Law of Transboundary Aquifers. Benefits of doing so include more effective management of transboundary freshwater resources that are interconnected hydrologically, a less fragmented and more consistent international water regime, and ultimately more benefits accruing to the populations and environmental goods dependent on shared water resources.

Keywords Conjunctive water management · International water law · Watercourses convention · UNECE water convention · Groundwaters · Aquifers

Abbreviations

UN	United Nations
UNWC	Convention on non-navigational uses of international watercourses
UNECE	United Nations economic commission for Europe
UNECE Water Convention	On the protection and use of transboundary watercourses and international lakes
ILC	International law commission
Draft Articles	Draft articles on the law of transboundary aquifers
IWL	International water law
TBAs	Transboundary aquifers
CWM	Conjunctive water management
MoP	Meeting of the parties
Model Provisions	Provisions on transboundary groundwaters
GAS	Guarani aquifer system

1 Introduction

There are numerous important conventions, declarations and protocols on international watercourses. Of these, the most influential at a global-level are the 1997 *United Nations (UN) Convention on non-Navigational Uses of International Watercourses* (hereafter UNWC) and the 1992 UN Economic Commission for Europe (UNECE) *Convention on the Protection and Use of Transboundary Watercourses and International Lakes* (hereafter UNECE Water Convention). Also worth acknowledgement, concerning international aquifers specifically but with no focus on surface water, is the 2008 International Law Commission (ILC) *Draft Articles on the Law of Transboundary Aquifers* (hereafter Draft Articles). The abovementioned mechanisms constitute the foundation of International Water Law (IWL), a subcategory of international environmental law, and provide the fundamental frame for the innumerable interactions on transboundary freshwaters across the world.

Surface water and groundwater are two components of a single water system (Gemma & Tsur, 2007) and are connected in most landscapes. It is generally groundwater discharge that keeps streams flowing between precipitation events or after snowmelt. According to Winter et al. (1998), streams connected with groundwater interact in three basic ways: (1) Water may flow from groundwater to streams through the streambed (gaining streams), (2) streams may lose water to the groundwater system (losing streams) and (3) streams may be gaining in some reaches and losing in other reaches. The importance of groundwater generally is reflected in transboundary waters. In arid and semi-arid regions, groundwater is often the only source of freshwater and majority of this resource is located in TBAs (Stephan, 2008). In transboundary contexts just like any other contexts, groundwater and surface waters interact in the context of a river or “hydrographic”¹ basin (Eckstein & Eckstein, 2005).

¹ A hydrographic basin is formed initially from the rain feeding into aquifers and reaching eventually the surface creating springs or water eyes based on which headwaters of the rivers appear (Bit Translators, n.d.). A hydrographic basin is a “physiographic unit bounded by topographic divides that limit the areas of land drained by a main river, its affluent and sub-affluent” (Arai, Pereira and Gonçalves, 2012, p. 591).

While the 1992 UNECE Convention and 1997 UNWC acknowledge groundwater in addition to surface water, the degree to which such acknowledgement aligns with intrinsic processes of the hydrologic cycle—and the surface–groundwater interactions central therein—remains subject to intense critique. Duric et al. (2008, p. 49) state that the UNWC “fails to address the specific needs of optimal and sustainable utilization and development of transboundary groundwaters” because of the definition of the term watercourse in the convention. Stephan et al. (2007) asserts that the rules and principles of the UNWC were initially adopted within IWL to address surface waters, but the groundwater component was added only later and only insofar as it is connected to surface water. Stephan (2009) states that the UNECE Convention does not include provisions addressing the specificities of groundwater. Eckstein and Eckstein (2003) argued that the approach adopted in the UNWC does not address surface–groundwater interaction. Related, limitations of the 2008 Draft Articles have been widely acknowledged. del Castillo Laborde (2019) criticized the Draft Articles given its sole focus on Transboundary Aquifers (TBAs). Traversi (2011) examined inadequacies in the UNWC and Draft Articles preventing the harmonization of IWL applicable to surface water and groundwater. McCaffrey (1990) expressed the need to address surface water and groundwater simultaneously.

While one way to address current limitations of international law may be to foster discussion that supports an improved interpretation of existing treaties, it is unclear that such an effort (i) is commensurate with the degree of codification required to achieve clarity on ground-surface water interactions and (ii) would resolve confusion or simply trigger additional interpretational debates. In that sense, relying solely on an evolving interpretation of existing treaties and instruments to characterize the role of groundwater interactions may discount how fundamental understanding such interactions is to transboundary water law. The literature oriented toward improving Conjunctive Water Management (CWM) in transboundary water law has indeed focused on linking, amending or formally adopting existing legal frameworks. Dellapenna and Loures (2013) suggest adopting the Draft Articles as a protocol to the UNWC allowing its provisions to complement those within the convention while Pincus (2008) suggests the amendment of existing UNWC articles to more broadly account for groundwater and fossil aquifers. Others suggest adoption of the Draft Articles as an independent convention either applicable to all types of shared aquifers (Carlson, 2011) or only to fossil aquifers (Stoa, 2012), or simply adopting them as a non-binding instrument (Eckstein & Sindico, 2014). Amendment of the Draft Articles for various purposes such as including the term groundwater was proposed by McIntyre (2011). Amendment of the UNWC to include confined aquifers within its scope given its exclusion was noted by Eckstein and Eckstein (2003). Despite clear value in existing research, a gap in knowledge remain surrounding the scope and parameters of developing a new protocol that complements the existing content of the 1992 UNECE Water Convention and 1997 UNWC. This gap may limit the potential to identify the optimal way to advance conjunctive management in international water law.

To fill this gap, this paper seeks to compare benefits associated with current proposals to strengthen the international legal framework for management of surface–groundwater interaction, *vis-a-vis* formulation and adoption of a new protocol on CWM—i.e., the monitoring and coordination of surface and groundwater resources simultaneously (Lautze et al., 2018). The paper seeks to answer the following question: does formulation and adoption of a new “conjunctive” protocol provide more value than existing proposals centered around modifications to *existing* law? This paper first reviews the ways current international water conventions and the Draft Articles have addressed the ground-surface water interactions and CWM within their texts, as well as obligations arising from these concepts. The paper

then investigates the comparative potential of linking or amending existing articles in the UNECE Water Convention, UNWC and the Draft Articles *vis-a-vis* the introduction of a new conjunctive protocol. The paper finds that while adoption of a protocol holds greater potential to enable IWL to foster conjunctive approaches, the choice is not an either-or but a both-and.

The focus of the article is on IWL in order to orient the analysis to international water conventions: the UNECE Water Convention and the UNWC in addition to the Draft Articles that remains as a non-binding instrument. They provide a powerful overarching framework for specific interactions at a basin and aquifer-level. Legal instruments applicable to basins and aquifers have already been examined in a separate paper (Lautze et al., 2018). While supporting documentation such as the Model Provisions on Transboundary Groundwaters were reviewed and are important as well, they are not considered to carry the same significance as the abovementioned mechanisms which are treated as a standalone instruments per se.

2 Surface–groundwater linkages in international water law: the current state

International Environmental Agreements cover a wide range of topics including transboundary water resources where existing water conventions and instruments are considered part of international environmental law (Elver, 2006). Globally influential international water agreements related to transboundary freshwaters—the 1992 UNECE Convention, the 1997 UNWC and the 2008 Draft Articles—build on a legal foundation that started more than 50 years ago. Three instruments are particularly important to this foundation. First, the 1966 *Helsinki Rules on the Uses of the Water of International Rivers*, applicable to use of the waters of international drainage basins, laid down rules applicable to surface water but excluded certain types of groundwater from its coverage (Helsinki Rules, 1966). Second, the 1986 *Seoul Rules on International Groundwaters* which address shared aquifers that are not covered under the Helsinki rules (Seoul Rules, 1986). Third, the 2004 *Berlin Rules on Water Resources* apply equally to shared surface waters and groundwaters as well as freshwater for domestic use. The Berlin Rules effectively extended focus of the Helsinki Rules to domestic use (Berlin Rules, 2004). All these documents are non-binding and have been developed by the International Law Association, a professional body rather than UN member states. They have different legal status of the conventions.

2.1 The UNECE water convention

The UNECE Water Convention was adopted in 1992 and has four major aims: (a) to prevent, control and reduce pollution of waters causing or likely to cause transboundary impact; (b) to ensure that transboundary waters are used with the aim of ecologically sound and rational water management, conservation of water resources and environmental protection; (c) to ensure that transboundary waters are used in a reasonable and equitable way, taking into particular account their transboundary character, in the case of activities which cause or are likely to cause transboundary impact; (d) to ensure conservation and, where necessary, restoration of ecosystems (UNECE Water Convention 1992, Article 2.2.(a)(b)(c)(d)). Originally adopted as a regional treaty, the convention was amended in 2003 allowing non-UNECE States the possibility to become a party. The amendment entered

into force in 2013 and the convention became global when the procedure was finalized in 2016. Since then, “any request—through formal accession by non-UNECE nations—shall be automatically considered as being approved by the Meeting of the Parties (MoP) to the Convention” (Rieu-Clarke & Kinna, 2014, p.19). So far, few countries outside Europe have signed and ratified the convention mainly Chad, Ghana, Senegal, Guinea Bissau and Togo (United Nations, 2022; United Nations treaty collection, 2003) while countries like Lebanon, Jordan, Iraq and Tunisia have expressed interests in joining (Lammers et al., 2018).

The convention covers both surface and groundwater. Article 1 (1) of the convention mentions the types of transboundary waters covered, namely: any surface or groundwaters which mark, cross or are located on boundaries between two or more States; wherever transboundary waters flow directly into the sea, these transboundary waters end at a straight line across their respective mouths between points on the low-water line of their banks (UNECE Water Convention, 1992). The UNECE Water Convention “addresses both the geological formation containing the groundwater and the water contained therein” (Tanzi & Kolliopoulos, 2015, pp. 410–411). The UNECE Water Convention thus applies to confined and unconfined aquifers and the catchment area of the shared water body be it basin or aquifer (Fitzmaurice & Merkouris, 2015).

Specific mention of the integrated nature of surface and groundwater, and hydrologic interlinkages, could not be found in the text of the convention. As a result, the UNECE developed several documents addressing these challenges such as the UNECE *Guidelines on Monitoring and Assessment of Transboundary Groundwaters* adopted in 2000 (Tanzi, 2013), to support development of rules for transboundary groundwater monitoring and assessment (UN/ECE Task Force on Monitoring & Assessment, 2000). In fact, this approach led to the development of the *Model Provisions on Transboundary Groundwaters* in 2014 (Tanzi & Kolliopoulos, 2015). The Model Provisions aim to support sharing transboundary groundwaters intersected by State boundaries or sharing transboundary surface waters linked with groundwaters (Model Provisions on Transboundary Groundwaters, 2014). The focus on the interconnection between groundwater and surface water in the Model Provisions is confirmed through provision 4 stating that “The Parties shall cooperate on the integrated management of their transboundary groundwaters and surface waters” (Model Provisions on Transboundary Groundwaters, 2014, p. 9). The model provisions indeed give focus to interactions between the two resources in the context of integrated water resources management but do not go into details with regards to conjunctive management (Model Provisions on Transboundary Groundwaters, 2014). While these supplementary materials are clearly positive, valid questions can equally be raised concerning the extent to which their principles are reflected in the core fabric of the convention. Notably, the Model Provisions and UNECE Guidelines on Monitoring and Assessment of Transboundary Groundwaters remain non-binding instruments that are limited to guidance for the party members to the UNECE Convention.

2.2 The UNWC

The UNWC aims to “ensure the utilization, development, conservation, management and protection of international watercourses and the promotion of the optimal and sustainable utilization thereof for present and future generations” (UNWC, 1997, Art. 2 (a)). It “applies to uses of international watercourses and of their waters for purposes other than navigation and to measures of protection, preservation and management related to the uses of those

watercourses and their waters” (UNWC, 1997, Art. 1 (1)). The UNWC entered into force in 2014, seventeen years after its adoption (Yihdego, 2017).

The UNWC focuses on watercourses, defined as “a system of surface waters and groundwaters constituting by virtue of their physical relationship a unitary whole and normally flowing into a common terminus” (UNWC, 1997, Art. 2 (a)) while it defined an international watercourse as a “watercourse, parts of which are situated in different States” (UNWC, 1997, Art. 2 (b)). In effect, the treaty applies to transboundary surface waters and the shared groundwater bodies apart from those “that do not receive water from or contribute water to surface waters” (Salman, 2019, p. 52). Confined aquifers which cross borders are thus excluded (Eckstein & Eckstein, 2003). Moreover, the definition of watercourses including a common terminus also affected the way groundwater is covered in the UNWC since groundwater and surface water may not always share a common terminus excluding further TBAs from its scope (Nanni n.d.).

Despite according direct focus on the interlinked nature of surface and groundwater in its definition of watercourse, the UNWC’s conceptualization of such interlinkage contains anomalies. Termini of many shared groundwaters, for example, do not align with those of shared surface waters. Boundaries of groundwaters indeed normally align with aquifer extent, with the exception of alluvial aquifers connected to river. As such, many important resources for conjunctive management may be excluded from the remit of the UNWC. Related, procedural rules of the UNWC that are focused on elements such as regular exchange of data and information do not address the unique characteristics of transboundary groundwater such as increased pollution vulnerability (UNWC, 1997).

2.3 Draft articles

The Draft Articles were adopted by the ILC in 2008. They apply to “(a) utilization of transboundary aquifers or aquifer systems; (b) other activities that have or are likely to have an impact upon such aquifers or aquifer systems; and (c) measures for the protection, preservation and management of such aquifers or aquifer systems” (Draft Articles, 2008, Article 1 (a) (b) (c)). It aims at ensuring “the development, utilization, conservation, management and protection of groundwater resources in the context of the promotion of the optimal and sustainable development of water resources for present and future generations” (Draft Articles, 2008, p. 2). The Draft Articles were annexed to a Resolution of the UN General Assembly that encouraged countries to take into account the instrument when establishing bilateral and regional water agreements addressing TBAs. Still, the instrument remains a non-binding one (Sindico & Pateiro, 2018).

Unlike the existing water conventions covering both groundwaters and surface waters, this instrument covers all types of TBAs excluding surface water resources (Mechlem, 2009). The particularities surrounding shared groundwaters resulted in a wider scope of activities in comparison with the UNWC (Sindico & Pateiro, 2018). Domestic aquifers connected to shared surface waters are excluded from the scope of the Draft Articles, Article 1 which limits the Articles’ scope only to TBAs (Draft Articles, 2008, Art. 1). In that sense, the instrument covers the utilization of shared aquifers but also activities that may impact these aquifers such as the use of chemicals (Caponera et al. 2019). The term aquifer was defined as “a permeable water-bearing geological formation underlain by a less permeable layer and the water contained in the saturated zone of the formation” (Draft Articles, 2008, Art. 2 (a)). As such, the scope of the instrument not only includes shared aquifers but also the geological formation where the water is located (Draft Articles, 2008, Art. 2 (a)).

The dynamic connection between surface water and groundwater was not addressed within the text of the Draft Articles (Mechlem, 2009). Instead, surface water—only receives one mention—framed as a “discharge zone”, into which “water originating from an aquifer flows to its outlets, such as a watercourse, a lake, an oasis, a wetland or an ocean” (Draft Articles, 2008, Article 2). This approach resulted in the adoption of several controversial provisions that ignore the hydrological connection that exist between surface water and groundwater (Tanzi, 2011), as the physical links between groundwater and surface water are not acknowledged (Dellapenna & Loures, 2011). The Draft Articles do not refer to the term groundwater² but rather the term aquifer³ (Tanzi, 2011). The ILC justified this approach by stating that “the term is more scientifically precise and leaves no ambiguity for both lawyers and groundwater scientists and administrators” (ILC 2006, 196). As a result of the definition provided to the term aquifer and the focus on it, the Draft Articles focused on underground geologic formations instead of groundwaters (Vick, 2008). For example, the instrument calls for the establishment and implementation of management plans for the aquifer or aquifer systems and not groundwater resources (Draft Articles, 2008, Art. 14).

The focus on the geological formation in turn meant that the Draft Articles were not capable of addressing the circumstances of CWM putting the aquifers at risks as a result of potential negative consequences arising from areas or elements that are beyond the scope of this instrument such as the pollution of surface water connected to the aquifer (Dellapenna & Loures, 2013).

Even when all the instruments are interpreted collectively in accordance with the 1969 Vienna Convention on the Law of Treaties (VCLT), this does not lead to a clear support of a CWM approach. The VCLT calls for interpreting a treaty in good faith considering other agreements related to it (VCLT, 1969). A discussion concerning the harmonization of these mechanisms has occurred in the literature given the need for creating synergies among them (Stoa, 2012; Tanzi, 2011). This is as these contain overlapping and contradictory provisions (Eckstein & Sindico, 2014). Given this reality, proposals have been made to tackle this issue including the amendments of existing mechanisms and a specific focus on the Draft Articles given their non-binding nature and the ability to adopt it considering all the dilemmas (Eckstein & Sindico, 2014; Pincus, 2008). Hence, the collective interpretation may not yield the expected results as highlighted above.

This is not to say that a dynamic interpretation may not imply flexibility to accommodate such commitment. For instance, a dynamic interpretation of the principle of equitable and reasonable utilization along its list of non-exhaustive factors could accommodate such an approach.⁴ Similarly, the UNECE Water Convention calls upon Riparian Parties to develop ‘harmonized policies, programs and strategies covering the relevant catchment areas, or parts thereof....’ (UNECE Water Convention, 1992, Art. 2(6)). The obligation to prevent significant harm is a due diligence standard, i.e., ‘all appropriate measures’ should be taken to prevent significant harm including the consideration of CWM.⁵ The UNECE Water Convention is also being interpreted as supporting an integrated water resources management approach despite the latter not being mentioned in the text (UNECE, 2013). This can be

² According to the US geological survey, “Groundwater is water that exists underground in saturated zones beneath the land surface. The upper surface of the saturated zone is called the water table” (USGS, n.d.).

³ Defined above.

⁴ UNWC, Articles: 5 & 6; Draft Articles: 4 & 5.

⁵ UNWC, Article 7, Draft Articles: 6.

Table 1 Summary of coverage of conjunctive water management

	Surface water	Groundwater	Interconnections and conjunctive management
UNECE	Covered	Covered	Not covered—partially covered in non-binding “model provisions”
UNWC	Covered	Partially covered	Partially covered—inclusion of shared groundwater that does not have a terminus common to surface waters is questionable
Draft Articles	Not covered	covered	Not covered

implied via Article 2(2) for instance. It calls for an ecosystem approach (UNECE Water Convention, 1992, Article 2(1)d; Article 3(1) d & i) and has a broad definition of trans-boundary impact in Article 1(2) (UNECE Water Convention, 1992). All of these would mean that CWM is somehow covered within the treaty. Nonetheless, the various principles and provisions have been interpreted differently over the years by states considering their interests. Clashes over the exact meaning and interpretation for instance of the principle of equitable and reasonable utilization and the obligation not to cause significant harm took place despite their inclusion within the scope of the instruments (Salman, 2021). Even the principle of cooperation has been subject to debate (Leb, 2013; Oranye & Atemu, 2021) while concepts such as ecosystem approach are still developing in IWL where disagreements are noticed (McIntyre, 2014). It is easier for states to do the same for CWM given its non-inclusion in any of the instruments even when a nation claims that the principles of the UNECE Water Convention, the UNWC and the Draft Articles can be interpreted to cover CWM within its scope. This is as this concept is not directly stated giving nations a great margin to avoid its implementation in practice and solid legal basis to support this rejection.

In summary, none of the existing frameworks give full coverage to surface and groundwater (Table 1). The UNECE Water Convention covers surface water and groundwater within its scope but interlinkages between them are only acknowledged in the model provisions. The UNWC covers surface water and some shared aquifers but excludes other types of aquifers from its coverage. The Draft Articles cover only shared aquifers and provide no acknowledgement to the connection between surface water and groundwater. And even with treaty and instruments interpretation, CWM would not be adequately tackled requiring a new approach to it.

3 From hydrologic interactions to policy tenets: an ideal state

Surface and groundwater interact in most landscapes. It is generally groundwater discharge that keeps streams flowing between precipitation events or after snowmelt. For a stream to gain water, the elevation of the groundwater table in the vicinity of the stream must be higher than the stream water surface. For a stream to lose water to groundwater, the water table must be below the elevation of the stream water surface in the vicinity of the stream. If the water table has large variations during the year, a stream segment could receive water from groundwater for a portion of the year and lose water to groundwater at other times (Vandas et al., 2002). Drinking water resources may rely on hydrologic fluxes between groundwater and surface water for example while nutrients and pollutants can also be transported across the interface and experience transformation, enrichment, or retention

along the flow paths and cause impacts on the interconnected receptor systems (Lewandowski et al., 2020). Surface water and groundwater are, as such, two components of a single water system (Gemma & Tsur, 2007).

Failure to address surface–groundwater interactions in the context of transboundary water agreements exposes loopholes. In the Limpopo Basin, river depletion from groundwater abstraction for irrigation along the reaches of the river in South Africa affect surface flows into Mozambique (Owen, 2011). In the Indus basin, aquifers along the India-Pakistan border have suffered excessive groundwater abstraction and caused salinization on agriculture land, but the Indus Water Commission could not act as this fall outside its mandate. The Indus Treaty, signed between the two countries in 1960, does not cover groundwater (IUCN, 2013). In Central Asia, the Amu Darya (Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) and the Syr Darya rivers (Kyrgyzstan, Tajikistan, Uzbekistan and Kazakhstan) are connected to aquifer systems forming a single water resource without being managed conjunctively (Howard and Griffith, 2008). The Jordan river shared between Jordan, Israel, Syria and Palestine suffers from a similar lack of consideration of the interaction between groundwater and surface water even in the existing agreements such as Treaty of Peace Between the State of Israel and the Hashemite Kingdom of Jordan of 1994 (Zeitoun et al., 2019). In South America, failure to take a conjunctive approach in the Guarani Aquifer System (GAS) has undermined effective water management. Surface water cooperation is implemented through the La Plata Treaty of 1969, which covers the five riparians Argentina, Brazil, Bolivia, Paraguay and Uruguay and is coordinated through a River Basin Organization. The underlying GAS, spanning the same countries except Bolivia, is governed by the Guarani Aquifer Agreement of 2010 (Sugg et al., 2015). This agreement protects the national sovereignty of groundwater use, which has contributed to overexploitation of the aquifer to enable land use changes and agriculture development.

While guidelines for transboundary policy coverage of surface–groundwater interactions and conjunctive management are not known to exist, work at national level contains lessons that may be relevant at an international level. Blomquist et al. (2001) suggest that well-defined, quantified water rights, encompassing understanding of surface and groundwater interactions, are essential in implementing conjunctive management. Dudley and Fulton (2006) state that the practice of conjunctive management requires scientific knowledge to inform decision-making, and technical and management capacity development. Foster and van Steenberg (2011) support the establishment of an apex body at a national level that supervises both groundwater and surface water institutions. Evans and Evans (2014) propose that groundwater and surface water monitoring should be aligned through joint planning and assessment of surface and groundwater resources. Drawing on experience in Australia, the Government of Australia (2014) notes that water rights frameworks must be flexible to allow conjunctive surface and groundwater use, and recommends harmonizing objectives across institutions that manage surface and groundwater.

Concepts of hydrologic connectivity and CWM could be incorporated within IWL through adaptation of principles derived from national-level discourse, as well as derivation of guidance from lacunae found in existing instruments. A simple starting point for including conjunctive management in international law is acknowledging and referencing all types of water sources that contribute to conjunctive management, their single system nature, and the importance of groundwater boundaries (namely aquifer extent) in addition to basin boundaries—in effect, acknowledging that termini may not always be common. Related, there should be recognition of the greater benefits, and reduced risks, associated with adopting conjunctive approaches and accounting

for ground-surface water interactions. Finally, drawing directly from guidance on conjunctive management at a national-level, conjunctive management principles should be embedded into frameworks for management for example by including both sources in water allocation rules, and linking water sources with central principles of water allocation in international waters namely (i) equitable and reasonable use, and (ii) no significant harm. Translating these threads into a set of points for adoption, results in the following eight tenets (on which examples are provided in the next section):

1. Inclusion of all types of transboundary water sources. All surface waters. All groundwaters. No exclusions.
2. Direct reference to the single system nature of surface and groundwater. Use of words such as connectivity, interactions.
3. Acknowledgements of aquifers and groundwater
4. Recognition that there are greater benefits, and reduced risk, through consideration of conjunctive management of the two interlinked water sources.
5. Acknowledgement that management of one water source, without consideration of the other, may create a dangerous loophole that undermines implementation of a transboundary agreement.
6. When allocation of water is involved, disaggregation of water according to source.
7. Consideration of the contribution of CWM toward equitable and reasonable use.
8. Consideration of surface-groundwater interactions in obligations not to cause significant harm.

4 Moving from current to ideal state: comparing options

Unfortunately, tenets to enable conjunctive management across borders are not fully embraced at present (Table 2). The UNWC only covers three of the tenets as it makes direct reference to the single system nature of surface and groundwater, acknowledges aquifers and groundwater and that both resources must be managed together. The UNECE Water Convention covers the tenets covered by the UNWC, as well as all types of transboundary water sources in its scope. The Draft Articles only acknowledge TBAs and groundwater. None of them cover all of the tenets or explicitly mention the CWM concept.

There are no doubt different options for crafting international law to address the eight tenets. Amendment of the Draft Articles to expand specific types of TBAs and include the term groundwater was proposed by McIntyre (2011). Amendment to the UNWC to include confined aquifers within its scope given its exclusion was noted by Eckstein and Eckstein (2003). Coupling the UNWC and the Draft Articles has been proposed and justified by Dellapenna and Loures (2011, 2013). Finally, though not known to be formally proposed as yet, adopting a protocol as a follow-up to the UNECE Water Convention and the UNWC could enable fresh conceptualization of a binding CWM frame that may be free from piecemeal compromises the other options may face. Further, pursuit of a fresh protocol would avoid potentially tedious processes associated with amendments of the UNECE and UNWC instruments.

Table 2 Current Coverage of tenets

	UNECE 1992	UNWC 1997	Draft Articles 2008
Inclusion of all types of transboundary water sources. All surface waters. All groundwaters. No exclusions (UNECE Water Convention, 1992, Art. 1 (1))	✓		
Direct reference to the single system nature of surface and groundwater. Use of words such as connectivity, interactions (UNWC, 1997, Art. 2(a); UNECE Water Convention, 1992, Art. 1 (1))	✓	✓	
Acknowledgement of aquifers and groundwater (UNWC, 1997, Art. 2(a); UNECE Water Convention, 1992, Art. 1 (1); Draft Articles 2008)	✓	✓	✓
Recognition that there are greater benefits, and reduced risk, through consideration of conjunctive management of the two interlinked water sources			
Acknowledgement that management of one water source, without explicit consideration of the other, may create a dangerous loophole that undermines implementation of a transboundary agreement	✓	✓	
When allocation of water is involved, disaggregation of water according to source			
Consideration of the contribution of CWM toward equitable and reasonable use			
Consideration of surface–groundwater interactions in obligations not to cause significant harm			

4.1 Option 1: amendment

The suggestion of amending existing international water instruments is not new. Due to heavy criticisms of the provisions of these instruments, numerous calls for amending them were made over the years by various scholars to consider existing shortcomings and include new provisions (Eckstein, 2007; Salman, 2015). It is in this context, that the first option suggested by the authors is related to amending existing instruments to include the eight tenets. Proposals for amending existing conventions most frequently center on revisions to the Draft Articles given its non-binding nature (Tanzi, 2011). At least two revisions to the Draft Articles have been proposed: (i) addressing the overlap between the UNWC and the Draft Articles covering several types of TBAs simultaneously and (ii) including focus on groundwater and not just aquifers (McIntyre, 2011). Revisions to UNWC center on inclusion of confined aquifers (Eckstein & Eckstein, 2003). While positive, amending the Draft Articles to address the overlap with the UNWC and including a focus on groundwater does not result in recognition of the interconnection between transboundary surface water and groundwater. This is because the Draft Articles focus solely on TBAs and exclude shared surface water; likewise, the articles fail to contain provisions connecting shared surface water and groundwater. In that sense, even after amending this instrument, surface water resources and a direct reference to the interlinkage between surface water and groundwater will still be excluded from it (tenets 1–2). This means that the benefits of CWM would also not be acknowledged resulting potentially in a dangerous loophole that undermines implementation of a transboundary agreement (tenets 4–5). Moreover, water accordingly will not be disaggregated according to the source while CWM and surface–groundwater interlinkages would not be considered

when applying the principle of equitable and reasonable use as well as the obligation not to cause significant harm (tenets 5–7). Amending the UNWC would solve one of the important issues for which this convention has been criticized; exclusion of confined aquifers. Nonetheless, confined aquifers are not the only ones that are excluded from the UNWC, it is not clear whether aquifers not sharing a common terminus with surface waters, and those contained by one country in a shared basin, are excluded and may remain excluded. As such, amending the UNWC may not ensure the inclusion of all types of water resources in its scope or the acknowledgement of the greater benefits of CWM (tenets 1 & 4). Moreover, it may not lead to disaggregating water according to source nor the implementation of equitable and reasonable use principle and the obligation not to cause significant harm in the context of CWM (tenets 5–7). Hence, the proposed amendments to the Draft Articles and the UNWC in the literature do not fully ensure the conjunctive management of water resources and would not cover additional tenets stipulated above.

4.2 Option 2: coupling

Given the shortcomings of both the Draft Articles and the UNWC, the idea of connecting these two instruments via a protocol or other means have also been discussed (e.g., (Eckstein & Sindico, 2014). Among the many means discussed is the adoption of the Draft Articles as a protocol to the UNWC. Because of that, the second option is focused on coupling instruments by adding the Draft Articles as a protocol to the UNWC (Dellapenna & Loures, 2011, 2013) in a manner that allows the creation of synergies between both instruments and the implementation of the tenets. Implementation of this option would ensure that all types of transboundary water sources are covered (tenet 1), with UNWC covering surface waters and connected aquifers and Draft Articles covering all types of TBAs. Similarly, by packaging an appreciation for groundwater and shared aquifers with transboundary watercourses more generally, this option could foster progress toward conjunctive management and support recognition that there are greater benefits, and reduced risk, through consideration of conjunctive management of the two interlinked water sources (tenet 4). To practically achieve this coupling, the Draft Articles would require amendment to iron out inconsistency and overlap across the two instruments. Related, two new provisions would need to be added within the Draft Articles related to CWM and the relation between this instrument and the UNWC. This harmonization would enable the two instruments to collectively cover tenets 1 through 5. Indeed, such coupling would allow the covering of all transboundary water resources while referring to a single system nature of surface and groundwater (tenets 1 & 2). This also means that groundwater as a resource is acknowledged in addition to the benefits of CWM in particular for the implementation of water agreements (tenets 3–5). Still, it remains unclear whether such coupling would lead to ensuring the disaggregation of water according to source and considering CWM when applying equitable and reasonable use principle and the obligation not to cause significant harm (tenets 6–8).

4.3 Option 3: new protocol

Besides amending existing instruments or connecting them, the literature also examined the suggestion of adopting new independent mechanisms such as conventions and protocols. This has been the case for instance for the Draft Articles as it has been suggested for

example its adoption as an independent convention (Eckstein & Sindico, 2014). It is in this context that a third option is to develop a new protocol—or alternatively two distinct but similar protocols for the UNECE Water Convention and UNWC, respectively—to directly address the concept of CWM building on the tenets in a manner that is less encumbered by provisions of existing conventions. In case of the adoption of two protocols, each of these two should dovetail with the contents of the UNECE Water Convention and the UNWC, respectively, given that these two conventions have different scopes. These protocols would include each tenet related to CWM mentioned above and ensure contextualization of scope and tenets within each convention. Nonetheless, given that neither convention directly address CWM,⁶ a single protocol addressing both the application of the concept of CWM would hit all eight tenets. For instance, the provisions of the new protocol(s) must cover all types of water resources, refer to the single system nature of surface and groundwater while acknowledging the importance of aquifers and groundwater (tenets 1–3). The provisions must also acknowledge the greater benefits of CWM mainly on the implementation of water agreements (tenets 3–5). It must also consider the disaggregation of water according to source and the texts of the principles of equitable and reasonable utilization and the obligation not to cause significant harm in both conventions (tenets 6–8) in order to ensure that the tenets included in the protocol(s) related to these principals are not contradictory.

4.4 Mutually exclusive, false dichotomy, or something in-between?

Ultimately, it may be preferable to explore whether the different options can be pursued together, rather than treating them as an either/or. The idea of exploring all these options together has also been examined. For instance, proposals were made for the amendment of the Draft Articles and the UNWC while adopting the Draft Articles as a protocol to the UNWC (Dellapenna & Loures, 2011; Eckstein & Sindico, 2014). Proposals were also made to amend the Draft Articles and adopting them as an independent convention. Hence, the idea of having hybrid options is not new (Eckstein & Sindico, 2014). Unfortunately, it is likely not possible to adopt the three options together. Adopting the Draft Articles as a protocol to the UNWC after amending both mechanisms in accordance with option 1 and 2 cannot go in parallel with the adoption of one or two protocols to the UNWC and the UNECE Water Convention addressing CWM (option 3). Indeed, this would only lead to further fragmentation of IWL as well as confusion in terms of the significance of the independent protocols. However, two ways to combine two options may be feasible.

- Amending the Draft Articles in accordance with option 1 and adoption of the Draft Articles as a protocol to the UNWC in accordance with option 2.
- Amending the Draft Articles in accordance with option 1 and adoption of protocols to the UNECE Water Convention and UNWC in accordance with option 3.

The former option is certainly possible and would add value by fostering more complete coverage of CWM. In practice, the latter of these two consolidated options may be preferable since it accounts for all three relevant instruments and fosters harmonization across

⁶ UNECE Water Convention does that through provision 4 of Model Provisions on Transboundary Groundwaters that is a non-binding document.

them. And, perhaps more importantly, the latter option would cover all rather than just some of the eight tenets.

5 Discussion

The paper is believed to be the first to juxtapose and interrogate the range of options for enhancing conjunctive management of shared waters, which can be reflected in an updated framework of international environmental agreements. This paper derived a novel assessment framework to gauge the degree to which a legal instrument embraces conjunctive management and applied it to assess the value addition achieved through pursuit of existing proposals to modify the international legal regime *vis-a-vis* adoption of a new protocol. The results of this work can guide the direction taken to realize conjunctive management in international watercourses, in order to more fully unlock the benefits secured from trans-boundary water management.

The analysis reveals four major findings. First, current international frameworks do not give strong coverage to CWM. Second, proposals for amendment and coupling only partially enhance the degree to which CWM would be embraced by IWL. Third, development and adoption of protocols to the UNECE Water Convention and UNWC would go a substantial way to enhance coverage of CWM in shared waters. Fourth, hybrid options to advance conjunctive management may be possible.

The paper's first finding reinforced assertions that are widespread in literature. Duric et al. (2008) and Stephan et al. (2007) identified limitations of the UNWC, for example, and Stephan (2009) highlighted the UNECE Water Convention's failure to fully address specificities of groundwater. In contrast to approaches in previous efforts, however, the findings in this paper resulted from application of a systematic framework which enabled more concrete pinpoint of insufficiencies. Ultimately, the bottom line is that our work adds to volume of literature calling for change to status quo, to support realization of more conjunctive approaches.

The paper's second finding provides a reality-check on the value that would be added through implementation of proposals to modify the current legal frameworks. Amending the Draft Articles or coupling of the UNWC and the Draft Articles would, unfortunately, go only part of the way toward embracing CWM. This is because such amendment would not result in considering the UNECE Water Convention. Moreover, the purpose of amending the Draft Articles is not simply to address CWM in the general context of adopting this instrument as a Protocol to the UNWC. Rather, the focus is on amending all the provisions of the Draft Articles clashing with the UNWC provisions (McIntyre, 2011; Tanzi, 2011) and adding new ones including the provision on CWM. This means that CWM would not be treated as a priority. Nonetheless, such proposals should not be flippantly dismissed as they ultimately need to be considered in the context of implementation feasibility; a part-measure that can be feasibly implemented may ultimately be preferable to a comprehensive approach that fails to achieve acceptance and realization.

The paper's third finding confirms the potential of a more robust approach to fully support advancement of conjunctive management principles in international waters. It is worth underlining that the pre-existing literature had stopped short of exploring a new protocol addressing CWM as a supplement to current international instruments, instead focusing mainly on amendment or coupling. Possible reasons for devoting focus to amending and

coupling may include fears of a tedious process that would accompany introduction of a new mechanism—protocol or other—as well as a possible increased ease associated with specifying modification to an existing document *vis-a-vis* conceptualizing something new. Whatever the case, focus has been overwhelmingly on options which produce less benefit than the ones considered in this paper. In particular, the option of amending the Draft Articles in accordance with option 1 and adoption of protocols to the UNECE Water Convention and UNWC in accordance with option 3 provide relatively high benefit.

This is not to say that the adoption of a protocol is an easy process. Without proper political will, it is impossible to do so. In any event, this will take a lot of time similarly to any binding environmental instrument where eventually states would come around and agree on its formation. This would be the case for the parties to the UNECE Water Convention whose current efforts are on expanding membership. These would have to see CWM as extremely important matter to dedicate substantial time and resources to it. Such outcome takes time, consensus among the parties as well as a push from various stakeholders that have interests in such a protocol. The ILC would be tasked with the creation of the first draft based on which negotiations will take place. Countries being parties to both the UNECE Water Convention and the UNWC would not affect much the implementation of the protocol as both treaties are seen in a complementary light despite existing differences (Rieu-Clarke, 2014).

The paper's fourth finding underlines the reality that avenues to advance CWM can be pursued together. The urgent need to harness benefits of CWM may indeed call for simultaneous pursuit of multiple tracks, both to: (i) maximize impact, and (ii) diversify in case not all tracks achieve practical traction and advance. An ideal principle can indeed meet harsh practical reality. Testing the practical feasibility of the different tracks could begin with the adoption of a declaration from a group of prominent international lawyers to put this issue on the international agenda. The ultimate test would then follow and be measured by the pace of advance. In this context, one may wonder whether the establishment of a non-binding instrument is more effective especially as for instance already mechanisms such as the model provisions on transboundary groundwater exist as guidelines. In that sense, new guidelines and programs may be developed to specifically address CWM. While the importance and role of soft instruments is progressively growing as highlighted in the literature to the point where some of them have great influence (Bruch et al., 2020; Pronto, 2015; Shaffer & Pollack, 2010), binding commitments via treaties and protocols remain the best way to implement an obligation that a state voluntarily decides to accept. Still, a non-binding instrument can be adopted initially to then be transformed into a protocol.

Before concluding this section, it is worth devoting some attention to the comparatively late focus on CWM in International Environmental Agreements generally and IWL specifically. The initial focus of international law in transboundary waters was undoubtedly oriented toward surface water. This may simply be because this water source is more visible, more easily measured and shared, and more aligned with the large-scale water uses that drove cooperation. However, it appears recognition of the disproportionate historic focus on surface water first drove focus on groundwater as a discrete entity, reflected in the 2008 Draft Articles. While definitive reasons for this are unclear, it may be that there is greater legal comfort with separate compartmentalization of surface water and groundwater—regardless of whether this aligns with practical realities. Related, devising principles that respond to more complex realities of surface–groundwater interactions and their management may not have been viewed as an attractive pursuit.

6 Conclusion

Conjunctive management of water resources can bring a range of benefits that include reducing vulnerability and improving water security, yet its coverage in IWL is presently incomplete. This paper presented and analyzed various options to include this concept within globally influential international environmental agreements. To answer the paper's central question, we conclude that a more holistic change, reflected in a new protocol, adds greater value than undertaking piecemeal modifications to existing legal frames. Nonetheless, multiple options can and should be pursued together. This finding adds to existing literature, which has limited its focus to existing instruments and not previously focused on potential scope and value associated with new protocol development.

Two practical first steps to motivate practical movement toward embracing conjunctive management in international environmental agreements is to demonstrate and document the added value—specific and practical cases—of CWM in shared waters. To do so, international organizations may seek to partner with riparians to apply a conjunctive approach in specific transboundary basins. For instance, international organizations like the UNECE conducted projects on the Water-Energy-Food-Ecosystem Nexus in several basins to provide evidence of the concept's benefits (De Strasser et al., 2016). Analogous initiatives—for example, conducting projects in several basins and identifying, capturing and disseminating the benefits they bring—could be undertaken for CWM. Equally, to help concretize a conjunctive management instrument that provides policymakers with a tangible proposal, a draft conjunctive protocol can be developed. This protocol could build on and refine the 8 tenets elaborated above.

It nonetheless needs to be acknowledged that IWL regime will, almost invariably, be behind-the-times. The gestation period required for development and ratification of international environmental agreements, including IWL specifically, requires time. It may thus be inevitable that years required for entry into force of any new law, means that such law will be eclipsed by new developments by the time it becomes active. To address this, Jafroudi (2018, p. 708) suggested 'using agreements with short and finite time horizons' while Kilgour and Dinar (2001) developed a mechanism to ensure flexible water sharing, in addition to Cooley and Gleick (2011) who examined specific flexible legal and institutional arrangements that can be included with water agreements to address uncertainties resulting from climate change. Ultimately, while there is no definitive solution to this dynamic, what can be done is to go into changes with circumspection—recognizing additional change come.

The paper contained three limitations. First, focus was placed on (global) IWL and not basin-specific agreements. Second, the eight tenets provided a good approximation of points that are required for inclusion of conjunctive management; further investigation may nonetheless drive some refinement. Third, focus was mainly oriented toward modifications that would foster a deeper embrace of the principle of conjunctive management; complementary future investigation could be placed on practical viability of modifications. These limitations drive areas of future work, namely (i) investigation into basin-level conjunctive treaties, building on Lautze et al. (2018), (ii) optimal principles of conjunctive management in international waters, and (iii) practical aspects of adopting and implementing conjunctive management principles.

Ultimately, the following recommendations are offered:

- The status quo within IWL must change to respond to emerging issues including CWM. Present treatment of conjunctive management in IWL is insufficient.
- Enhance coverage of conjunctive management in IWL to encourage more effective management of transboundary freshwater resources, a less fragmented and more con-

sistent international water regime, and ultimately more benefits accruing to the populations and environmental goods dependent on shared water resources.

- Consider different options and consider their joint pursuit, to advance CWM in IWL. In particular, consider formulation and adoption of protocols to both UNECE Water Convention and UNWC and amendment of the Draft Articles to enable greater address of conjunctive management.
- Undertake future research to test the practical feasibility of the different avenues through, for instance, the adoption of a declaration from a group of prominent international lawyers to put this issue on the international agenda. Then, one can assess the position of the different states on this issue to figure out whether it would be easy to adopt CWM as a new principle within IWL.
- Promote CWM concept as a new principle of IWL among international water lawyers and scholars, water professionals and the wider water community. Currently, these actors have not examined this concept or considered it from a legal perspective.

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