# FINDING THE RIGHT FIT: ONE DESIGN ELEMENT IN THE INTERNATIONAL GROUNDWATER RESOURCE REGIME

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## INTRODUCTION

The international transboundary groundwater resource regime will continue to develop as a series of bilateral or regional agreements related to specific resource pools often referred to as aquifers or aquifer systems.[1] Unlike the emerging climate change regime, the groundwater regime will not, and need not, become global in scope. This prediction will not be surprising for those familiar with the spatial distribution and physical attributes of groundwater and the concept of territorial sovereignty in the international legal system. However, with respect to forests – another resource that is rooted in the territory in which it is located – a regime with global scope is emerging. Why do we get different answers with respect to regime scope for these two quintessentially sovereign resources?

The reason is straight-forward: the externalities – both positive and negative – associated with groundwater are spatially bounded, albeit on a continental scale, while some of the externalities associated with forests are not since their spillover effects can be global.[2] Put another way, the goods and services associated with



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1. Among the questions put to the panel on water issues at the *Duke Journal of Comparative & International Law* Symposium titled *Local Property, Global Justice: Law and Resources in the Era of Climate Change* was this one: "Will water rights issues continue to develop as agreements between neighboring countries, or do we need a more global vision?" I understand this to be, primarily, a question about regime design, in particular the number and identity of the actors that should be involved.

2. Breyer uses some of these terms in the context of describing rationales for regulation: "The differences between true social costs and unregulated price are 'spillover' costs (or benefits) – usually referred to by economists as 'externalities.'" STEPHEN BREYER,

groundwater are fully excludable from non-groundwater states. The same is not true for forests, which provide some non-excludable benefits – or positive externalities – and some spatially unbounded negative externalities. Despite their location within the territory of a single state, forests, as sinks for terrestrial carbon sequestration, are an open-access common pool resource and, as sources of greenhouse gas emissions create spillover effects with global scope.[3]

Understanding the spatial extent of the externalities associated with a resource is an important first step in designing a regime to address the human/environment problems arising from that resource. Matching the spatial extent of the externalities with the spatial extent of the regime is part of finding the right "fit" and is one determinant of regime effectiveness.[4] Although there are several elements of fit between a resource regime and the biogeophysical system it is meant to address, this essay deals only with identifying the appropriate international actors. In the international domain, the question is which states should (and which states should not) be included in the management of a particular resource pool.

This essay contemplates the regime design question in the international domain – the domain in which states interact – and largely ignores the local domain, although it borrows concepts and terminology from local property and common-pool resource arrangements.[5] In the process of scaling up and down between the

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REGULATION AND ITS REFORM 23 (1982). In theory, regulation would internalize the costs of negative externalities. *See id*. In this essay, externalities occur when costs or benefits associated with a resource "spillover" an international boundary; these are transnational externalities. A properly designed international resource regime would include only those actors required to internalize the externalities associated with that resource.

3. "Terrestrial carbon sequestration involves the net removal of $CO_2$ from the atmosphere by plants during photosynthesis and its fixation in vegetative biomass and in soils." U.S. DEP'T OF ENERGY & NAT'L ENERGY TECH. LAB., CARBON SEQUESTRATION ATLAS OF THE UNITED STATES AND CANADA 6 (2d ed. 2008), *available at* http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasII/atlasII.pdf.

4. The concept of fit, loosely applied in this essay, is borrowed from the institutional design literature. *See, e.g.*, ORAN R. YOUNG, THE INSTITUTIONAL DIMENSIONS OF ENVIRONMENTAL CHANGE: FIT, INTERPLAY, AND SCALE 55 (2002) ("[T]he effectiveness of environmental and resource regimes . . . is determined in considerable measure by the degree to which they are compatible with the biogeophysical systems with which they interact. . . . It follows that we should resist temptation to think that one size fits all when it comes to designing regimes to solve a variety of environmental problems.").

5. I attribute my use of the word "domain" to the edited volume by Robert Keohane and Elinor Ostrom in which the authors explore some of the convergences of the common pool resource and international relations literatures that have grown out of these "two domains." *See* LOCAL COMMONS AND GLOBAL INTERDEPENDENCE: HETEROGENEITY AND COOPERATION IN TWO DOMAINS (Robert O. Keohane & Elinor Ostrom eds., 1995).

two domains, one finds many analogs but most are not perfect matches; territorial sovereignty does not quite equal real property ownership. Moreover, some concepts or institutions found in one domain simply do not exist in the other; overarching state authority, an ever-present element in the local domain, is absent in the international domain. Thus, while borrowing between the two domains can be enlightening, it also has potential pitfalls.

Despite what may seem like an obvious prediction – groundwater resource pools will be managed under bilateral or regional agreements among states in which those pools are located – there are some indications that groundwater is being misconceived as a commons resource subject to a regime with global scope. This misconception could lead to a misfit between the scope of the resource-related problems and the scope of the regime, particularly with regard to the number and identity of the actors involved.[6] Such a mismatch could in turn contribute to regime ineffectiveness and inefficiency.

## I. UNPACKING THE GROUNDWATER RESOURCE

The focus of this essay is on groundwater – water held in aquifers underground in the phreatic or saturated zone[7] – as opposed to surface water (*e.g.* rivers and lakes). Still, much of this analysis is also applicable to surface water and other shared resources in several ways. First, groundwater, like most surface water, is located exclusively within the territory of sovereign states. Second, groundwater and surface water are often hydraulically connected such that dividing them into two separate resources, although

6. The goal of finding the right fit is to avoid a misfit. This essay is specifically concerned with avoiding a spatial misfit, which can occur when the "[i]nstitutional jurisdiction [is] too small or too large to cover or affect the areal extent of the ecosystem(s) subject to the institution." Victor Galaz et al., *The Problem of Fit among Biophysical Systems, Environmental and Resource Regimes, and Broader Governance Systems: Insights and Emerging Challenges*, *in* INSTITUTIONS AND ENVIRONMENTAL CHANGE: PRINCIPAL FINDINGS, APPLICATIONS AND RESEARCH FRONTIERS 147, 150 (Oran R. Young, Leslie A. King & Heike Schroeder eds., 2008).

7. Aquifers are the "water-bearing layers of saturated underground rock and sand" while "the water in them is called *groundwater*." JEFFREY S. ASHLEY & ZACHARY A. SMITH, GROUNDWATER MANAGEMENT IN THE WEST 5 (1999). The fact that groundwater moves within aquifers should not be misunderstood to mean aquifers are underground rivers. With the exception of "karst aquifers" which do resemble underground rivers, water flow in aquifers has been compared to the flow of water through a sponge. *See* Gabriel Eckstein & Yoram Eckstein, *A Hydrogeological Approach to Transboundary Ground Water Resources and International Law*, 19 AM. U. INT'L L. REV. 201, 217 (2003).

convenient, does not conform to hydrological reality.[8] Finally, ground and surface water are indistinguishable $H_2O$ from a hydrochemical perspective. Accordingly, these two parts of the freshwater resource base are also often considered together in international legal arrangements. Surface water has been the predominant concern, while groundwater has been addressed as a secondary issue in water-specific treaties or as one of many concerns in boundary delimitation treaties.[9]

This emphasis on surface water is curious considering the relative abundance of groundwater. If we exclude the vast amounts of freshwater held in polar ice and in glaciers,[10] groundwater is by far the more abundant of the two remaining sources of freshwater – surface water and groundwater – comprising 97% of all freshwater available on the planet.[11] Despite its relative abundance, the legal and policy issues associated with groundwater are not as well-studied, and the regimes governing its use in both the local and international domains are in their infancy compared to the longer-standing regimes addressing surface water.[12] The reason for this state of relative neglect

8. Influent rivers replenish aquifers directly, and groundwater can discharge directly into effluent rivers, other aquifers and the ocean. Kerstin Mechlem, *International Groundwater Law: Towards Closing the Gaps?*, 14 Y.B. INT'L ENVTL. L. 47, 49 (2003); *see also* Eckstein & Eckstein, *supra* note 7, at 214-15.

9. *See, e.g.*, Convention on the Law of the Non-navigational Uses of International Watercourses art. 2, May 21, 1997, 35 I.L.M. 700, 704 (not in force) (including most types of groundwater in the definition of "watercourse"); Albert E. Utton, *The Development of International Groundwater Law*, *in* INTERNATIONAL GROUNDWATER LAW 1, 10 (Ludwik A. Teclaff & Albert E. Utton eds., 1981) ("[G]roundwater is usually only a secondary issue which is mentioned almost in passing.") [herinafter Utton, The Development]; Dante A. Caponera & Dominique Alhéritière, *Principles for International Groundwater Law*, *in id.* at 29-30 (discussing international land boundary delimitation treaties in which transboundary groundwater is considered); Mechlem, *supra* note 8, at 47 ("International law has only rarely taken account of groundwater."). For the texts of agreements that address transboundary groundwater resource pools through approximately 1980, see Utton, *The Development*, *supra*, at 189. For the texts of agreements concluded since approximately 1980, see U.N. EDUC., SCIENTIFIC & CULTURAL ORG. [UNESCO] & FOOD AND AGRICULTURAL ORG. OF THE U.N. [FAO], FAO LEGISLATIVE STUDY NO. 86, GROUNDWATER IN INTERNATIONAL LAW: COMPILATION OF TREATIES AND OTHER LEGAL INSTRUMENTS (Stefano Burchi & Kerstin Mechlem eds., 2005).

10. Eckstein and Eckstein put the amount of freshwater held in ice caps, glaciers, ground ice, permafrost and perennial snow at approximately 70% of total freshwater stocks on the planet. Eckstein & Eckstein, *supra* note 7, at 204 fig. 1.

11. Int'l Law Comm'n, *Seventh Report on the Law of the Non-Navigational Uses of International Watercourses*, 52, U.N. Doc A/CN.4/436 (Mar. 15, 1991) (*prepared by* Stephen C. McCaffrey).

12. Utton, *The Development*, *supra* note 9, at 4 ("The laws governing groundwater nationally are inadequately developed, and the law governing transboundary groundwaters is only at the beginning state of development."); Miguel Solanes, *Institutional and Legal Issues*

can be attributed to the invisibility of groundwater: out of sight, out of mind.

This attitude toward groundwater appears to be changing. In 2002, for example, the United Nations International Law Commission (ILC) decided to include the topic of "shared natural resources" in its program of work, the overall object of which is "the promotion of the progressive development of international law and its codification."[13] At that time the ILC took up the task of preparing draft articles on the law of transboundary aquifers. The ILC drafting committee adopted the text of those draft articles on second reading in May 2008.[14] While the draft articles reflect some existing principles and customary rules of international law, the articles themselves have, to date, not been adopted by the United Nations General Assembly, are not in force, and do not create any new rights or obligations. Nonetheless, the draft articles will be considered below as both a possible source of misconception about the scope of the regime and, as the positive manifestation of United Nations member states' perspectives on the issue, one yardstick against which to measure conclusions.

In order to understand the characteristics of groundwater and the spatial extent of the externalities associated with its use, it is helpful to unpack the suite of goods and services the resource provides. Resources tend not to be monolithic in their functionality. Instead, they have multiple functionalities that, if not considered separately, could mask each other's distinct characteristics and lead to a misconception of the biogeophysical system.[15]

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*Relevant to the Implementation of Water Markets*, *in* GROUNDWATER: LEGAL AND POLICY PERSPECTIVES: PROCEEDINGS OF A WORLD BANK SEMINAR, WORLD BANK TECHNICAL PAPER NO. 456, 69, 71 (Salman M. A. Salman ed., 1999) ("The evolution of groundwater law regarding ownership of this particular manifestation of water resources has been somehow slower than the evolution of surface water law.").

13. Statute of the International Law Commission art. 1(1), G.A. Res. 174(II), at 105, U.N. Doc. A/519 (Nov. 21, 1947).

14. Int'l Law Comm'n [ILC], *Shared Natural Resources: The law of transboundary aquifers*, U.N. Doc. A/CN.4/L.724 (May 29, 2008).

15. Keohane and Ostrom demonstrate this point with respect to the rival or non-rival characteristic of two aspects of groundwater:

> Although this distinction is clear in the abstract, many physical resources can be viewed as public goods in regard to some aspects of their provision or use and as CPRs in regard to other aspects. Consider, for instance, the problem of managing a groundwater basin. In regard to appropriation or receiving benefits, the resource is clearly a common-pool resource – the water extracted by one user reduces the supply available to others. In regard to the regulation of the basin itself or its provision, protection of a

It may be helpful for the reader, who likely is more familiar with surface water, if only through casual observation, to make some comparisons between surface water and groundwater.[16] Groundwater and surface water share many traits, but they also differ in important ways. Groundwater and surface water both exist on a *continental scale*, however, their distribution within the geography is markedly different. As a general observation, groundwater is more widely dispersed covering larger total areas, while surface water tends to be channeled and more restrictively bounded. Indeed, groundwater resource pools exist at such a large scale that many straddle not only local property or federal state boundaries, but also international boundaries, and, with the exception of remote islands, almost all states share groundwater resources with at least one neighbor.[17] Groundwater and surface water are both *sources* of water for municipal, agricultural, and industrial uses, however, due largely to their geographic distribution, the manner in which the two sources are accessed is quite different. Groundwater, at least in principle, is accessible to all inhabitants living above an aquifer through highly-distributed, mostly private, low-intensity investments and unlike surface water does not require large public investment to extract, store or transport.[18] Groundwater and surface water are also *sinks* of

> groundwater basin from salt-water intrusion, soil compaction or pollution is a public good because protection of one user against destruction of the basin also increases the supply of protection available to others.

Robert O. Keohane & Elinor Ostrom, *Introduction*, *in* LOCAL COMMONS AND GLOBAL INTERDEPENDENCE: HETEROGENEITY AND COOPERATION IN TWO DOMAINS, *supra* note 5, at 14.

16. Groundwater, especially groundwater found in "fossil" aquifers, may have more similarities to hydrocarbon deposits of oil and gas. These aquifers are non-recharging and hold water that may have been isolated from the hydrologic cycle for thousands if not millions of years. Eckstein & Eckstein, *supra* note 7, at 216-17. They do not experience flow and are "de-coupled from contemporary recharge." Jacob Burke et al., *Groundwater and Society: Problems in Variability and Points of Engagement*, *in* GROUNDWATER: LEGAL AND POLICY PERSPECTIVES, *supra* note 12, at 31, 36. It is possible that the sharing and management of these resources could benefit from the oil and gas model in both the local and international domains.

17. Robert Glennon et al., *Turning on the Tap: The World's Water Problems*, 3 FRONTIERS IN ECOLOGY AND THE ENVIRONMENT 503, 504 (2005); Caponera & Alhéritière, *supra* note 9, at 26.

18. *See* Burke et al., *supra* note 16, at 32. (noting the differences between groundwater and surface water in the socioeconomic context); Shammy Puri, Alice Aureli & Raya M. Stephan, *Shared Groundwater Resources: Global Significance for Social and Environmental Sustainability*, *in* OVEREXPLOITATION AND CONTAMINATION OF SHARED GROUNDWATER RESOURCES 3, 7 (C.J.G. Darnault ed., 2008). It is this close spatial relationship between groundwater users and the resource that inspires comments such as "Groundwater is a local resource par excellence," *id.*, and "Groundwater is above all else a vicinity resource." UNESCO, INT'L HYDROLOGICAL PROGRAMME [IHP], GROUNDWATER RESOURCES OF THE

pollution. In this role their main difference is their ability to recover from overexploitation, pollution of groundwater often resulting in irreversible damage as the "self-purifying qualities" of groundwater and aquifers are less effective than those of surface water.[19]

Groundwater and surface water both *flow*,[20] however, groundwater flows at a much slower rate, can flow vertically as well as horizontally,[21] and flow direction and rate can be influenced by pumping. One of the most important political consequences of flow in surface water – the creation of upper and lower riparians – is more complex when it comes to groundwater. In the international domain, these factors are relevant because groundwater flow can, under some conditions, create an upstream/downstream relationship between sharing states.[22] Often, however, the direction of flow is not uniform, does not always flow toward a common terminus, can connect otherwise unrelated river basins, and is difficult to detect. Moreover, the impacts of its use as a source or a sink can cause effects throughout the resource pool, with pollution traveling in all directions from the point of contamination and the water table dropping throughout the aquifer as a result of overdrafting.[23] Under these flow conditions hydrological "blowback" is a real possibility with groundwater.

Finally, groundwater and surface water are both *renewable*, yet the rates at which they are renewed through natural recharge can vary dramatically. Surface water renews through the direct effects of precipitation on a daily, weekly, or monthly time scale. By contrast, groundwater renews on a monthly to millennial time scale through

WORLD AND THEIR USE 24 (Igor S. Zekster & Lome G. Everett eds., 2004), *available at* http://unesdoc.unesco.org/images/0013/001344/134433e.pdf.

19. Mechlem, *supra* note 8, at 58 (2003); *see also* Burke et al., *supra* note 16, at 40 (noting the technical impossibility or economic infeasibility of cleaning up an aquifer once polluted).

20. With the exception of groundwater in fully confined, "fossil" aquifers, groundwater does flow through aquifers.

21. Stephen Foster, *Essential Concepts for Groundwater Regulators*, *in* GROUNDWATER: LEGAL AND POLICY PERSPECTIVES, *supra* note 12, at 15, 16 (noting predominantly horizontal flow).

22. *See*, *e.g.*, Eckstein & Eckstein, *supra* note 7, at 213-14 (describing the hydrogeology of the mixed confined-unconfined Mountain, or West Bank, Aquifer that recharges only in the unconfined portion located in the Judean Mountains of the West Bank and flows toward the confined portion in Israel); M. El-Fadel, R. Quba'a, N. El-Hougeiri, Z. Hashisho & D. Jamali, *The Israeli Palestinian Mountain Aquifer: A Case Study in Ground Water Conflict Resolution*, 30 J. NAT. RESOURCES & LIFE SCI. EDUC. 50 (2001) (providing a detailed case study of this transboundary aquifer).

23. *See* Mechlem, *supra* note 8 (discussing some of the physical characteristics of groundwater).

the less direct effects of surface water and precipitation percolating through the unsaturated zone. Slower rates of groundwater recharge are both a strength and weakness of groundwater: groundwater is more vulnerable to overdrafting, but it can also be a more reliable source of water since it is relatively immune to seasonal fluctuations in precipitation.

The spatial externalities associated with the use of groundwater are bounded, more or less, by the aquifer system in which the particular groundwater resource pool is located. Although pollution can flow out of an aquifer into hydraulically connected surface water, and overdrafting can have negative effects on the flow of connected surface water and the stability of the overlying land, the scope of these effects is regional, not global. Because the hydrologic cycle will be impacted by climate change, climate change and related water issues are sometimes considered together.[24] Although connected, the human/environment problems of water on the one hand, and climate change on the other, are quite different, especially in scope. With respect to the climate puzzle in which greenhouse gas emissions, the atmosphere, and forests are all directly involved, groundwater is an innocent bystander.[25] Groundwater is neither part of the climate change problem – groundwater is not a source of greenhouse gas emissions – nor part of its solution – it does not act as a carbon sink as forests do.[26] Although climate models predict an increase in overall

24. *See, e.g.*, Symposium, *Local Property, Global Justice: Law and Resources in the Era of Climate* Change, 19 DUKE J. COMP. & INT'L L. (forthcoming 2009) (consisting of three panels on greenhouse gas emissions, forests, and water).

25. In this sense groundwater stands in the same place relative to the climate puzzle as sea level rise. Scarce groundwater and rising sea levels do not contribute to the problem or to the solution of climate change, but are directly affected by the changing climate. Of course the truly innocent bystanders are those who rely on groundwater to survive in areas where it will become increasingly scarce as a result of changes in climate, or those living in low lying coastal areas that might soon be inundated.

26. Groundwater is not without links to climate change, however it is not directly involved in the processes.

Groundwater does not emit greenhouse gases. However, its extraction often requires pumping which can involve the use of greenhouse gas emitting processes. Biswas notes that "[t]he linkages between groundwater and energy requirements are high. . . . Estimates . . . indicate that 12%-13% of all electricity generated in Mexico is used to pump water up and down." Asit Biswas, *Water Crisis: Current Perceptions and Future Realities*, *in* GROUNDWATER: LEGAL AND POLICY PERSPECTIVES, *supra* note 12, at 1, 9.

Groundwater is not a carbon sink. However, it is used to irrigate vegetation that in turn acts as a carbon sink. The vegetation in wetlands, which require the presence of surface water (and in some cases groundwater) make substantial contributions to the carbon sequestration process. Groundwater does have a sink functionality in the sense that it absorbs pollution, but most of precipitation globally, the spatial and temporal distribution of this increased precipitation will not lead to increased groundwater recharge in those regions most in need of it.[27] In some regions groundwater could become scarcer as a result of climate change, especially in already arid, low- or mid-latitude regions.[28] In arid regions major aquifer recharge episodes are already rare, occurring "as infrequently as once a decade, or even once a century."[29] Reduced precipitation could have a multiplicative effect on groundwater recharge. Indeed, one recent MIT study found that "a 20 percent decrease in rainfall could lead to a 70 percent decrease in the recharging of local aquifers."[30]

## II. A TAXONOMY OF INTERNATIONAL RESOURCES

Scholars of collective action and common-pool resource arrangements differentiate types of goods and services on the basis of their rivalness and their excludability.[31] Unfortunately, most of the

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this pollution attenuation functionality can be attributed to the soil and sediment of the unsaturated, or vadose zone through which groundwater percolates.

Finally, it seems conceivable that certain deep and fully confined aquifers could be used for future geologic carbon sequestration, although that use is not currently being pursued in the United States. "Geologic carbon sequestration involves the separation and capture of $CO_2$ at the point of emissions from stationary sources followed by storage in deep underground geologic formations." 2008 Carbon Sequestration Atlas of the United States and Canada, *supra* note 3, at 6.

27. *See* GROUNDWATER RESOURCES OF THE WORLD AND THEIR USE, *supra* note 18, at 285 (discussing the limitations of general circulation models to predict changes at a regional scale).

28. *See* Isamu Kayane, *Global Warming and Groundwater Resources in Arid Lands*, *in* FRESHWATER RESOURCES IN ARID LANDS, UNU GLOBAL ENVIRONMENTAL FORUM V 70 (Juha I. Uitto & Jutta Schneider eds., 1997) (discussing indirect influence of global warming on local precipitation).

29. Stephen Foster, *supra* note 21, at 15, 23.

30. David Chandler, *Water Supplies could be strongly affected by climate change*, MIT NEWS, Dec. 18, 2008, http://web.mit.edu/newsoffice/2008/agu-groundwater-1218.html.

The same MIT study indicates a disproportionately large recharge effect with only small increases in precipitation, which is not good news for areas plagued with an overabundance of groundwater. This article assumes scarcity or underprovision of the goods and services associated with the groundwater resource, although it is possible that some regions will experience an overabundance of groundwater as a result of changing patterns of precipitation. An overabundance of groundwater would create flooding. Combined with predicted sea level rise and intensified storm events, this could create serious problems in low-lying coastal areas.

31. Dichotomizing these two variables into rival/non-rival (or subtractibility) and excludable/non-excludable we can differentiate between private goods (rival/excludable), pure public goods (non-rival/non-excludable), club goods (non-rival/excludable), and common pool resources (rival/non-excludable). The last of these types poses the problems associated with the tragedy of the commons. *See* Oran R. Young, *Rights, Rules, and Common Pools: Solving Problems Arising in Human/Environment Relations*, 47 NAT. RESOURCES J., 1, 3 fig.1 (2007).

goods and services provided by the limited natural resources of our planet – including water, land, fish, and the sink functionalities of our air, atmosphere, stratospheric ozone, forests and water – are rival, such that the use of a good or service by one reduces the availability of that good or service to others. Although these resources do not vary in terms of their rivalness, they do vary markedly in the level of excludability. For the purpose of understanding the appropriate scope of a regime or the spatial extent of the externalities associated with a resource, excludability is the more useful variable. The ability or right to exclude is also an element in the traditional bundle of local property rights and excludability goes directly to the question of relevant actors. In the context of finding the right fit, the relevant actors are those who have access to the goods and services provided by the resource or who experience the externalities of its use.[32]

A three-class taxonomy of resources in the international domain dependent entirely on the excludability variable could be a useful tool for understanding the appropriate scope of the related regime. Positioning within this taxonomy will shed light on the spatial extent of the externalities of the resource and therefore, who should be considered in the management of the resource. It should be noted that the physical location of the resource is not important to this taxonomy, but rather what are the number and identities of the actors who are impacted by or enjoy the externalities associated with the resource. The three classes are (1) sovereign resources (fully excludable); (2) shared resources (partially excludable); (3) commons resources (non-excludable).

## A. Sovereign Resources

*Sovereign resources* are located wholly within the territory of a single state, the goods and services of the resource are fully excludable to those beyond the territory of that state, and the externalities associated with the use of the resource do not spill over

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Non-rivalness is also referred to as jointness. *See* MANCUR OLSON JR., THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS 14 n.21 (rev. ed. 1971). However, Ostrom cautions against confusing rivalness of resource units with jointness of a resource system. ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 32 (1990).

32. "Excludability" is often used to mean keeping potential users from goods or services, which I have equated with positive externalities in this essay. Here, "excludability," is also used to draw the line between those who are and those who are not impacted by "bads" or negative externalities.

the territorial boundaries of the resource state.[33] In general, the resources controlled by a sovereign state include those on the surface, in the airspace (*ad coelum*) and those in the subsoil (*ad inferos*) of the territory.[34] For coastal states, sovereign territory also generates sovereign rights over the natural resources of the water column, seabed and subsoil of the exclusive economic zone.[35] A coal deposit or biological resource located entirely within the territory of a single state would fall into this category of sovereign resources.[36] Such sovereign resources, being fully excludable, are private goods. Their 'ownership' structure most closely resembles private property: a single rights-holder with a complete bundle of sticks that is subject only to the omni-present rule of property ownership *sic utere tuo ut alienum non laedas* (use your own so as not to injure another). Because this limiting rule is only activated in the event of spillover, its activation necessarily changes the resource from a sovereign resource into one of the other two types; shared resource or commons resource.

## B. Shared Resources

*Shared resources* are those subject to the exclusive jurisdiction of two or more states. These are excludable for non-members but non-excludable within the group of sharing states since there is spillover among a limited subset of all states. In other words, the spatial extent of the externalities may be regional, but is not global. Shared resources, being only partially excludable, are limited-access common pool resources – a form of collective good. Their 'ownership' structure most closely resembles common property with some duties

33. These are also referred to as "internal resources." *See, e.g.*, Eyal Benvenisti, *Collective Action in the Utilization of Shared Freshwater: The Challenges of International Water Resources Law*, 90 AM. J. INT'L L. 384, 384 (1996). Specifically with respect to groundwater found within the exclusive jurisdiction of a single state, one author has coined the term "State-owned aquifers." Julio Barberis, *The Development of International Law of Transboundary Groundwater*, 31 NAT. RESOURCES J. 167, 167 (1991). This term, which was developed to describe the resource in the international domain, could confuse if misapplied in the local domain where it would imply state or public as opposed to private ownership of the resource.

34. *See* Rainer Lagoni, *Oil and Gas Deposits across National Frontiers*, 73 AM. J. INT'L L. 215, 216 (1979) (*ad inferos* with respect to mineral resources).

35. United Nations Convention on the Law of the Sea art. 56(1)(a), Nov. 16, 1994, 18 U.N.T.S. 3.

36. The latter despite the perambulatory affirmation that "biological *diversity* is a common concern of humankind." Convention on Biological Diversity pmbl., *entered into force* Dec. 29, 1993, 1760 U.N.T.S. 79 (emphasis added).

owed from one rights holder to another.[37] In the international domain many of these duties may not rise to the status of binding obligations, but they would at least define standards of good behavior and might include good neighborliness, a general obligation to cooperate, the principles of information and consultation, environmental impact assessment procedures, and the principle of non-discrimination.[38] Some resources in this category include hydrocarbon deposits that straddle an international boundary and shared fish resources found within the exclusive economic zones of two or more countries. Transboundary airsheds and watersheds would also qualify as shared resources. The question of how, exactly, these transboundary resources are to be shared – both in terms of allocating the benefits and mitigating or compensating for the negative externalities associated with the resource – is one for the sharing states to determine by agreement within the strictures of any overarching international law rules and obligations. At a minimum, sharing states are bound by the customary rule against allowing activities within their territory to cause significant harm in the territory of another state.[39] It is also argued that "equitable utilization" is the customary international law sharing rule for shared resources creating binding, if vague, obligations for sharing states.[40]

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37. At the outset of the ILC's work on "shared natural resources," member states were careful to distinguish between shared ownership, an idea some were resistant to, and shared responsibility for resource management, which was the understanding of "shared" adopted by the Special Rapporteur. *See* Int'l Law Comm'n [ILC], *Report of the Commission at the Fifty-Eight Session*, ch. 9, ¶403, supplement no. 10 (A/58/10) (2006).

38. *See* Pierre-Marie Dupuy, *Soft Law and the International Law of the Environment*, 12 MICH. J. INT'L L. 420, 434 (1991) (describing the role of "soft" international environmental law norms in describing standards of behavior for states).

39. This rule is considered by most to be a binding rule of customary international law, one of the only of its kind in the field of international environmental law. There seems to be some agreement that this limiting rule, expressed in Principle 2 of the Rio Declaration, has achieved the status of customary international law. *See, e.g.*, PETER MALANCZUK, AKEHURST'S MODERN INTRODUCTION TO INTERNATIONAL LAW 250 (7th ed. 1997) ("Principle 2 [of the Rio Declaration] confirms the prohibition of transboundary environmental harm . . . which is now recognized as customary law reflecting the principle of limited territorial sovereignty and integrity . . . .").

40. Malgosia Fitzmaurice, *General Principles Governing the Cooperation between States in Relation to Non-Navigational Uses of International Watercourses*, 14 Y.B. INT'L ENVTL. L. 3, 10 (2003); *see also* Julio Barberis, *The Development of International Law of Transboundary Groundwater*, 31 NAT. RESOURCES J. 167, 175 (1991) ("The rule [of equitable utilization] enjoys wide acceptance today and is part of general international law."); Eyal Benvenisti, *Collective Action in the Utilization of Shared Freshwater: The Challenges of International Water Resources Law*, 90 AM. J. INT'L L, 384, 414 (1996) ("[T]he vague standard [of equitable use] increases the likelihood of cooperation by encouraging riparians to negotiate rather than litigate. . . .").

### C. Commons Resources

*Commons resources* typically exist in an area of the "global commons" – those areas beyond the limit of national jurisdiction of any state – such as the living marine resources outside the exclusive economic zone, the stratospheric ozone layer, and, at least for now, Antarctica. But the location of the resource is not the determining factor in this taxonomy; rather, it is whether the benefits of the goods and services supplied by the resource can be accessed by all users or whether the negative externalities associated with the resource have global reach. Commons resources, being non-excludable, are open-access, common-pool resources. Because they are typically rival in nature, commons resources are not pure public goods, although they are sometimes referred to as public goods.[41] Within commons resources there are two distinct subtypes: *res nullius* the ownership structure of which resembles null property subject to the rule of capture, and common heritage of humankind resources, which resemble public property in that these resources may not be appropriated through capture and are normally subject to international management.

In the interest of effective regime design, and with proper fit in mind, it is clear that the position of a resource in this taxonomy should drive the scope of the regime intended to address problems associated with that resource. A wholly internal, sovereign resource, for instance, will need no international resource regime, as all of the problems associated with the resource will be internal to the state in which the resource is located. On the other hand, a commons resource will require a regime that includes all states, that is, a regime of global scope. Forests as sources and sinks of greenhouse gases with global spillover effects and total non-excludability are positioned squarely within the commons resource classification and, thus, are a prime example of resources that require a regime of global scope. Regimes designed to address shared resources fall in the middle of these extremes, requiring the participation of sharing states only. Groundwater, whose externalities are spatially bounded and which is excludable to non-groundwater states, is a shared resource requiring a

41. *See* OSTROM, *supra* note 31, at 32-33 (distinguishing between common pool resources on the one hand and collective or public goods on the other); *see also* OLSON, *supra* note 31, at 14-15 (using "common," "collective," and "public goods" interchangeably to describe a non-rival good within a limited group of users); Benvenisti, *supra* note 40 at 384 (referring to public goods as those "to which all states enjoy potentially unrestricted access" and distinguishing from a "collective good to which only the riparian states enjoy access").

regime with a more limited scope: involving only the particular groundwater states. To apply a regime of global scope to problems associated with shared resources would create an unhelpful and unnecessary mismatch.

The emerging international law regimes for forests, in the context of climate change, and for shared groundwater tend to confirm these classifications. The Kyoto Protocol to the United Nations Framework Convention on Climate Change is part of a regime of global scope designed to achieve the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[42] Forests as sources and sinks of greenhouse gases are explicitly included within the accounting scheme created under the Kyoto Protocol and subsequent agreements within the climate change regime.[43] In contrast, the emerging transboundary groundwater regime contemplates only bilateral or regional agreements or arrangements for the management of particular shared resource pools.[44]

## III. THE MISCONCEPTION OF GROUNDWATER AS A COMMONS RESOURCE

There are some indications in the academic literature and in the record of multilateral law-making negotiations that groundwater is being misconceived as a commons resource. There are several possible sources of this misconception; some originate in the international domain, others in the local domain. If fit is an important

42. United Nations Framework Convention on Climate Change art. 2, May 9, 1992, 1771 U.N.T.S. 107.

43. Kyoto Protocol to the United Nations Framework Convention on Climate Change art. 3 ¶ 3, Dec. 11, 1997, U.N. Doc FCCC/CP/1997/7/Add. 1 ("The net changes in greenhouse gas emissions by sources and removal by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990 . . . shall be used to meet the commitments under this Article of each Party included in Annex I.").

At the sixth session of the Conference of the Parties (part two) in Bonn the Parties expanded on the principles governing forestry activities within the climate change regime. Framework Convention on Climate Change, Bonn, June 16-27, 2001, *Review of the Implementation of Commitments and of Other Provisions of the Convention*, Annex VII, U.N. Doc FCCC/CP/2001/L.7 (July 24, 2001).

44. Int'l Law Comm'n [ILC], *Draft Articles on the Law of Transboundary Aquifers*, art. 9, U.N. Doc. A/CN.4/L.724 (May 29, 2008) ("For the purpose of managing a particular transboundary aquifer or aquifer system, aquifer States are encouraged to enter into bilateral or regional agreements or arrangements among themselves.").

determinant of regime effectiveness, the misconception must be dispelled.

It is undeniable that international environmental problems pose a challenge to "the traditional notion of national sovereignty that states may do whatever they please within their own territory."[45] This tension between absolute territorial sovereignty and international environmental problems can be restated: notions of absolute territorial sovereignty pose a major obstacle to the solution of some international environmental problems. In fact, this tension has put absolute territorial sovereignty under pressure for more than a century, and has resulted in a widely-recognized rule of customary international law that limits or constrains absolute territorial sovereignty, one of the more recent verbalizations of which is found in Principle 2 of the 1992 Rio Declaration:

> States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental *and* have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.[46]

Principle 2 of the Rio Declaration is little more than a restatement of a long-standing rule of customary international law.[47] Nonetheless, relatively new realizations about the far-reaching affect of human activities on the environment have brought new attention to the transboundary, and in some cases global, scope of activities carried out within the territory of a sovereign state, the broader relevance of the obligations embodied in Principle 2, and the duty owed to a growing number of actors beyond the territory of individual sovereign states.

But the modern international law view of constrained or limited sovereignty does not equate to an absence of sovereignty. Indeed,

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45. David Freestone, , GROUNDWATER: LEGAL AND POLICY PERSPECTIVES, note 12, at 191-92 (citing Gunther Handl, , 1 Y.B. INT'L ENVTL. L. 3, 32 (1990)).

46. U.N. Conference on Env't and Dev., June 3-14, 1992, , Rio de Janeiro, princ. 1, U.N. Doc. A/CONF.151/26/Rev.1/Vol.1 (1992) (emphasis added). This language is identical to Principle 21 of the 1972 Stockholm Declaration except "and developmental" was added to Rio. See ("Stockholm Declaration"), Stockholm, June 5-16, 1972, princ. 21, U.N. Doc. A/CONF.48/14/Rev.1 (1973).

47 ., Trail Smelter Case (U.S. v. Can.), 3 R. Int'l Abr. Awards 1905 (1941).

real obligations to neighboring states with respect to shared resources do not equate to obligations owed *erga omnes* to all states irrespective of their relationship to the resource in question. Nonetheless, well-respected scholars make statements that appear to be based on just these false equations. With respect to groundwater in particular one author writes:

> Exploitation of scarce, transboundary groundwater resources can no longer be seen as an issue exclusively within the jurisdiction of the State under the territory of which these resources extend. For the vast continental groundwater resources . . . there can be argued to be obligations owed *erga omnes* *resources of international concern*

*all states have a legal interest*

tor noted that "[t]hroughout much of the debate leading to the Draft Articles, numerous Members of the [ILC] and of the Sixth Committee opined that permanent sovereignty over natural resources was central to the subject matter and must be recognized in the Draft

48. Freestone, note 45, at 202 (second emphasis added) (footnote omitted). In his *ERGA OMNES*

*erga omnes*

*erga omnes*

*ERGA OMNES*

*supra* *quoting* *International Law and the Protection of the Global Atmosphere: Concepts, Categories and Principles in*

*Second Report on Shared Natural Resources: Transboundary Groundwater* *prepared by*

*Commentary on the U.N. International Law Commission's Draft Articles on the Law of Transboundary Aquifers*

. *Id.*

*See, e.g*

*supra*

. *See*

. *See* *The Problem of Water*

per, http://www.u.artizona.edu/~libecap/downloads/TheProblemOfWater.pdf) (comparing the resource characteristics of land, fresh water and wild-ocean fish stocks, and concluding that the challenges of defining property rights in water is more like the challenges associated with fish than with land.); Stephen Foster, *Essential Concepts for Groundwater Regulators*, *in* GROUNDWATER: LEGAL AND POLICY PERSPECTIVES, *supra* note 12, at 21 ("Groundwaters in the international domain is non-excludable in the local domain. Scaling-up to the international domain, the number of 'owners' is reduced by many orders of magnitude, and the natural boundaries of the resource no longer far outstrip the artificial territorial boundaries of its users.

Second, in the local domain, the problem with water is typically described as one in which private property interests thwart the management of a common pool resource.[56] This relationship is flipped when viewed at the international scale, where the concern is misconceiving groundwater as a commons resource when in fact it is a sovereign resource similar to private property, or at most a shared resource similar to common property jointly owned by a small group.

Third, in some national systems the state owns the groundwater resources of the nation, such that groundwater is in the public domain and not owned privately, appurtenant to land ownership or otherwise.[57] Yet, the international domain does not have an analog to the public domain in areas otherwise subject to the exclusive jurisdiction and control of a sovereign state. The common heritage of humankind concept is the closest equivalent, but has only been applied to resources and areas beyond national jurisdiction.

The first two examples are entirely a function of scale and the changes that occur in the relationship between the spatial extent of the resource and the spatial extent of the actors involved in its use. The third example demonstrates that local institutions do not necessarily have international counterparts. All three examples demonstrate that borrowing across the two domains – applying local property and common pool resource concepts and lessons to similar problems in the international domain – can be useful but should be done cautiously.

## CONCLUSION

A regime intended to manage the use of a particular groundwater resource pool as either a source of water or a sink for

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(like fish) are a resource for which property rights are not obviously defined in the legal sense.").

56. Jacob Burke, Marcus Moench & Claude Sauveplane, *Groundwater and Society: Problems in Variability and Points of Engagement*, *in* GROUNDWATER: LEGAL AND POLICY PERSPECTIVES, *supra* note 12, at 49 ("[C]ontrol over abstraction and protection of the resource base continues to be thwarted by the perception and treatment of groundwater as a private resource – despite the evident common pool properties of groundwater.").

57. Solanes, *supra* note 12, at 70 ("Most systems of water law explicitly include water within the public domain of the state, the people or the nation.").

pollution need not be global in scope; rather, the spatial extent of the regime should match the spatial extent of the externalities associated with the resource. Beyond that scope users can be excluded from the benefits of the resource, are not subject to its negative externalities, and should be excluded from the regime designed to manage the resource. The ILC draft articles on the law of transboundary aquifers and the limited amount of state practice that exists both indicate that the international groundwater resource regime is heading in this direction.

This is the international groundwater resource regime as it is currently developing: the *lex lata*

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