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Water Law in the United States and Brazil--Climate Change & Two Approaches to Emerging Water Poverty

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WATER LAW IN THE UNITED STATES AND BRAZIL—CLIMATE CHANGE & TWO APPROACHES TO EMERGING WATER POVERTY

DAVID N. CASSUTO & RÔMULO S. R. SAMPAIO*

ABSTRACT

This article examines two of the major water legal regimes in the Americas—that of Brazil and the United States. Both countries have extensive wet and dry regions and both hydro-regimes face a significant threat from global warming. Brazil, for instance, is home to between eight and fifteen percent of the world's fresh water, and its fast-growing economy and population present major challenges in management and allocation. The U.S. also faces major water allocation problems resulting from past settlement policies; unsustainable reclamation projects; and also fast-growing domestic, industrial and agricultural demand.

In the United States, water has traditionally been perceived as a renewable and limitless resource, a cultural legacy that has exerted a powerful influence on the nation's common law. Similarly, in Brazil, the notion of water as infinitely abundant drove water policies until the enactment of the Constitution in 1988. In both countries, however, hydrological realities have become impossible to ignore. Their respective laws and jurisprudence have begun shifting toward management and allocation systems that acknowledge the limited nature of the resource.

This article surveys the two countries' water regimes, offering a brief history of their evolution and then focusing on the challenges of the present. It examines how the notion of a strong private property right in water is slowly (in the North-American case) and more abruptly (in

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the Brazilian case) evolving in the face of increased governmental intervention.

The article then turns to the challenges of climate change. In Brazil, policies that fail to take desertification into account may threaten the country's energy supply as well as the availability of potable water. In the United States, ignoring climate change in water management and allocation policies could significantly increase the existing water scarcity in the West and exacerbate the growing and already serious water shortage in the traditionally humid East.

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INTRODUCTION

In an age when man has forgotten his origins and is blind even to his most essential needs for survival, water along with other resources has become the victim of his indifference.

—Rachel Carson¹

Brazil and the United States face similar hydrological challenges. Both countries have abundant water that is unevenly distributed.² Those water reserves—already unequal to demand in some regions—are forecast to diminish considerably in coming years due to climate change.³ The respective water law regimes of the two nations are also in flux. Brazil enacted significant changes to its laws in recent decades, moving from a system that allowed private ownership of water to one that treats water exclusively as a common resource.⁴ The United States' laws have also evolved, from strict riparian and prior appropriation regimes (in the East and West, respectively) to permitting systems that are more cognizant of both shortage and the need for regulatory oversight.⁵

¹ RACHEL CARSON, *SILENT SPRING* 39 (40th Anniversary ed. 2002).

² See Thomas Brown et al., *Spacial Distribution of Water Supply in the Coterminous United States*, 44 J. AM. WATER RES. ASS'N 1474, 1484–85 app. tbl.A.2 (2008), available at http://www.fs.fed.us/rm/value/docs/spatial_distribution_water_supply.pdf; Roberto Luiz do Carmo, *Population and Water Resources in Brazil*, in NÚCLEO DE ESTUDOS DE POPULAÇÃO, *POPULATION AND ENVIRONMENT IN BRAZIL: RIO + 10* 168, 169, 171, tbl.1 (2002), available at <http://www.nepo.unicamp.br/textos/publicacoes/livros/rio+10/rio10p167a182.pdf>; and Food and Agriculture Organization of the United Nations [FAO], *Review of World Water Resources by Country*, WATER REPORT 23, at 22 (2003), available at <http://www.fao.org/DOCREP/005/Y4473E/y4473e00.htm>.

³ See Z.W. Kundzewicz et al., *Freshwater Resources and their Management*, in CLIMATE CHANGE 2007: IMPACTS, ADAPTATION, AND VULNERABILITY—CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 175 (M.L. Parry et al. eds., 2007), available at http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm.

⁴ See Brendan McNallen, *Fixing the Leaks in Brazil's Water Law: Encouraging Sound Private Sector Participation Through Legal and Regulatory Reform*, 9 GONZ. J. INT'L L. 147, 175 (2006).

⁵ See Christine A. Klein et al., *Modernizing Water Law: The Example of Florida*, 61 FLA. L. REV. 403, 405–13 (2009).

Nevertheless, daunting challenges remain. Brazil's regulatory apparatus is ill-equipped to enforce its laws, and the nation's dependence on hydroelectricity makes it difficult to put the underlying principles of precaution, equity, and multiple use into practice. In the United States, despite the increased use of permitting, water rights remain privately held even as the water itself is a public good. This makes for a legal thicket and a rigid system wherein private rights can trump public needs and structural adaptation gets hindered by unsustainable preexisting arrangements.

This article argues that the challenges faced by the two countries, while different, are based on similar geographical realities. Thus, the solutions required must be similar as well. Although the two legal systems differ (Brazil is a civil law country while the United States employs common law), there is much overlap. The United States would do well to study the adaptability and flexibility built into modern Brazilian water law. Brazil could in turn benefit by analyzing how the United States has managed to effectively enforce its laws despite a large land area and varying geography.

Part I of this article surveys the United States' water legal system, reviewing the riparian laws of the eastern U.S. and the prior appropriation scheme of the West. It looks at the way the two systems incorporate the concept of water as a public good while allowing significant property rights in water. It then describes how both the East and West have slowly transitioned toward permitting while still retaining significant vestiges of the prior regimes. This section then looks briefly at the limitations of the two systems and their incompatibility with forecasted climate-related hydrological shifts.

Part II examines the Brazilian water regime. It looks first at the private property era that preceded the 1988 Constitution and then tracks the evolution of the modern Brazilian system that treats water as a resource common to all. It analyzes in some detail the post-1988 permitting system created by the National Water Management Act and discusses the enforcement challenges presented by the new regime.

The final part looks at the looming challenges presented by climate change and the differing but related problems that the two countries face in adapting to a water-scarce reality. There is no panacea for Brazil, the United States, or any other nation. However, even as the world attempts to diminish the severity of anthropogenically-caused climatic shifts, some significant changes are inevitable. Water shortages will occur (indeed, they are already occurring) and will grow more severe over time. Water laws must acknowledge and compensate for these losses

while continuing to equitably divide what remains and enable universal access. These are not small challenges and the regimes of both countries will require significant retrofitting before they can hope to manage the task. It is our hope that this comparative study will help facilitate that process in both countries.

I. THE AMERICAN WATER LEGAL REGIME

Water in the United States is considered a “public good.”⁶ Public goods are indivisible, public and free.⁷ This means that they cannot be divided or sold and that all people have the right of access without cost (excluding those costs associated with “capture, transportation, and delivery”).⁸ There are characteristics of the American water regime that cast doubt on this classification, but, in the main, the term “public good” remains a useful descriptor.⁹ Privately held water rights confer rights of use; they do not convey actual legal title to the water.¹⁰ Furthermore, no one can prevent members of the public from accessing and enjoying water regardless of the seniority of one’s water right.¹¹ The reasons for this are partly biological. Because water is biologically critical, the state has an obligation to provide access for its citizenry.¹²

⁶ Cf. HENRY P. FARNHAM, *THE LAW OF WATERS AND WATER RIGHTS* §§ 9–10, 113, 113b (1904); Bill Staudenmaier, *Water and the Law: A Guide to What Matters*, 15 *BUS. L. TODAY* 13, 16 (2006).

⁷ A public good offers a tangible correlative to the Brazilian concept of a “diffused right” which refers to a right that is common to all people and indivisible. See Joseph W. Dellapenna, *Adapting Riparian Rights to the Twenty-First Century*, 106 *W. VA. L. REV.* 539, 545 (2004); CÓDIGO CIVIL [C.C.] art. 81, I. (Braz.); see also CONSTITUIÇÃO FEDERAL [C.F.][CONSTITUTION] art. 225 (Braz.).

⁸ Dellapenna, *Adapting Riparian Rights*, *supra* note 7, at 545.

⁹ For example, water can be exclusively owned in small amounts (the most common example being bottled water) and water rights provide a means of controlling access. See Dellapenna, *Adapting Riparian Rights*, *supra* note 7, at 549. However, outside of *de minimis* amounts, water rights are usufructuary and that fact alone militates for their classification as a public rather than a private good. See Staudenmaier, *supra* note 6, at 16; see also Gustavo Capdevila, *UN Consecrates Water as Public Good, Human Right*, INTER PRESS SERVICE NEWS AGENCY (Nov. 27, 2002), <http://ipsnews.net/interna.asp?idnews=14204>.

¹⁰ *But see* Fed. Power Comm’n v. Niagara Mohawk Power Corp., 347 U.S. 239, 240–41 (1954); *Casitas Mun. Water Dist. v. United States*, 543 F. 3d 1276 (Fed. Cir. 2008); *Alameda Gateway, Ltd. v. United States*, 45 Fed. Cl. 757 (1999); *Store Safe Redlands Assocs. v. United States*, 35 Fed. Cl. 726 (1996).

¹¹ Cf. FARNHAM, *supra* note 6, at §§ 23, 113b; Staudenmaier, *supra* note 6, at 16.

¹² See Capdevila, *supra* note 9, at 546.

Because all can access public goods without cost, they are not responsive to market pressures. For example, broadcast frequencies are available to anyone with the proper equipment (i.e., a radio, a TV or internet access).¹³ One cannot effectively control or charge for access; there will always be “free riders.”¹⁴ Consequently, there exists no incentive on the part of users to invest in the maintenance or betterment of the resource.¹⁵ As a result, regulation—not the market—provides the most effective means of managing public goods.¹⁶ Water’s unique status creates further regulatory complications as well. For example, the fact that water rights provide for (and the market values) rights of access and control adds complexity to the legal regime governing its allocation and use.

The American water law regime arose from pre-industrial English common law and began with the common law of riparianism. Riparian rights, in their pure form, allowed owners of land adjoining a body of water to make unrestricted use of that water.¹⁷ As the United States expanded to the semi-arid western territories, a different “prior appropriation” water regime evolved.¹⁸ Today, with a few exceptions (states in which both systems co-exist), the country is divided into versions of riparian legal regimes in the East and prior appropriation schemes in the West. The dividing line (more or less) is the 100th meridian, west of which annual rainfall tallies drop precipitously.¹⁹ For the most part, state law governs water management and allocation.²⁰ However, there are

¹³ See 47 U.S.C. §§ 151, 254(c)(1) (2006); see also Frequently Asked Questions, DTV.GOV, <http://www.dtv.gov/consumercorner.html#faq6>. (last visited Jan. 20, 2011).

¹⁴ Other examples of public goods include clean air, lighthouses, public roadways and the like. See Dellapenna, *Adapting Riparian Rights*, *supra* note 7, at 546; John K. Setear, *An Iterative Perspective on Treaties: A Synthesis of International Relations and International Law*, 37 HARV. INT’L L. J. 139, 174–75 (1996); Amnon Lehavi, *Property Rights and Local Public Goods: Toward a Better Future for Urban Communities*, 36 URB. LAW. 1, 13 n.26, 14 n.27 (2004).

¹⁵ See Dellapenna, *Adapting Riparian Rights*, *supra* note 7, at 546.

¹⁶ See *id.* (discussing restrictions on riparian rights); e.g., Ronald Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 9–10 (1960) (illustrating how the private property system can be the most efficient mechanism for allocating resources).

¹⁷ Cf. Dellapenna, *Adapting Riparian Rights*, *supra* note 7, at 555–56 (discussing the few restrictions on riparian rights).

¹⁸ See Staudenmaier, *supra* note 6, at 15.

¹⁹ See Reed D. Benson, *Rivers to Live By: Can Western Water Law Help Communities Embrace Their Streams?*, 27 J. LAND RESOURCES & ENVTL. L. 1, 3 n. 8 (2007); see Klein et al., *supra* note 5, at 406; see also JOHN WESLEY POWELL, REPORT ON THE LANDS OF THE ARID REGION OF THE UNITED STATES, WITH A MORE DETAILED ACCOUNT OF THE LANDS OF UTAH 46-56 (Govt. Printing Office 1879).

²⁰ Cf. Klein et al., *supra* note 5, at 419.

federal water laws (regarding, e.g., endangered species,²¹ interstate rivers,²² navigation,²³ reserved rights for federal land,²⁴ and Native American Reservations²⁵) that interact with and can preempt state laws.²⁶

As already noted, the American regime accommodates both private and public interests in water. The market-based allocation policies guiding the settlement of the West,²⁷ however, increased consumption levels and imposed significant use pressures upon water reserves.²⁸ Growing demand led to more stringent regulation, which led to greater litigation as tensions between market allocation and regulatory schemes became inevitable.²⁹ The resulting systems of law in both

²¹ Endangered Species Act, 16 U.S.C. §§ 1531–1544 (2006); see generally David N. Cassuto & Steven M. Reed, *Water Law and the Endangered Species Act* (July 28, 2010), in WHOSE DROPS IS IT ANYWAY?: EFFECTIVE MANAGEMENT OF OUR NATION'S WATER RESOURCES (Megan Baroni ed., 2010), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1650241.

²² *Colorado v. New Mexico*, 459 U.S. 176, 183–85 (1982) (discussing the federal common law doctrine of equitable apportionment); *Nebraska v. Wyoming*, 325 U.S. 589, 627–30 (1945); *Hood ex rel. Mississippi v. City of Memphis*, 570 F.3d 625, 629–631 (5th Cir. 2009).

²³ See *Boone v. United States*, 944 F.2d 1489 (9th Cir. 1991); *Alameda Gateway, Ltd. v. United States*, 45 Fed. Cl. 757 (1999); see also Jennifer L. Chapman, Note, *Navigable Purpose? Prove It. Rethinking the Role of the Navigational Servitude in Regulatory Takings Claims After Lucas v. South Carolina Coastal Council*, 35 GA. L. REV. 1195, 1195–97 (2001); Benjamin Longstreth, Note, *Protecting “The Wastes of the Foreshore”: The Federal Navigational Servitude and its Origins in State Public Trust Doctrine*, 102 COLUM. L. REV. 471, 471 (2002).

²⁴ See Heather Blomfield Lee, Note, *Forcing the Federal Hand: Reserved Water Rights v. States’ Rights for Instream Protection*, 41 HASTINGS L.J. 1271, 1271–72 (1990).

²⁵ See Liana Gregory, Note, *“Technically Open”: The Debate Over Native American Reserved Groundwater Rights*, 28 J. LAND RESOURCES & ENVTL. L. 361, 361–62 (2008); see also Nicole C. Salamander, *A Half Full Circle: The Reserved Rights Doctrine and Tribal Reacquired Lands*, 12 U. DENV. WATER L. REV. 333, 334, 342 (2009).

²⁶ U.S. CONST. art. VI, cl. 2. See generally *Hawaiian Navigable Waters Pres. Soc’y v. Hawaii*, 823 F.Supp. 766 (D. Haw. 1993) (discussing preemption of federal laws regarding navigation of ocean water surrounding Hawaii).

²⁷ See John E. Thorson et al., *Dividing Western Waters: A Century of Adjudicating Rivers and Streams*, 8 U. DENV. WATER L. REV. 355, 362 (2005) (discussing the homestead movement: “Congress enacted a series of measures to ‘privatize’ or otherwise dispose of much of the public domain east of the Mississippi River.”).

²⁸ See Staudenmaier, *supra* note 6, at 15 (“[T]he population of most western states has grown steadily for more than a century as limited water supplies have been harnessed and made available for agriculture, municipal and industrial uses.”); see also Stephen N. Bretsen & Peter J. Hill, *Water Markets as a Tragedy of the Anticommons*, 33 WM. & MARY ENVTL. L. & POL’Y REV. 723, 724 (2009). See generally LAWRENCE J. MACDONNELL, *FROM RECLAMATION TO SUSTAINABILITY: WATER, AGRICULTURE, AND THE ENVIRONMENT IN THE AMERICAN WEST* (2000).

²⁹ See Ginette Chapman, Note, *From Toilet to Tap: The Growing Use of Reclaimed Water*

riparian and prior appropriation states evolved over time to address population pressures and ongoing issues of scarcity. However, it remains inflexible and ill-equipped to deal with the hydrological realities forecasted for the coming decades as climate change alters patterns of rainfall and ambient temperatures. What follows is a brief description of the water law regimes in the eastern and western United States.

A. *Riparian Rights*

Riparianism is based on the English common law and, over time, became the governing law of the eastern United States.³⁰ Only landowners whose property borders a river, stream or lake are permitted to make use of the water.³¹ Under the traditional "natural flow" doctrine,³² each riparian is entitled to receive water of undiminished quality and quantity.³³ Furthermore, since water rights inhere in riparian property rights, they are not dependent on use.³⁴ A riparian landowner could elect to not exercise her water right for years without any penalty.³⁵

and the Legal System's Response, 47 ARIZ. L. REV. 773, 773–76 (2005) (stating that "[s]tricter water quality standards, improved treatment technology, and growing demand for water have led to an upsurge in the reuse of wastewater to meet a variety of municipal, residential, agricultural, commercial, and environmental needs."); David S. Baron, *Water Quality Standards for Rivers and Lakes: Emerging Issues*, 27 ARIZ. ST. L.J. 559, 559 (1995); Robert Vitale, *Privatizing Water Systems: A Primer*, 24 FORDHAM INT'L L.J. 1382, 1385–86 (2001).

³⁰ Riparian doctrine remains the law in some form in thirty-one states: Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin. Peter N. Davis, *Law and Fact Patterns in Common Law Water Pollution Cases*, 1 MO. ENVTL. L. & POL'Y REV. 3, 4 nn.20–22 (1993).

³¹ Staudenmaier, *supra* note 6, at 15. Indeed, the term riparian derives from the Latin word "ripa," meaning riverbank. Conflicts among water users are as old as language itself, as one can see from the term "rival," derived from the term "rivalis," which refers to one using the same stream as another. DAVID N. CASSUTO, DRIPPING DRY: LITERATURE, POLITICS, AND WATER IN THE DESERT SOUTHWEST 149 n.2 (2004).

³² The "natural flow" doctrine states that "each riparian proprietor on a watercourse is entitled to have the stream flow through the land in its natural condition, without other users perceptibly retarding, diminishing, or polluting the flow." Richard Ausness, *The Distribution of Water Rights: Water Rights, the Public Trust Doctrine, and the Protection of Instream Uses*, 1986 U. ILL. L. REV. 407, 416 (1986).

³³ *Id.*

³⁴ *Id.* at 416–17.

³⁵ See generally Lynn B. Squires, *Unused Riparian Water Rights in Washington*—Department

1. Natural Flow vs. Reasonable Use

Over time, as the American population grew and industrial uses of water became prevalent, the natural flow doctrine became increasingly unworkable.³⁶ Off-stream uses, necessary to sustain America's growing agricultural and industrial demands, proliferated.³⁷ In addition, differences in natural landscape, geographical context, and population density between the United States and the United Kingdom, meant that riparian doctrine had to evolve to meet the needs of the American landscape. The milestone case reflecting that evolution, *Tyler v. Wilkinson*,³⁸ introduced the notion of "reasonable use." *Wilkinson* held that riparians could use water in ways that diminished quantity and quality, so long as that use was "reasonable."³⁹

Under the reasonable use rule, riparian landowners apply their collective and individual judgments to determine what uses are and are not reasonable. Courts intervene only when conflicts become irreconcilable.⁴⁰ At such times, courts must decide which among the competing uses is the more reasonable. While criteria for reasonableness vary from state to state, all agree that domestic uses take precedence.⁴¹ Amongst non-domestic uses, however, it is less easy to predict how a court will determine which uses are the most reasonable.⁴² Furthermore, riparian

of *Ecology v. Abbott*, 103 WN.2D 686, 694 P.2D 1071 (1985), 60 WASH L. REV. 787, 801-03 (1985). Note that abandonment and forfeiture are not easily established under governing legal standards.

³⁶ See Ausness, *supra* note 32, at 417-18.

³⁷ Staudenmaier, *supra* note 6, at 13 ("Approximately 48 percent of all water used in the United States in 2000, more than 195 billion gallons per day, was used to generate electricity. Agriculture is the second largest water user in the United States, consuming approximately 34 percent of all water used in 2000, followed by municipal and industrial uses, which totaled approximately 16 percent of water consumption.")

³⁸ *Tyler v. Wilkinson*, 24 F.Cas. 472 (C.C.R.I. 1827) (No. 14,312).

³⁹ *Id.*

⁴⁰ Ausness, *supra* note 32, at 417-18.

⁴¹ See *Harris v. Brooks*, 283 S.W.2d 129, 134 (Ark. 1955); see also, Joseph W. Dellapenna, *The Right to Consume Water under "Pure" Riparian Rights*, in 1 WATERS AND WATER RIGHTS §§ 7.03-7.03(e) (Robert E. Beck ed., 2009).

⁴² See Dellapenna, *Adapting Riparian Rights*, *supra* note 7, at 559. Factors for determining use priority include:

- a) Purpose of use,
- b) Suitability of the use to the water source,
- c) Economic value of the use,
- d) Social value of the use,
- e) Extent and amount of the harm it causes,
- f) Practicality of avoiding the harm by adjusting the use or method

doctrine in its pure form does not adequately account for the needs of municipalities⁴³ and has a built in bias against smaller users who are less able to litigate or organize against larger users' unreasonable usage of the available water.⁴⁴ As a result of all these factors, riparian doctrine has evolved to become more statutory and regulated (discussed below).⁴⁵ In addition, many states have enacted statutes giving priority to uses including municipal needs, irrigation, and hydropower.⁴⁶

2. Shifting from Riparianism to an Administrative Permit System

Increasing demand for water and the intensification of droughts, along with skepticism regarding the efficiency of the common law in addressing water allocations have challenged the responsiveness of riparian doctrine.⁴⁷ As a result, a more proactive managerial system emerged, commonly known as "regulated riparianism."⁴⁸ Regulated riparianism is based on a comprehensive administrative permit system and has been adopted by eighteen states.⁴⁹

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- of use of one or the other of the disputants,
 - g) Practicality of adjusting the quantity of water used by the respective disputants,
 - h) Protection of existing value of water, land, investments and enterprises,
 - i) Justice of requiring the user ostensibly causing the harm to bear the loss.

RESTATEMENT (SECOND) OF TORTS § 850A (1982); see Rebecca Sugerman, *The Mojave Basin Physical Solution: It's a Good Idea, but is it Good Law?*, 6 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 307, 320 (2000); see also RESTATEMENT (SECOND) OF TORTS § 855 cmt. b (1979) (rejecting the concept of absolute prohibition of non-riparian uses and acknowledging that the most economic use of the water be off-tract for mining, agriculture, manufacturing, etc.); Gregory J. Hobbs, *Priority: The Most Misunderstood Stick in the Bundle*, 32 ENVTL. L. 37, 43–44 (2002). However, the Restatement rule retains the requirement that users own some riparian land (albeit even a square foot) to use the water. This approach has been adopted in a number of states, including Georgia, Kansas, Massachusetts, New Hampshire, New York, North Carolina, Oklahoma, Texas, and Vermont. See *Pyle v. Gilbert*, 265 S.E.2d 584, 589 (Ga. 1980), *overruled by Tunison v. Harper*, 690 S.E.2d 819 (2010); see generally Christopher L. Len, *Synthesis—A Brand New Water Law*, 8 U. DENV. WATER. L. REV. 55, 90–92 (2004).

⁴³ See generally Lynda L. Butler, *Allocating Consumptive Water Rights in a Riparian Jurisdiction: Defining the Relationship Between Public and Private Interests*, 47 U. PITT. L. REV. 95, 102–03 (1985).

⁴⁴ Dellapenna, *Adapting Riparian Rights*, *supra* note 7, at 560.

⁴⁵ See Len, *supra* note 42, at 66–70.

⁴⁶ Hobbs, *supra* note 42, at 46.

⁴⁷ See Len, *supra* note 42, at 69.

⁴⁸ *Id.*

⁴⁹ Those states are (in ascending chronological order): Maryland, Arkansas, Iowa,

Benefits of regulated riparianism include: efficiency in resource allocation and conservation incentives (resulting from public management), stability in designating water rights, and the ability to take proactive steps prior to any anticipated shortage.⁵⁰ By contrast, common law riparianism creates incentives for owners to take as much water as they possibly can in order to obtain larger portions of the resource. This can lead to the “tragedy of the commons.”⁵¹ Public permit systems work more equitably in accommodating the interests of competing users and uses.⁵²

By charging for water, administrative permit systems also instill a conservation ethic (of sorts) among licensees.⁵³ Moreover, while common law riparianism does not quantify the amount of water to which one is “reasonably” entitled, a managerial regime clearly sets the amount of water available to permittees.⁵⁴ It thereby creates a much more stable environment amongst competing users, beneficially affecting land values as well as facilitating commerce.⁵⁵

The downside of this system is that it can be very costly. It requires a bureaucratic apparatus that can be both cumbersome and resource-intensive.⁵⁶ Nor does it guarantee fairness in implementation, as administrative judgments can be both arbitrary and biased.⁵⁷ Further-

Wisconsin, Delaware, New Jersey, Kentucky, North Carolina, Florida, Minnesota, Georgia, New York, Connecticut, Massachusetts, Mississippi, Hawaii, Virginia, and Alabama. See Dellapenna, *Adapting Riparian Rights*, *supra* note 7, at 584–85.

⁵⁰ See Ling-Yee Huang, *Fifth Amendment Takings & Transitions in Water Law: Compensation (Just) for the Environment*, 11 U. DENV. WATER L. REV. 49, 65 (2007). See also Len, *supra* note 42, at 69–70; Jeremy Nathan Jungreis, “Permit” Me Another Drink: A Proposal for Safeguarding Water Rights of Federal Lands in the Regulated Riparian East, 29 HARV. ENVTL. L. REV. 369, 414–16 (2005).

⁵¹ See JOHN VOGLER, *THE GLOBAL COMMONS ENVIRONMENTAL AND TECHNOLOGICAL GOVERNANCE* 10 (2d. ed. 2000).

⁵² See Butler, *supra* note 43, at 156–58; Joseph. W. Dellapenna, *The Law of Water Allocation in the Southeastern States at the Opening of the Twenty-First Century*, 25 U. ARK. LITTLE ROCK L. REV. 9, 34–35 (2002).

⁵³ See Barton H. Thompson, *Institutional Perspectives on Water Policy and Markets*, 81 CALIF. L. REV. 671, 756–57 (1993).

⁵⁴ *Id.* at 697.

⁵⁵ See *id.* at 717–18.

⁵⁶ See *Funding Topics*, CAL. DEP’T OF WATER RES., <http://www.water.ca.gov/nav/nav.cfm?loc=t&id=103> (last visited Jan. 20, 2011), and *State Water Agencies*, COLO. DEP’T OF PUB. HEALTH & ENV’T, <http://www.cdph.state.co.us/op/wqcc/GeneralInfo/StateWaterAgencies.htm> (last visited Jan. 21, 2011), for a list and description of water resource agencies in each state.

⁵⁷ Robert Abrams, *Water Allocation by Comprehensive Permit Systems in the East: Considering a Move Away From Orthodoxy*, 9 VA. ENVTL. L. J. 255, 264–65 (1990).

more, cultural resistance to regulation,⁵⁸ as well as entrenched suspicion of government interference in water allocation,⁵⁹ helps explain why resistance to regulation continues even in the face of worsening water shortages and heightened conflict. That resistance and continuing struggle to adapt the common law of water to modern society are not limited to the Eastern United States. In the West, the prior appropriation system has also faced adaptive struggles, as the next section makes clear.

B. *The Prior Appropriation Regime*

After the Civil War, American policy turned toward settling the West,⁶⁰ where the climate becomes steadily more arid before reaching a narrow humid zone along the Pacific Coast.⁶¹ Initially, settlers attempted to adapt riparian laws to the western territories.⁶² However, the region's aridity made riparian land comparatively scarce even as mining and agricultural settlements increased the demand for water. Problems of shortage and allocation soon arose.⁶³

It became evident that the common law of riparianism was not practical in an arid region where much of the land was publicly owned⁶⁴ (those occupying federal land did not own their holdings, thus making riparian rights unattainable).⁶⁵ In addition, mining claims had already established a common law of appropriation based on the same principle as those used in staking mining claims: first in time, first in right.⁶⁶ Settlers established local water management and allocation authorities, which were then taken over by the government at the beginning of the twentieth century.⁶⁷ The federal government explicitly recognized prior

⁵⁸ See Thompson, *supra* note 53, at 753.

⁵⁹ See *id.*

⁶⁰ See Thorson et al., *supra* note 27, at 378.

⁶¹ See *The United States: Bioclimatic Regions*, ENCYCLOPAEDIA BRITANNICA, <http://www.britannica.com/EBchecked/topic/616563/United-States/77962/The-bioclimatic-regions> (last visited Feb. 6, 2011)

⁶² See Thorson et al., *supra* note 27, at 378–79.

⁶³ *Id.* at 378.

⁶⁴ The vast amount of public landholdings resulted from the Louisiana Purchase as well as cessions by Mexico. See generally ANDERS STEPHANSON, *MANIFEST DESTINY: AMERICAN EXPANSIONISM AND THE EMPIRE OF RIGHT* (1996).

⁶⁵ See Thorson et al., *supra* note 27, at 379.

⁶⁶ *Id.*; JOHN A. FOLK-WILLIAMS, *WATER IN THE WEST* 18 (W. Network ed. 1983) (the author adds that “development has an important effect on western water resources . . .”).

⁶⁷ Thorson et al., *supra* note 27, at 379.

appropriation in the 1866 Mining Act,⁶⁸ the 1877 Desert Land Sales Act,⁶⁹ and through the judiciary in numerous cases.⁷⁰

Put simply, prior appropriation means that the first person (or entity) to divert water from a water source and put that water to beneficial use has a senior and superior right to all subsequent appropriators. There is no requirement of reasonable use.⁷¹ Junior appropriators whose diversions disappear during times of shortage are simply out of luck.⁷² For purposes of determining seniority, the date on which the appropriator started the diversion project by taking the “first step”⁷³ establishes her place in line. More recently, in most states priority date is established through a permit system and the right is perfected by completion of the permit process.⁷⁴

By requiring that perfected rights make beneficial use of water, prior appropriation doctrine quantifies uses among all appropriators. Furthermore, if an appropriator wishes to increase her diversion, she must go through another appropriation and permit process.⁷⁵ That additional right will be junior to all other appropriations completed prior to the date of the new appropriation.⁷⁶

1. Diversion, Beneficial Use, and Appurtenance

Two important terms in the doctrine of prior appropriation are “diversion” and “beneficial use.”⁷⁷ Until recently, all prior appropriation states required that water be actually diverted from the stream (or other water source) in order for a water right to be perfected.⁷⁸ As streams

⁶⁸ 30 U.S.C. § 28 (2006).

⁶⁹ 43 U.S.C. § 641 (2006).

⁷⁰ See Staudenmaier, *supra* note 6, at 15 (quoting *Yunker v. Nichols*, 1 Colo. 551 (1872)); *Hewitt v. Story*, 64 F. 510, 520 (9th Cir. 1894); see also *Murphy v. Kerr*, 296 F. 536, 540–45 (D. N.M. 1923).

⁷¹ John C. Ruple & Robert B. Keiter, *Water for Commercial Oil Shale Development in Utah: Allocating Scarce Resources and the Search for New Sources of Supply*, 30 J. LAND RESOURCES & ENVTL. L. 95, 116 (2010).

⁷² *Id.* at 97.

⁷³ See 2 WATERS AND WATER RIGHTS § 12.02(b) (Robert E. Beck et al., eds., 1991).

⁷⁴ *Id.* Colorado, however, remains a pure prior appropriation state. It does not have a permit system. See *Coffin v. Left Hand Ditch Co.*, 6 Colo. 443 (1882) (eliminating common law reliance on traditional riparian water rights as a result of Colorado’s lack of water resources).

⁷⁵ See 2 WATERS AND WATER RIGHTS, *supra* note 73, at § 12.02(b).

⁷⁶ *Id.* at § 12.02(c).

⁷⁷ *Id.*

⁷⁸ *Id.* at § 12.02(c)(1).

became fully appropriated, problems relating to lack of instream flow came increasingly to the fore.⁷⁹ As environmental sensitivity has grown, claims to instream flow have enjoyed growing judicial and statutory recognition.⁸⁰ There remain, however, a number of states where the concept still has little or no legal purchase.⁸¹

Even assuming a water right meets all other criteria for legal recognition, the claimed water must still be put to beneficial use.⁸² Beneficial uses can comprise practically any productive use, including domestic, municipal, agricultural, and industrial functions. The only caveat is that the uses must not be "wasteful."⁸³ Standards for what constitute waste vary by region, but in general, the law assumes that appropriators will not use water in ways that cause more loss than is typical.⁸⁴ This leaves room for considerable variability in efficiency depending on the region's wealth and geography.⁸⁵

⁷⁹ See Cassuto & Reed, *supra* note 21, at 16.

⁸⁰ See ALASKA STAT. ANN. § 46.15.030 (West 1982) (claims "reserved to the people" of Alaska so long as beneficial uses are sought); COLO. REV. STAT. § 37-92-102(3) (West 2008) (claims can be based on municipal purposes, including recreational, piscatorial, fishery, wildlife, and other beneficial uses); see also Board of County Comm'rs v. Collard, 827 P.2d 546 (Colo. 1992); Matter of Applications for Water Rights, 838 P.2d 840, 853-54 (Colo. 1992) (discussing what constitutes minimum instream flow); Central Platte Nat'l Res. Dist. v. State of Wyoming, 513 N.W.2d 847, 855 (Neb. 1994) (historical flow rates used to determine ecological effects of instream flows).

⁸¹ See, e.g., MONT. CODE ANN. § 85-2-102(1)(a)-(b) (2009) (private appropriator must "divert, impound or withdraw"). Some states, including California continue to require diversion. See California Trout, Inc. v. State Water Res. Control Bd., 90 Cal. App. 3d 816, 819-20 (1979).

⁸² See Thorson et al., *supra* note 27, at 414.

⁸³ See UTAH CODE ANN. § 73-1-3 (West 2010); ARIZ. REV. STAT. ANN. § 45-141(B) (1995); NEV. REV. STAT. ANN. § 533.035 (West 2009); N.M. STAT. ANN. § 72-1-2 (West 2010); S.D. CODIFIED LAWS § 46-1-8 (2010); see also Butler, Crockett and Walsh Dev. Corp. v. Pinecrest Pipeline Operating Co., 98 P.3d 1 (Utah 2004) (holding that irrigation of natural trees and vegetation may be a beneficial use but cautioning that this holding should not be interpreted as implying that the irrigation of natural vegetation is a beneficial use in general and may in fact be nonbeneficial and wasteful depending upon the particular facts and circumstances); Neubert v. Yakima-Tieton Irrigation Dist., 814 P.2d 199, 2003 (Wash. 1991) (frost prevention to crops is beneficial use); A. Dan Tarlock, *The Changing Meaning of Water Conservation in the West*, 66 NEB. L. REV. 145, 156 (1987).

⁸⁴ See 2 WATERS AND WATER RIGHTS, *supra* note 73, § 12.02(c)(2).

⁸⁵ See N.D. CENT. CODE § 61-04-01(1) (West 2009) ("Beneficial use" means a use of water for a purpose consistent with the best interests of the people of the state."); NEV. REV. STAT. ANN. § 533.030(2) (West 2009) ("The use of water, from any stream system as provided in this chapter and from underground water as provided in NRS 534.080, for any recreational purpose, . . . is hereby declared to be a beneficial use."); MONT. CODE ANN. § 85-2-102(4) (2009).

Another basic concept of the prior appropriation regime is that the right to appropriate water designates its use and therefore is constrained to a specific location where the water will be beneficially used.⁸⁶ This appurtenance limitation is not absolute. Certain jurisdictions allow for the “severance and transfer” so long as it does not interfere with other water users.⁸⁷

2. Limitations

As in riparian jurisdictions, water rights under prior appropriation are solely usufructuary.⁸⁸ Users do not own the water and uses are subject to limitations arising from conflicting governmental uses (municipal, state and federal, including interstate compacts).⁸⁹ As with riparian rights, post-hoc limitations on water rights may be subject to compensation under the Takings Clause of the Constitution.⁹⁰ Many prior appropriation states have enacted statutes that base permitting decisions on criteria that include the public interest, but such statutes do not apply to already existing appropriative rights.⁹¹ The simple hydrological truth of the matter is that most water in the western United States was appropriated long

‘Beneficial use,’ unless otherwise provided, means (a) a use of water for the benefit of the appropriator, other persons, or the public, including but not limited to agricultural, stock water, domestic, fish and wildlife, industrial, irrigation, mining, municipal, power, and recreational uses; (b) a use of water appropriated by the department for the state water leasing program under 85-2-141; (c) a use of water by the department of fish, wildlife, and parks through a change in an appropriation right for instream flow to protect, maintain, or enhance streamflows to benefit the fishery resource authorized under 85-2-436; (d) a use of water through a temporary change in appropriation right or lease to enhance instream flow to benefit the fishery resource in accordance with 85-2-408; (e) a use of water for aquifer storage and recovery project as provided in 85-2-368. *Id.*

⁸⁶ Staudenmaier, *supra* note 6, at 16.

⁸⁷ *Id.*

⁸⁸ Cassuto & Reed, *supra* note 21, at 26–27.

⁸⁹ *Id.* at 14–15.

⁹⁰ See U.S. CONST. amend. V; see also, e.g., Tulare Lake Basin Water Storage Dist. v. United States, 49 Fed. Cl. 313, 319 (2001) (holding that “the extent . . . that the federal government, by preventing plaintiffs from using the water to which they would otherwise have been entitled, have rendered the usufructuary right to that water valueless, they have thus effected a physical taking.”); Casitas Mun. Water Dist. v. United States, 543 F.3d 1276, 1296 (Fed. Cir. 2008) (Bureau of Reclamation’s diversion of water for fish ladder amounted to a taking); Cassuto & Reed, *supra* note 21.

⁹¹ See, e.g., Spear T Ranch, Inc. v. Knaub, 691 N.W.2d 116 (Neb. 2005).

ago.⁹² Moreover, a unique limitation on the prior appropriation regime is that, unlike in traditional riparian jurisdictions, water rights are subject to forfeiture,⁹³ though successfully making such cases remains very difficult.⁹⁴

Over time, the complexity of the prior appropriation regime has caused—in all states save Colorado, which remains a “pure” prior appropriation state—an evolution to a state-administered system based on water codes (laws and regulations) and permitting.⁹⁵ Though permitting reduces the threat of caprice and hegemony over access to water by delegating to government officials the responsibility for determining whether unappropriated water exists and whether a proposed use is beneficial, the system’s byzantine complexity still remains.⁹⁶ More problematic still is the fact that the basis of the doctrine—first in time, first in right—allows little flexibility in the face of changing hydrological realities. It also aggregates control over the resource to comparatively few people. This rigidity does not bode well as the geographical shifts accompanying climate change begin taking hold in earnest.

C. *Groundwater Is Legally Separate*

For reasons having little to do with hydrology and much to do with entrenched common-law assumptions, American law treats groundwater as separate from surface water,⁹⁷ and the various states have developed several different legal regimes for the management of groundwater.⁹⁸ In addition, the law distinguishes between groundwater flowing in a defined underground stream and groundwater percolating without

⁹² See Janet C. Neuman, *Beneficial Use, Waste, and Forfeiture: The Inefficient Search for Efficiency in Western Water Use*, 28 ENVTL. L. 919, 920-22 (1998).

⁹³ Under contemporary riparian law, it is possible for riparian right-holders to forfeit their rights through non-use. See 2 WATERS AND WATER RIGHTS, *supra* note 73, §§ 17.03(a) & (b).

⁹⁴ See *City of Union Gap v. Wash. State Dep't of Ecology*, 195 P.3d 580, 584 (Wash. Ct. App. 2008) (narrowly construing forfeiture actions under Washington State statute in favor of uses beneficial to the owner of a water right).

⁹⁵ WILLIAM GOLDFARB, *WATER LAW* 37 (2d ed. 1989).

⁹⁶ See *id.* at 37–39, for a discussion of the permitting and challenge process; see also Scott S. Slater, *State Water Resource Administration in the Free Trade Era: As Strong as Ever*, 53 WAYNE L. REV. 649, 668–75 (2007).

⁹⁷ RESTATEMENT (SECOND) TORTS § 858 cmt. c (1979).

⁹⁸ Stephen P. Mumme, *Minute 242 and Beyond: Challenges and Opportunities for Managing Transboundary Groundwater on the Mexico-U.S. Border*, 40 NAT. RESOURCES J. 341, 354 (2000).

a defined path.⁹⁹ Groundwater in a defined stream gets treated much the same as surface water.¹⁰⁰ For the latter, however, one of five possible analytical frameworks apply: absolute ownership, American reasonable use, correlative rights, Restatement (Second) of Torts reasonable use, and prior appropriation.¹⁰¹ These doctrines resemble surface water doctrines in some respects, but with important differences.

The doctrine of absolute ownership applies the law of capture to the groundwater—whoever captures the water has the rights over it.¹⁰² The American reasonable use approach modifies absolute ownership by requiring that captured water be put to reasonable use on the overlying tract.¹⁰³ Correlative rights mandate that groundwater be equitably shared among overlying landowners,¹⁰⁴ while the Restatement (Second) of Torts approach imposes liability upon those who unreasonably draw down the aquifer's level.¹⁰⁵ Finally, the prior appropriation doctrine mirrors the surface water doctrine of first in time, first in right.¹⁰⁶

II. THE BRAZILIAN WATER LEGAL REGIME

The Brazilian and United States water law systems resemble each other in many respects. Both are based on the principle that water is a public resource managed by the state and held in trust for the people. This doctrine, derived from Roman law,¹⁰⁷ and known in the United States as the Public Trust Doctrine,¹⁰⁸ is found in Article 225 of the 1988

⁹⁹ See RESTATEMENT (SECOND) TORTS, *supra* note 97, at cmt. c.

¹⁰⁰ *Id.*

¹⁰¹ 3 WATERS AND WATER RIGHTS § 23 (Robert E. Beck ed. 1991).

¹⁰² RESTATEMENT (SECOND) TORTS, *supra* note 97, at cmt. b.

¹⁰³ 3 WATERS AND WATER RIGHTS, *supra* note 101.

¹⁰⁴ RESTATEMENT (SECOND) TORTS, *supra* note 97, at cmt. c.

¹⁰⁵ *Id.* at cmt. e.

¹⁰⁶ Anne J. Castle, *Water Rights Law-Prior Appropriation*, FINDLAW, (Jan. 1, 1999), <http://library.findlaw.com/1999/Jan/1/241492.html>; 2 WATERS AND WATER RIGHTS, *supra* note 73, § 12.02(b).

¹⁰⁷ See CID TOMANIK POMPEU, DIREITO DE ÁGUAS NO BRASIL 40 [WATER LAW IN BRAZIL] (Revista dos Tribunais, 2006) (Braz.) (describing the origins of the Brazilian Water Legal framework in light of a historical division of water legal systems into dry and wet regions. The Brazilian Water Legal framework is based on the Roman Law of wet regions).

¹⁰⁸ See Dean Baxtresser, Note, *Antiques Roadshow: The Common Law and the Coming Age of Groundwater Marketing*, 108 MICH. L. REV. 773, 790 (2010) (noting that the public trust doctrine is confusing and describing it as follows: “[w]hen a state holds a resource which is available for the free use of the general public, a court will look with considerable skepticism upon any governmental conduct which is calculated either to reallocate that resource to more restricted uses or to subject public uses to the self-

Brazilian Constitution. Article 225 states that the “environment . . . is an asset of common use.”¹⁰⁹ No one owns it and all people shall have equal and unfettered access to it.¹¹⁰ Water Law n. 9.433 (enacted in 1997) codifies this principle by declaring water to be an asset within the public domain.¹¹¹ Article 98 of the 2002 Brazilian Civil Code provides further clarity, stating that resources within the public domain are public assets.¹¹² This constitutional and statutory combination places water solidly within the legal category of public assets of common use.

A. *Evolution of Brazilian Water Law*

The classification of all waters as a public good is a relatively new phenomenon in Brazil.¹¹³ Portuguese law, whose remnants can still be found in Brazilian law, allowed private ownership of water. Since its discovery in 1500,¹¹⁴ Brazil has had six Constitutions prior to 1988 (1824, 1891, 1934, 1937, 1946, and 1967).¹¹⁵ Prior to the 1988 Constitution, federal and/or

interest of private parties.”).

¹⁰⁹ CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 225 (Braz.). For an unofficial English version of the 1988 Brazilian Constitution, see *Brazil: 1988 Constitution with 1996 Reforms*, GEORGETOWN UNIVERSITY POLITICAL DATABASE OF THE AMERICAS, <http://pdba.georgetown.edu/Constitutions/Brazil/english96.html> (last updated Nov. 2008).

¹¹⁰ Equal access is construed in Brazilian law according to the principle of isonomy, which allows for differing capacities, needs and uses to dictate water management and allocation policies. See Odilon Castello Borges Neto, *Is the State Action Requirement Really Necessary?: A Comparative Study Between the American and the Brazilian System of Fundamental Rights Protection*, 75 REV. JUR. U.P.R. 805, 808, 858–59, & n.169 (2006).

¹¹¹ See Lei No. 9.433, de 8 de Janeiro de 1997, DIÁRIO OFICIAL DE UNIAO [D.O.U.] art. 1, I, de 9.1.1997 (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/L9433.htm.

¹¹² See C.C. art. 98 & 99, I (Braz.), available at http://planalto.gov.br/ccivil_03/Leis/2002/L10406.htm.

¹¹³ See Paulo Jose Leite Farias, *Brazil: The Evolution of the Law and Politics of Water*, in THE EVOLUTION OF THE LAW AND POLITICS OF WATER 69, 73 (Joseph W. Dellapenna & Joyeeta Gupta eds., 2009) (noting that under the 1934 Water Code, water was classified as “public, common and private.”).

¹¹⁴ The Portuguese expedition fleet was led by Pedro Álvares Cabral and first arrived in the Brazilian town of Porto Seguro, Bahia State, on April 21, 1500. See generally JOÃO CAPISTRANO DE ABREU, CAPÍTULOS DE HISTÓRIA COLONIAL [CHAPTERS OF COLONIAL HISTORY] 12–14 (1928) (detailing the history behind the Portuguese expedition led by Pedro Alvares Cabral, the first one arriving in Brazil).

¹¹⁵ The Brazilian Constitutions were enacted in chronological order as follows: March 25, 1824; February 24, 1891; July 16, 1934; November 10, 1937; September 18, 1946; January 1, 1967 and October 5, 1988. See generally JOSE AFONSO DA SILVA, CURSO DE DIREITO CONSTITUCIONAL POSITIVO [POSITIVE CONSTITUTIONAL LAW COURSE] 69–90 (Malheiros Editores 1976) (2008) (Braz.) (detailing the political and constitutional history

state governments were tasked with managing water resources but private ownership was still permissible.¹¹⁶ The 1916 Civil Code¹¹⁷ and 1934 Water Code¹¹⁸ continued this tradition. In 1981, the National Environmental Policy Act inaugurated a more environmentally-oriented water management phase, complemented and enhanced by the 1988 Constitution and Law no. 9.433.¹¹⁹ It was not until 1988, when the enactment of the 1988 Constitution banned all private rights over water

and evolution in Brazil). *See also* Presidencia da Republica, Casa Civil, Subchefia para Assuntos Juridicos, the official Brazilian Executive Power website, which provides a Portuguese version of all Constitutions, http://www.planalto.gov.br/ccivil_03/Constituicao/principal.htm (last visited Jan. 21, 2010).

¹¹⁶ *See* POMPEU, *supra* note 107, at 41–45 (describing the water legal regime in each Brazilian Constitution since 1824).

¹¹⁷ *See* Arlindo Daibert, *Historical Views on Environment and Environmental Law in Brazil*, 40 GEO. WASH. INT'L L. REV. 779, 823 (2009) (noting, in general, that the 1916 Brazilian Civil Code “played a pioneering role in Brazilian environmental law, similar to the role that the case law on torts has played in the evolution of the U.S. environmental legal system”).

¹¹⁸ *Id.* at 825–26.

Decreto Number 24,463 promulgated the Code of Waters (Codigo de Aguas), the stated purpose of which was, among others, to ‘change the state of affairs, endowing the country with an adequate legislation that, in accordance with the contemporary trend, may permit control by the public power and promote the use of industrial waters.’ The code classified waters, according to who ‘owned’ them, as public, common and private. *Id.*

¹¹⁹ *See* Antonio Herman Benjamin et al., *The Water Giant Awakes: An Overview of Water Law in Brazil*, 83 TEX. L. REV. 2185, 2193–94 (2005).

The legal regime for water continued without major changes until 1981, when the National Environmental Policy Act was promulgated. This Act recognized for the first time water’s environmental value. A few years later, the Assembleia Nacional Constituinte (National Constitutional Assembly) elaborated a new constitution that symbolized the end of the military regime installed in 1964. At the end of the 1990’s, a set of new laws was enacted. Among them was the 1997 Lei da Politica Nacional dos Recursos Hidricos (National Water Act), for whose implementation the Agencia Nacional de Aguas (National Water Agency or ANA) was subsequently created. These laws signaled a departure from the 1934 Code’s vision of water as an inexhaustible, power-generating resource. The National Environmental Policy Act defines environmental resources as: the atmosphere; internal waters, both surface and underground; estuaries; the territorial sea; the soil and the subsoil; and fauna and flora. *Id.*

resources,¹²⁰ that the laws of water allocation and ownership took their current form.¹²¹

Because of the importance of the shift from private ownership to an exclusively public regime that recognizes water as an asset of common use indispensable to a healthy life and ecologically balanced environment,¹²² our analysis of Brazilian water law is divided into two main sections: pre and post-1988 Constitution. During the post-1988 regime, Brazilian water law has also had to shift from a time of water abundance (when allocation decisions did not have to account for socioeconomic and demographic pressures) to the current era of periodic shortages, use pressures, and policymakers struggling to implement laws and regulations already in place.¹²³ Growing water scarcity resulting from poor environmental management,¹²⁴ natural catastrophes (including climate change),¹²⁵ and burgeoning population and water treatment issues¹²⁶ has made compliance and enforcement a priority at every governmental level. As with the United States,¹²⁷ the urgency of the problems related to fresh

¹²⁰ *Id.* at 2194 (“The current model of water management laws certainly would be unrecognizable to the crafters of the 1916 Civil Code, not only because of the current model’s rejection of private water ownership, but also and principally because it is based on new concepts like the user-pays principle, water basin committees, participatory management, and ecological concerns.”).

¹²¹ See CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 20, 3, 4, 5, & 6, and art. 26, 1, 2, & 3 (Braz.) (describing waters that are held in trust by the federal and state governments).

¹²² See Benjamin et al., *supra* note 119, at 2195 (“The Federal Constitution of 1988 marks the end of the 1934 Water Code’s private ownership system and (following the example of the Constitution of 1967) the elimination of its provision for municipal river ownership.”).

¹²³ See McNallen, *supra* note 4, at 175–76 (identifying implementation problems associated to the new water legal regime).

¹²⁴ See *id.* at 173–74.

¹²⁵ WORKING GROUPS I, II, AND III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT 49 (R.K. Pachauri & A. Reisinger eds., 2007), available at http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm [hereinafter IPCC FOURTH ASSESSMENT REPORT] (“Climate change is expected to exacerbate current stresses on water resources from population growth and economic and land-use change, including urbanisation.”).

¹²⁶ See McNallen, *supra* note 4, at 177–78.

¹²⁷ See Slater, *supra* note 96, at 668–69.

While state water laws vary and some are far more advanced than others in their comprehensive approaches, each state employs some legal methodology and venue to (a) divide limited water resources between competing water users; (b) provide for consideration of environmental water needs; and (c) ensure generally that the public interest is advanced in relation to the state’s water resources. Virtually

water quantity and quality in Brazil heightens the need for efficient governmental oversight.¹²⁸

B. *Water Law Prior to the 1988 Constitution*

From the discovery of Brazil in 1500 to its independence in 1822, the laws governing Brazil were the Portuguese Ordinances of the Kingdom.¹²⁹ The 1916 Civil Code continued the Portuguese concept of asserting a governmental interest in water only with respect to navigable bodies of water.¹³⁰ Even after Brazilian independence¹³¹ and under the Brazilian Constitutional regime of 1824, water rights were defined by a type of prior appropriation regime that allowed for privately held water

all states prohibit waste and unreasonable use in one form or another. Typically, the right to continued use of water is secured by compliance with state laws, including those conditions imposed upon the issuance of a license or permit, or arising under the common law right, such as the method and timing of withdrawals, storage, distribution, use and discharge. *Id.*

¹²⁸ McNallen, *supra* note 4, at 149–50.

Brazil's National Water Authority (ANA) recently announced that forty million of Brazil's 180 million citizens do not have access to treated drinking water and fifteen million lack drinking water service of any kind. Even more problematic, sanitary sewage systems capture only 48.9 percent of consumer wastewater produced and only 32 percent of captured sewage is treated, accounting for 15.6 percent of the total sewage created by Brazil. The lack of treated water and basic sanitation accounts for 68 percent of all hospitalizations in Brazil, costing Brazil's Ministry of Health over \$80 million annually. *Id.*

¹²⁹ See Daibert, *supra* note 117, at 787–91 (providing an overview of environmental protection under the Portuguese Ordinances of the Kingdom: "The Ordinances were a mixture of codified prior written sources, compilation of two other older preexisting codifications, and aggregated royal resolutions, concordats, and national and local customs previously in force.").

¹³⁰ See C.C. art. 563–568, 1.1.1916 (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/L3071.htm; see also Vladimir Passos de Freitas, *Águas—Considerações Gerais 17, 18 [Water—General Considerations]*, in *ÁGUAS ASPECTOS JURIDICOS E AMBEINTAIS [WATER LEGAL AND ENVIRONMENTAL ASPECTS]* (Vladimir Passos de Freitas, Coord., Juruá, 2002) (Braz.) (describing the water regime under the 1916 Civil Code). The focus on a navigability type of approach toward water policy was characterized as a "navigability phase." Benjamin et al., *supra* note 119, at 2190.

¹³¹ See Marcus Faro de Castro & Maria Izabel Valladao de Carvalho, *Globalization and Recent Political Transitions in Brazil*, 24 INT'L POL. SCI. REV. 465, 467–68 (2003) (detailing the different political cycles in Brazil, during the 1900s, including the 1964–85 military dictatorship government).

rights.¹³² Private ownership was restricted only when it interfered with navigability.¹³³

1. Private Ownership of Water

In a time of few demographic pressures, vast areas of available land, and abundant freshwater, privately held water posed little problem for the country's development.¹³⁴ Only when increasing energy needs began to jeopardize the country's economic development did authorities begin viewing water as a strategic resource. This reevaluation led to the 1934 Water Code.¹³⁵

The 1934 law represented a significant shift toward the public trust approach even while maintaining the right of private ownership.¹³⁶ Private rights were exclusive to springs within private property or to water bodies located entirely within or underneath a property's boundaries.¹³⁷ However, Brazil's size and historical settlement policies that favored awarding vast tracts of land to individuals meant that there were many very large private estates.¹³⁸ It was not uncommon for a water body

¹³² See POMPEU, *supra* note 107, at 149 (describing the Brazilian water legal regime based on prior appropriation before and under the 1824 Brazilian Constitution).

¹³³ See *id.*

¹³⁴ See Carlos Eduardo Frickmann Young, *Socioeconomic Causes of Deforestation in the Atlantic Forest of Brazil*, in *THE ATLANTIC FOREST OF SOUTH AMERICA: BIODIVERSITY STATUS, THREATS, & OUTLOOK* 103, 104 (Carlos Galindo-Leal & Ibsen de Gusmão Câmara eds., 2003) (providing a useful parallel on how cycles of demographic pressure linked to land occupation policies have a negative impact on natural resources exploitation).

¹³⁵ See Benjamin et al., *supra* note 119, at 2191 (drawing the parallel between Brazil's energy needs and the Decree no. 24,643, July 10, 1934 instituting the Water Code).

¹³⁶ See *id.*

The Water Code promulgated in 1934 by Getúlio Vargas gave water its own legal regime and revoked the treatment of water in the Civil Code. In a country that industrialized rapidly and whose cities grew suddenly, it is no surprise that the Code departed from the historical tradition of emphasis on agriculture and navigation by adopting an industrial vision of water. *Id.*

¹³⁷ See Decreto No. 24.643, de 10 Julho de 1934, D.O.U. art. 8, de 10.7.1934 (Braz.), available at http://www.planalto.gov.br/ccivil_03/decreto/D24643.htm [hereinafter 1934 Water Code].

¹³⁸ See LAURA BECK VARELA, *DAS SEMSMARIAS À PROPRIEDADE MODERNA: UM ESTUDO DE HISTÓRIA DO DIREITO BRASILEIRO [FROM SEMSMARIAS TO MODERN PROPERTY: A STUDY OF THE HISTORY OF BRAZILIAN LAW]* 108 (Renovar, 2005) (Braz.) (describing a chaotic land acquisition process impregnated into historical Brazilian settlement policies); see also Daibert, *supra* note 117, 796–97 (2009) for a brief description on how land was claimed

to reside solely within the boundaries of a private holding (indeed, in some regions of the country this remains true). Thus, under the 1934 law, large bodies of water remained in private hands, a status that fully comported with the precepts of the pre-1988 constitutions.¹³⁹

2. The Law's Progression Toward Classifying Water as an Asset of Common Use

Water policies predicated solely on navigability became problematic when Brazil began industrializing in the late nineteenth and early twentieth centuries.¹⁴⁰ The energy needs created by growing industrial demand directed the nation's attention toward the country's enormous hydroelectric potential. This shift in national priorities is reflected in the 1934 Code, which devotes an entire section to the regulation of the hydroelectric industry.¹⁴¹

under most of Portuguese ruling by squatters who

were free people who occupied any unclaimed land. The practice was illegal, though tolerated through the custom of posse (possession). Depending on the way the right of possession was acquired and exercised, a sesmaria could be granted to the squatter. This frequently occurred because of the practical difficulties in following the legal procedures to obtain a regular sesmaria, the granting of which did not depend on merit-based criteria but was rather a privilege of those who had the greatest number of slaves to produce exportable goods. As demand for land increased, property ownership became a matter of who had more power and influence. A sesmeiro thus needed no only to be white and Christian, but powerful.

This settlement policy:

would remain in place for a long time accompanied by its primary distinguishing feature—the gigantic size of tracts of land that were customarily granted to sesmeiros—which resulted in latifúndios (from the Latin, latifundium: *latus* = broad + *fundus* = landed estate). This phenomenon has had far-reaching effects on Brazilian society and the environment. *Id.*

¹³⁹ See Pompeu, *supra* note 107, at 161–211 (providing a thorough assessment of the provisions in the 1934 Water Code that are still valid in light of the 1988 Constitutional regime).

¹⁴⁰ See Filipe Domingos Commetti et al., *O Desenvolvimento do Direito das Águas Como Um Ramo Autônomo da Ciência Jurídica Brasileira*, 51 REVISTA DE DIREITO AMBIENTAL [ENVIRONMENTAL LAW JOURNAL] 45, 80 (2008) (referring to a shift in the economy in the beginning of the twentieth century from an agrarian-based to a more industrialized one, requiring in turn more energy to sustain that switch).

¹⁴¹ See 1934 Water Code, *supra* note 137, art. 139–144. This section was updated in 1941, reflecting the importance of water resources for Brazil to meet its growing energy demands. See Decreto-Lei No. 3.763, de 25 Outubro de 1941, D.O.U. de 25.10.1941 (Braz.),

The focus on growing energy demands obscured growing demographic and socioeconomic pressures.¹⁴² During most of the 1900s, Brazil faced rapid and uncontrolled urban growth.¹⁴³ The increasingly industrialized economy drove people to the cities in search of jobs.¹⁴⁴ This concentration of population and industry created significant water allocation and quality problems which the law was slow to address.¹⁴⁵

The pre-1988 navigability and hydroelectric water regimes started to change with the 1965 Forest Code.¹⁴⁶ This statute, amended and strengthened by Law 7,803 of 1989,¹⁴⁷ protected areas riparian¹⁴⁸ to rivers, lakes and springs throughout Brazil.¹⁴⁹ In succeeding years, growing international and national concern with environmental issues compelled the government to enact sweeping legislation. The 1972

available at http://www.planalto.gov.br/ccivil_03/Decreto-Lei/1937-1946/Del3763.htm#art144c.

¹⁴² See Edésio Fernandes, *Constructing the 'Right to the City' in Brazil*, 16 SOC. AND LEGAL STUDIES 201, 202–03 (2007), available at <http://sls.sagepub.com/cgi/content/abstract/16/2/201>.

As a result of a process of rapid urbanization in the past four decades, Latin America is the most urbanized region of the developing world, with over 75 per cent [sic] of the population living in urban areas; in Brazil, 83 per cent [sic] of the total population lives in cities. The socio-economic development model that has required rapid urbanization in the region has produced cities heavily marked by the presence of precarious peripheral areas. Despite the many existing differences in the processes of urban development verified in the region, generally speaking, urbanization has brought about combined processes of social exclusion, spatial segregation, and environmental degradation. *Id.*

¹⁴³ See Roger W. Findley, *Pollution Control in Brazil*, 15 ECOLOGY L.Q. 1, 1 (1988).

¹⁴⁴ See *id.* at 1, 54.

¹⁴⁵ See *id.* at 1 (noting that uncontrolled urban growth in Brazil resulted in water pollution and, consequently, impairment of public water supplies).

¹⁴⁶ See Commetti et al., *supra* note 140, at 88 (noting that the 1965 Forest Code protects water resources indirectly by providing for permanently protected areas, constituting those riparian to rivers, lakes, and springs).

¹⁴⁷ See Lei No. 7.803, de 18 de Julho de 1989, D.O.U. de 18.7.1989 (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/L7803.htm.

¹⁴⁸ While “riparian” technically refers to land along the banks of rivers (or owners thereof), we use it here to refer to land bordering any freshwater source and to those who own such land.

¹⁴⁹ See Lei No. 4.771, de 15 Setembro de 1965, D.O.U. art. 2, de 16.9.1965 (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/L4771.htm; see also Colin Crawford & Guilherme Pignataro, *The Insistent (And Unrelenting) Challenges of Protecting Biodiversity in Brazil: Finding “The Law That Sticks,”* 39 U. MIAMI INTER-AM L. REV. 1, 23–25 (2007) (describing the permanently preserved forested areas in the 1965 Brazilian Forest Code).

Stockholm Declaration on the Human Environment¹⁵⁰ was particularly influential in Brazil.¹⁵¹

The landmark statute of this environmental phase in Brazil is the 1981 National Environmental Policy Act.¹⁵² With the subsequent enactment of the 1988 Constitution,¹⁵³ followed by the 1997 National Water Management Act and the 1998 Environmental Crimes Law,¹⁵⁴ water management became entirely the province of the federal and state governments.¹⁵⁵

C. *Water Law in the Post-1988 Constitutional Regime*

The legal underpinning for the new water regime lies in the 1988 Constitution's declaration that the environment "is an asset of common use and essential to a healthy quality of life."¹⁵⁶ Water, as part of the

¹⁵⁰ See United Nations Conference on the Human Environment, Stockholm, Swed., June 5–16, 1972, *Declaration of the United Nations Conference on the Human Environment*, Principle 21, U.N. Doc A/Conf.48/14/Rev.1 (June 16, 1972).

¹⁵¹ See Findley, *supra* note 143, at 2. Findley notes that after the 1972 Stockholm Declaration on the Human Environment,

Brazilians have begun to realize that protection of the environment may be in their own interest. Popular environmental movements and organizations have arisen. In addition, a substantial body of regulatory law has been adopted, and public agencies with authority to implement the law have been created at the federal, state, and local levels. *Id.*

¹⁵² See Lei No. 6.938, de 31 de Agosto de 1981, D.O.U. de 2.9.1981 (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/L6938.htm.

¹⁵³ See Vladimir Passos de Freitas, *A Tutela Civil das Águas* 129, 131–33 [The Civil Law of Water], in *ÁGUAS ASPECTOS JURÍDICOS E AMBIENTAIS [WATER LEGAL AND ENVIRONMENTAL ASPECTS]* (Vladimir Passos de Freitas, Coord., Juruá, 2002) (BRAZ.) (examining the relationship between the environmental legal regime and water policies).

¹⁵⁴ See Marcelo Malucelli, *A Tutela Penal das Águas* 147, 152–56 [The Criminal Law of Water], in *ÁGUAS ASPECTOS JURÍDICOS E AMBIENTAIS [WATER LEGAL AND ENVIRONMENTAL ASPECTS]* (Vladimir Passos de Freitas, Coord., Juruá, 2002) (BRAZ.) (analyzing the 1998 Environmental Crimes Law as part of the water legal framework).

¹⁵⁵ José Ribeiro, *Propriedade das Águas e o Registro de Imóveis* 29, 35–42 [Property over Water and Property Registry], in *ÁGUAS ASPECTOS JURÍDICOS E AMBIENTAIS [WATER LEGAL AND ENVIRONMENTAL ASPECTS]* (Vladimir Passos de Freitas, Coord., Juruá, 2002) (BRAZ.) (describing the shift in approach before and after the 1988 Constitution from the notion of water as a renewable and unlimited resource to a renewable and limited resource that shall be managed for the public benefit).

¹⁵⁶ CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 225 (Braz.) ("All have the right to an ecologically balanced environment, which is an asset of common use and essential to a healthy quality of life, and both the Government and the community shall have the duty to defend and preserve it for present and future generations."). For an unofficial English version of the 1988 Brazilian Constitution, see *Brazil: 1988 Constitution with 1996 Reforms*, *supra* note 109.

environment, is covered by this principle as well.¹⁵⁷ Codifying statutes soon followed. For example, Article 99 of the 2002 Brazilian Civil Code specifically states that rivers and oceans are public assets of common use¹⁵⁸ and Article 1 of the National Water Policy Act declares that water lies within the public domain.¹⁵⁹ This powerful statutory combination replaced centuries of governmental indifference and lack of recognition of looming issues of water scarcity.¹⁶⁰

Along with the extension of public domain over water, the post-1988 Constitutional water regime enhanced the 1981 National Environmental Policy Act.¹⁶¹ Among other relevant provisions, it requires the government to “preserve and restore . . . essential ecological processes and ecosystems,” “preserve the diversity and integrity of the genetic patrimony of the country,”¹⁶² oversee “entities engaged in research and manipulation of genetic material,”¹⁶³ identify and protect areas of special environmental significance,¹⁶⁴ and to protect fauna and flora.¹⁶⁵ These principles, all of which are broadly relevant to water policy, were further buttressed by the 1997 National Water Management Act.

The National Water Management Act specifically declares water a limited natural resource endowed with economic value¹⁶⁶ and requires that in shortage situations priority uses be those relating to human consumption and to animals.¹⁶⁷ It further states that water policies should facilitate multiple uses¹⁶⁸ and that local management authority should reside with river basin committees.¹⁶⁹ The language of the statute codified

¹⁵⁷ See Passos de Freitas, *supra* note 153, at 131 (relating water policies to the environmental legal framework).

¹⁵⁸ C.C. art. 99 (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/2002/L10406.htm.

¹⁵⁹ Lei No. 9.433, *supra* note 111, art. 1, I.

¹⁶⁰ See Commetti et al., *supra* note 140, at 85 (noting the shift in paradigms towards water throughout the twentieth century).

¹⁶¹ Lei No. 6.938, de 31 de Agosto de 1981, D.O.U. de 2.9.1981 (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/L6938.htm.

¹⁶² CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 225, para. 1, 1–2 (Braz.).

¹⁶³ *Id.* at art. 225, para. 1, 2.

¹⁶⁴ *Id.* at art. 225, para. 1, 3.

¹⁶⁵ *Id.* at art. 225, para. 1, 7.

¹⁶⁶ Lei No. 9.433, *supra* note 111, art. 1, II.

¹⁶⁷ *Id.* at art. 1, III. This prioritization raises interesting questions of law (i.e., what exactly is a prioritized animal use?) that we will be exploring in a subsequent essay.

¹⁶⁸ *Id.* at art. 1, IV.

¹⁶⁹ *Id.* at art. 1, V. & VI.; see also Benjamin et al., *supra* note 119, at 2201 (“The committees are responsible for decisions about the use of water resources in their designated basins.”). A lengthy discussion of the role of river basin committees is beyond

into law the hortatory principles articulated in the Constitution. Specifically, it is the legislative response to the constitutional provision mandating the creation and management of the national water legal regime.¹⁷⁰

While these new constitutional and regulatory principles represented a dramatic policy shift, they also raised significant challenges of implementation.¹⁷¹ The following sections examine some of those challenges.

1. Public Domain Over Waters (Groundwater and the Issue of Takings)

Article 20, 3 and Article 26, 1 of the 1988 Constitution entrust the federal government with managing lakes, rivers, and watercourses on lands within its domain that wash more than one state, and that serve as boundaries with other countries.¹⁷² It also extends jurisdiction over beaches and the territorial sea.¹⁷³ Article 26, 1 also significantly expands the number of water bodies entrusted to the various states, granting them sovereignty over most surface waters that do not pertain to the federal government.¹⁷⁴ Private water rights were abrogated, including rights over groundwater.¹⁷⁵

While the 1988 Constitution did not specifically address groundwater, the public ownership regime applied to all of Brazil's water, a designation that includes groundwater.¹⁷⁶ Some still-valid 1934 Water

the purview of this study. However, their role in allocation, quality control, and management is significant and growing.

¹⁷⁰ CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 21, 19 (Braz.).

¹⁷¹ See McNallen, *supra* note 4, at 176. McNallen argues that

[t]he transfer of ownership from the private to the public sphere in 1988 had little to no effect. The federal and state governments did not curtail the use of its water at that time. The ramifications of this change will likely be felt in the future, if and when Brazil elects to enforce its rights as owner and deny or restrict use of water resources. *Id.*

See also Benjamin et al., *supra* note 119, at 2201 (referring to implementation struggles regarding water basin committees and that “[t]his delay in establishing water basin committees demonstrates that, despite the legal advances envisioned by the National Water Act, it is at the institutional level that the new system’s effectiveness will be tested.”).

¹⁷² CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 20, 4 & 6 (Braz.).

¹⁷³ *Id.*

¹⁷⁴ CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 26, 1 (Braz.).

¹⁷⁵ See POMPEU, *supra* note 107, at 218

¹⁷⁶ See *id.* (noting that the groundwater provisions in the 1934 Water Code were revoked by mining law, the 1988 Constitution, and the 2002 Civil Code).

Code provisions¹⁷⁷ as well as the 2002 Civil Code section dealing with groundwater¹⁷⁸ must therefore be construed in light of the governing constitutional principles and the National Water Act.¹⁷⁹ This abrupt change in the law meant that much privately held water was expropriated into the public domain, which raised takings issues.

The 1988 Brazilian Constitution contains a takings provision similar in many respects to that of the United States.¹⁸⁰ While some scholars argue that the private water ownership provisions under the 1934 Act were not revoked by the 1988 Constitution,¹⁸¹ most agree that the water rights were in fact expropriated.¹⁸² The issue then becomes whether the owners are entitled to compensation.¹⁸³

Interestingly, there have not been many takings claims brought on this issue. This may be in part due to Brazil's water abundance (which means that the expropriated water held little monetary value) and also a lack of enforcement.¹⁸⁴ Property owners who have springs or wells on their property have not yet felt the impact of the nationalization of their water.¹⁸⁵ However, as water shortages grow and enforcement spreads, litigation will almost certainly follow.

One example of a brewing conflict lies in the state of Mato Grosso do Sul, where the passage of Resolution 8 in July 2009 empowers the state Environmental Authority to require permits for property owners

¹⁷⁷ 1934 Water Code, *supra* note 137, art. 96–101.

¹⁷⁸ C.C. art. 98–103 (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/2002/L10406.htm.

¹⁷⁹ See Benjamin et al., *supra* note 119, at 2207–08 (“Although the 1934 Water Code contains an entire title on groundwater, it should be read in conjunction with the 1988 Federal Constitution and the National Water Act. Likewise, the new Civil Code of 2002, which also addresses groundwater, should be read in conjunction with these two enactments.”).

¹⁸⁰ CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 5, 24 (Braz.).

¹⁸¹ See, e.g., JOSÉ DOS SANTOS CARVALHO FILHO, MANUAL DE DIREITO ADMINISTRATIVO 1024 [ADMINISTRATIVE LAW MANUAL] (Lumen Júris, 17th ed., 2007) (Braz.).

¹⁸² José Ribeiro, *Propriedade das Águas e o Registro de Imóveis* [Property over Water and Property Registry], in ÁGUAS ASPECTOS JURÍDICOS E AMBIENTAIS [WATER LEGAL AND ENVIRONMENTAL ASPECTS] 29, 42 (Vladimir Passos de Freitas, Coord., Juruá, 2002) (Braz.).

¹⁸³ See *id.* at 42–43 (understanding that those private owners are entitled to compensation according to art. 5, 22 of the 1988 Constitution, while also recognizing this is not a settled issue among Brazilian scholars). See PAULO AFFONSO LEMEMACHADO, DIREITO AMBIENTAL BRASILEIRO [BRAZILIAN ENVIRONMENTAL LAW] 446 (Malheiros 16th ed., 2008).

¹⁸⁴ See *infra* parts II.D and III.B.

¹⁸⁵ See Ribeiro, *supra* note 182.

seeking to operate wells on their land.¹⁸⁶ As the agency begins rationing permits to prevent groundwater overdraft, property owners whose titles predate the 1988 Constitution may file takings claims.

The argument against compensating those whose water rights were expropriated lies within Article 8 of the Water Code.¹⁸⁷ Article 8 states that water can be privately held but that ownership is conditional on the waters not being declared assets of common use.¹⁸⁸ As the 1988 Constitution, Article 99 of the 2002 Civil Code¹⁸⁹ and the 1997 Water Policy Act¹⁹⁰ all declared water to fall under the category of common use, claims for compensation become murkier.¹⁹¹ The argument against compensation aligns with what Joseph Sax calls an “economy of nature,”¹⁹²

¹⁸⁶ Resolução Semac No. 08, de 6 de Julho de 2009, arts. 1 & 2, DIÁRIO OFICIAL DO ESTADO DE MATO GROSSO DO SUL de 7.7.2009 (Braz.), available at [http://www.imasul.ms.gov.br/legislacao/Resolucoes/docs/RESOLUÇÃO%20SEMAMAC%20n.%2008-09%20\(POÇO\)%20consolidada.doc](http://www.imasul.ms.gov.br/legislacao/Resolucoes/docs/RESOLUÇÃO%20SEMAMAC%20n.%2008-09%20(POÇO)%20consolidada.doc).

¹⁸⁷ 1934 Water Code, *supra* note 137, art. 8.

¹⁸⁸ *Id.*

¹⁸⁹ C.C. art. 99, I. (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/2002/L10406.htm.

¹⁹⁰ Lei No. 9.433, *supra* note 111, art. 1, I.

¹⁹¹ As in the United States, fact patterns for takings claims can get quite complex. For example, when one landowner sued an oil company over rights to the water found when the oil company drilled a well in search of oil, the court denied his claim. S.T.J.-9, No. 2003/0048439-9, Relator: Exmo. Luiz Fux, D.O.U. de 3.2.2004 (Braz.). The Superior Court of Justice held that the 1988 Constitution and the 1997 Water Act had revoked the 1934 Water Code private water provisions. *Id.* Therefore, the Court denied the plaintiff's claim on the grounds that he would only be entitled to compensation if he had a permit to use the water. *Id.*

¹⁹² See Joseph L. Sax, *Property Rights and the Economy of Nature: Understanding Lucas v. South Carolina Coastal Council*, 45 STAN. L. REV. 1433, 1445 (1993).

Viewing land through the lens of nature's economy reduces the significance of property lines. Thus a wetland would be an adjunct of a river, in service to the river as a natural resource. Beach dune land would be the frontal region of a coastal ecosystem extending far beyond the beach itself. A forest would be a habitat for birds and wildlife, rather than simply a discrete tract of land containing the commodity timber. Under such a view the landowner cannot justify development by simply internalizing the effect of such development on other properties. Rather, the landowner's desire to do anything at all creates a problem, because any development affects the delicate ecosystem which the untouched land supports. In an economy of nature the landowner's role is perforce custodial at the outset, before the owner ever transforms the land. Moreover, the object of the custody generally extends beyond the owner's legally defined dominion. The notion that land is solely the owner's property, to develop as the owner pleases, is unacceptable. *Id.*

wherein the state can and should encourage adaptive behavior. Compensating those who do not conform to ecological realities does not serve the larger purpose of encouraging societal migration toward a sustainable property regime, nor does it offer any benefit to individuals who are more sensitive to changes and able to foresee indispensable regulatory intervention.¹⁹³ Therefore, there is little social utility to a statutory entitlement to compensation under such circumstances. Nevertheless, neither Sax's nor the Brazilian government's approach directly addresses the inequity befalling individuals caught up in the transition to an economy of nature from a private property regime.¹⁹⁴

2. Water as a Limited Natural Resource Endowed With Economic Value

The post-1988 water regime shifts from a policy that paid scant attention to water and viewed it as an unlimited, valueless resource to a management strategy that treats water as precious, vital, and finite. With the enactment of the 1988 Constitution, the user-pays/polluter-pays principles were enshrined as pillars of Brazilian water policy.¹⁹⁵ This shift had tremendous implications for Brazilian water law. However, it has not yet been fully enforced.

Despite an impressive set of laws and policies, the pace of implementing the modern water regime remains a challenge. Under the 1997 Water Policy Act, it is incumbent upon River Basin Committees to determine who will be charged for water use and how much those users will pay.¹⁹⁶ Yet, after twelve years with this policy in place, only 141 State and 8 Interstate River Basin Committees have been formed.¹⁹⁷ Out of those, only twelve State and two Interstate River Basin Committees have effec-

¹⁹³ *See id.* at 1449.

¹⁹⁴ *See id.* Sax does suggest several mitigating measures governments could take, including exempting already developed lands from the new rules, allowing variances for hardships, gradual phase-in of new regulations, and exempting individual homesites from subdivision regulations. *Id.* at 1451.

¹⁹⁵ The charge for water uses is conditional upon the establishment of river basin committees. *See Lei No. 9.433, supra* note 111, art. 38, VI.

¹⁹⁶ *Id.*

¹⁹⁷ *See* AGÊNCIA NACIONAL DE ÁGUAS, A IMPLEMENTAÇÃO DA COBRANÇA PELO USO DE RECURSOS HÍDRICOS E AGÊNCIA DE ÁGUA DAS BACIAS DOS RIOS PIRACICABA, CAPIVARI E JUNDIAÍ [THE IMPLEMENTATION OF WATER USE CHARGES AND WATER AGENCY IN THE PCJ RIVER BASINS]42 (December 2009), available at http://www.ana.gov.br/CobrancaUso/_docs/Implementacao_PCJ_PORTeING.pdf

tively instituted a system for charging for water use.¹⁹⁸ When one considers Brazil's size (nearly that of the continental United States¹⁹⁹), these data clearly demonstrate the gap between policy and implementation that plagues Brazilian water law (and Brazil's environmental law in general).

3. The National Water Management System (Law 9,433/97) and its Fundamental Principles

The chief implementing statute in the Brazilian water regime is Law No. 9.433, known as the National Water Management System.²⁰⁰ It aims to 1) preserve water quality and quantity for, 2) present and future generations, and 3) protect the resource against critical hydrological events.²⁰¹ Lawmakers recognized that sustainable development required a syncretic water policy that allowed for multiple uses including transportation.²⁰² They also knew that sound management dictated precaution and planning for critical hydrological events, whether natural or anthropogenic in origin.²⁰³

The multiuse principle, even when not directly articulated in a given statute, underlies all contemporary Brazilian water law.²⁰⁴ According to this principle, no use shall be prioritized to the detriment or exclusion of another.²⁰⁵ In addition, water bodies are grouped into categories based on prevailing uses determined by the Federal Environmental Deliberative Council ("CONAMA").²⁰⁶ The aim is to ensure water quality is compatible

¹⁹⁸ See National Water Agency—Brazil [hereinafter ANA], *Cobranca Pelo Uso de Recurso Hidricos*, <http://www.ana.gov.br/CobrancaUso/default2.asp> (last visited Feb. 6, 2010).

¹⁹⁹ See Central Intelligence Agency, *Country Comparison: Area*, THE WORLD FACTBOOK, <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2147rank.html?countryName=Brazil&countryCode=br®ionCode=sa&rank=5#br> (last visited Nov. 6, 2010).

²⁰⁰ Lei. No. 9.433, *supra* note 111.

²⁰¹ *Id.*; see also Benjamin et al., *supra* note 119, at 2199 ("The heart of federal legislation applicable to water is the Lei da Política nacional de Recursos Hidricos (National Water Act) of January 8, 1997, the substance of which was strongly influenced by European law.").

²⁰² Lei. No. 9.433, *supra* note 111, art. 2, II.

²⁰³ *Id.* at art. 2, III.

²⁰⁴ The principle of multiuse is reflected in the sole paragraph of article 13 of the Law 9,433/97. See *id.* art. 13.

²⁰⁵ See *id.* at art. 11–18.

²⁰⁶ See *id.* at art. 9–10. See generally Luiz Fernando Henry Sant'Anna, *General Overview of Brazilian Environmental Law*, 15SPG INT'L L. PRACTICUM 22, 22 (2002).

National Environmental Council or 'CONAMA' [Conselho Nacional do Meio Ambiente]—The main objective of CONAMA, which is the

with use patterns, make efficient use of public funds, and to design water pollution strategies that suit prevailing uses.²⁰⁷

4. The Post-1988 Permitting System

One major component of the post-1988 water management regime is the provision governing the awarding of rights to water resources.²⁰⁸ This administrative permit system is broadly comparable to that of the United States. The underlying premise is that water is a vital and limited resource held in trust for the common good.²⁰⁹ Its use shall be subject to governmental award.²¹⁰ However, the government cannot award a possessory right; permits only guarantee the right of use.²¹¹

Brazil requires permits for any action that could significantly affect quantity or quality of water.²¹² The policy justification for the permits is threefold. First, the National Water Management Act classifies water as a limited resource endowed with economic value.²¹³ Second, the Act envisions the creation of conservation incentives that will shape and guide water use.²¹⁴ Finally, revenues generated by the permit system will be used to finance water management projects as well as the administrative costs of the system.²¹⁵ In the interest of equity, the 1997 law specifically exempted water needs of small communities in rural areas, insignificant uptake, siphoning-off and discharges, and insignificant accumulations of water volumes.²¹⁶ Nevertheless, despite these clearly laid out statutory

National Council for the Environment, is to deliberate, within the scope of its competence, about rules and standards that are essential to public health and safety and that are compatible with an ecologically balanced environment, and to support, study, and propose to the Ministry of the Environment . . . governmental policy relating to the environment and natural resources. *Id.*

²⁰⁷ See Lei. No. 9.433, *supra* note 111, art. 9.

²⁰⁸ See *id.* at art. 11–18.

²⁰⁹ See *id.* at art. 11–12.

²¹⁰ See *id.* at art. 12–14.

²¹¹ See generally *id.* at art. 11–18 (describing government award of rights of use). As in the United States, possession of de minimis amounts of water is possible and common (e.g., bottled water).

²¹² See *id.* at art. 11–12.

²¹³ Lei. No. 9.433, *supra* note 111, art. 11–12.

²¹⁴ See *id.* at art. 19.

²¹⁵ See *id.* at art. 22.

²¹⁶ *Id.* at art. 12.

directives as well as substantial penalties for disobeying the law,²¹⁷ the government's ability to protect watersheds and ensure equitable access to water for the Brazilian citizenry remains in question.

D. From Abundance to Emerging Water Poverty in Brazil

Although Brazil is water-rich, the water is not distributed evenly throughout the country.²¹⁸ Seventy-five percent of the country's surface water is concentrated in northern Brazil, home to the Amazon rainforest and the country's least populated region.²¹⁹ By contrast, the Southeast—the most populated and industrialized region—contains only ten percent of the country's water.²²⁰

However, despite the country's biggest cities (São Paulo, Rio de Janeiro, Belo Horizonte, Curitiba, Porto Alegre, etc.), largest population, and highest levels of industrialization residing in the South and Southeast of Brazil, that region's freshwater remains relatively plentiful.²²¹ The problem lies with how water availability is defined. If fresh water availability means sufficient potable water to fulfill human and animal vital needs, then water availability is a challenge for the entire country, including the Southeast.²²² These shortages arise in large part from decades of unplanned industrial development.²²³ In addition, municipal

²¹⁷ Penalties range from warnings to fines and imprisonment. See *id.* at art. 49–50.

²¹⁸ See *infra* notes 219–20. For a map of the urban demographic distribution in Brazil, see THE BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS [IBGE], available at <http://www.ibge.gov.br/home/estatistica/populacao/censo2000/atlas/pag034.pdf>.

²¹⁹ Rosa M. F. Johnsson & Karin E. Kemper, *Institutional And Policy Analysis Of River Basin Management: The Alto-Tiete River Basin, São Paulo, Brazil* 8 (World Bank Policy Research Working Paper 3650, 2005), available at http://www-wds.worldbank.org/external/default/WDSContentServer/TW3P/IB/2005/06/16/000016406_20050616092016/Rendered/PDF/wps3650.pdf.

²²⁰ *Id.*; Água [Water], in ALMANAQUE BRASIL SOCIOAMBIENTAL 291, 292 (Beto Ricardo & Maura Campanili eds., 2008).

²²¹ See Johnsson & Kemper, *supra* note 219, at 8.

²²² For example, almost no one in Brazil drinks tap water because it is widely considered (with good reason) to be unpotable. Bottled water is the norm. *Brazil (Fast Facts)*, FROMMER'S, <http://www.frommers.com/destinations/brazil/0813020157.html> (last visited Jan. 22, 2011) (excerpted from ALEXANDRA DE VRIES & SHAWN BLORE, FROMMER'S BRAZIL (5th ed. 2010)); see also U.S. ENVTL. PROT. AGENCY, GUIDELINES FOR WATER REUSE 258–60 (2004), available at <http://www.epa.gov/ORD/NRMRL/pubs/625r04108/625r04108chap8.pdf>.

²²³ See Roberta M. Delson & John P. Dickenson, *Perspectives on Landscape Change in Brazil*, 16 J. LAT. AM. STUD. 101, 114 (1984), available at <http://www.jstor.org/stable/157289> ("A major feature, therefore, of twentieth-century change has been the

supply chains waste between forty and sixty percent of the water they draw.²²⁴ Inevitably, these factors combine to create scarcity and expensive clean water.

Recurrent water shortages in a country that is home to an estimated ten percent of the world's freshwater is a clear signal that implementing Brazil's environmental laws has proven more of a challenge than enacting its innovative legal framework. Furthermore, population and climate pressures are growing. In 2001, Brazil faced a major drought that jeopardized the country's energy supply and imposed severe caps on industrial and domestic electricity uses.²²⁵ Long periods of drought are becoming more frequent, even in wet states in the South like Paraná and Rio Grande do Sul.²²⁶ A major diversion project aimed at diverting water from the San Francisco River for the arid northeast region of Brazil offers another example of how water management policies, in a country known for its water abundance, must now focus on avoiding water shortages.²²⁷

introduction of factories, chimneys, dirt, pollution and other signs of 'progress' into the Brazilian scene."); Findley, *supra* note 143, at 31–37 (detailing major recent water pollution incidents in southeastern Brazil).

²²⁴ See Aldo da C. Rebouças, *Água no Brasil: Abundância, Desperdício e Escassez* [Water in Brazil: Abundance, Waste and Scarcity], 13 BAHIA ANÁLISE & DADOS 341, 342 (2003), available at http://www.icb.ufmg.br/big/benthos/index_arquivos/pdfs_pagina/Minicurso/pag_341.pdf; see also TERESA WAGNER, U.S. COMMERCIAL SERVICE, BRAZIL: OVERVIEW OF THE ENVIRONMENTAL SECTOR IN BRAZIL (2008), available at <http://www.buyusa.gov/environmental/99.doc>; Francesca McCann, *Government Commitment Around the Globe to Improving Water and Sanitation Infrastructure and Countering Water Loss*, WATER UTIL. INFRASTRUCTURE MGMT. (Jun. 1, 2008), <http://www.uimonline.com/index/webapp-stories-action?id=138&archive=yes&Issue=2008-06-01>.

²²⁵ Venkataraman Krishnaswamy & Gary Stuggins, *Closing the Electricity Supply-Demand Gap* 48–50 (World Bank, Working Paper No. 39741), available at <http://www-wds.worldbank.org/> (enter 39741 in search box).

²²⁶ See, e.g., Carlos Caminada & Carla Simoes, *Brazil Drought Threatens 10 Million Tons of Corn, Soy*, BLOOMBERG, Jan. 7, 2009, <http://www.bloomberg.com/apps/news?pid=21070001&sid=a7Ks4iGegt8o>.

²²⁷ See Julie McCarthy, *Brazil River Dispute Highlights Larger Issue*, NPR (Aug. 29, 2007), <http://www.npr.org/templates/story/story.php?storyId=14004755>. See generally *Transposição do Rio São Francisco* [San Francisco River Diversion Project], FUNDAÇÃO JOAQUIM NABUCO, <http://www.fundaj.gov.br/docs/tropico/desat/fran.html> (last visited Jan. 22, 2011) (containing detailed information regarding the San Francisco River diversion project).

III. CLIMATE CHANGE: IN SEARCH OF A LEGAL MODEL FOR EMERGING WATER POVERTY

According to the International Panel on Climate Change (“IPCC”), there is “high confidence” that the western United States and northeastern Brazil “will suffer a decrease in water resources due to climate change.”²²⁸ It projects significant adverse impacts on agriculture, water supply, energy production and health.²²⁹ While dry regions will become drier, there will also be changes in rainfall patterns and runoff in traditionally humid zones that will increase floods.²³⁰ This will impact water availability and quality and present “challenges to society [and] physical infrastructure.”²³¹ These projections, which apply to both countries, are already visible in southeastern Brazil as well as in many regions of the United States.²³²

The climatic shifts and accompanying infrastructural stresses present significant challenges to the water laws of both Brazil and the United States. Neither system has shown itself sufficiently flexible or adaptive to dramatic environmental changes. Brazil has implemented a national climate change policy at the end of 2009 that highlights the need to manage natural resources in light of the risks posed by climate change.²³³ However, the policy provisions merely offer guidelines rather than any specific plan of action. Specific regulatory measures were left to the executive branch to enact and also delegated to the various states and municipalities.²³⁴

²²⁸ Zbigniew W. Kundzewicz, Luis J. Mata et al., *Freshwater Resources and Their Management*, in INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY 175 (Martin Parry et al., eds., 2007), available at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter3.pdf>.

²²⁹ IPCC FOURTH ASSESSMENT REPORT, *supra* note 125, at 49.

²³⁰ *Id.*

²³¹ *Id.*

²³² See, e.g., Tom Watkins, *Northeast Flooding Sets Record*, CNN.COM (Mar. 30, 2010, 2:47 PM EDT), available at <http://www.cnn.com/2010/US/weather/03/30/northeast.flood.fears/index.html> (detailing recent rain events in northeastern United States that caused extensive property damage); *Brazil Death Toll Rises to 224*, REUTERS, (Apr. 11, 2010), available at <http://www.reuters.com/article/idUSN12106727> (detailing the devastation in Rio de Janeiro resulting from severe rainfall).

²³³ See Lei No. 12.187, de 29 de Dezembro de 2009, D.O.U. de 30.12.2009 (Braz.), available at http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2009/L12187.htm (last visited Feb. 6, 2011). An unofficial English translation of the law is available at <http://preventionweb.net/go/12488> (last visited Jan. 22, 2011).

²³⁴ The Federal Government enjoys concurrent authority with States and Municipal

Brazil is already struggling with the implementation of the post-1988 water regime.²³⁵ Incorporating the guidelines of the new climate change policy act into existing water law will present significant new challenges. For example, the current overdependence on hydroelectricity and the lack of enforcement of water management and allocation provisions cannot be sustained.²³⁶

In the United States, the situation is even more dire. There is, as yet, no consensus at the governmental level regarding the existence of climate change or the need for a comprehensive national response.²³⁷ Some states have taken action either individually or in tandem with other states,²³⁸ but this piecemeal response cannot substitute for broad federal action. While the 2008 Supreme Court decision in *Massachusetts v. EPA* has galvanized the EPA to begin regulating carbon emissions under the Clean Air Act²³⁹ and the agency has taken some tentative steps toward using the Clean Water Act,²⁴⁰ these measures are aimed at reducing carbon emissions rather than adapting to the changing climate. The same could be said for the various bills examined in the 111th Congress.²⁴¹ Consequently, any legal adaptive strategy in the United States

Governments to legislate over environmental matters and common authority to control pollution related problems. See CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 23, 6-7 & 24, 6 (Braz.).

²³⁵ See *supra* Part II.C.

²³⁶ See Krishnaswamy & Stuggins, *supra* note 225, at 43–44; see also *infra* Part III.B.

²³⁷ Compare *Climate Change*, U. S. ENVTL. PROT. AGENCY, <http://www.epa.gov/climatechange/> (last visited Jan. 22, 2011) (explaining the evidence of climate change and the government's proposed solutions) with Jonathan Karl and Z. Byron Wolf, *Amid Heat Wave, Senator Talks 'Global Cooling,'* ABC NEWS (July 23, 2010), <http://abcnews.go.com/Politics/amid-heat-wave-senator-talks-global-cooling/story?id=11237381> (quoting the second-ranking Senator on the Environment and Public Works Committee as stating “[w]e’re in a cycle now that all the scientists agree is going into a cooling period.”).

²³⁸ See generally PACE L. SCH. CENTER FOR ENVTL. LEGAL STUD., THE STATE RESPONSE TO CLIMATE CHANGE: 50 STATE SURVEY POSTED MARCH 2010 REFLECTING DEVELOPMENTS FROM MAY 2009–OCTOBER 2009, available at http://www.abanet.org/abapubs/globalclimate/docs/50States_Survey_ThruNov09final.pdf.

²³⁹ See *Massachusetts v. EPA*, 549 U.S. 497, 533–35 (2007). See generally Clean Air Act, 42 U.S.C. § 7401 *et seq.* (containing statutory provisions designed to address air pollution issues).

²⁴⁰ Les Blumenthal, *EPA May Try to Use Clean Water Act to Regulate Carbon Dioxide*, M C C L A T C H Y N E W S P A P E R S (updated Nov. 24, 2010), <http://www.mcclatchydc.com/2010/04/04/v-print/91486/clean-water-act-might-be-used.html>. See generally Fed. Water Pollution Control Act, 33 U.S.C. § 1251 *et seq.* (describing federal provisions addressing water pollution).

²⁴¹ See *Climate Action in Congress*, PEW CTR. ON GLOBAL CLIMATE CHANGE, <http://www>

will almost certainly be reactive rather than proactive and will face additional challenges as a result.

Given the looming challenges presented by climate change, both the United States and Brazil must determine whether their respective systems of water law are adequate to the task ahead and/or whether they can sufficiently adapt to the changed environment. We believe that the answer in both cases is no. We further believe that this lack of readiness poses a grave threat to each country's national security.

A. *United States Water Law is Unequal to the Task*

One prominent Brazilian scholar has pointed to the water law of the western United States as a model for other nations to follow. According to Édís Milaré, the United States has one of the most advanced water policies in the world due to its promotion of rational use.²⁴² In his view, the abundant harvests of the Midwest are evidence of sound management strategies.²⁴³ We respectfully disagree.

The harvests in the Midwest and the West of the United States result from groundwater overdraft, massive appropriations of water, government subsidies, and a willingness to expend enormous amounts of money and resources to grow water-dependent crops in arid regions.²⁴⁴ The prior appropriation regime privileges users based on priority rather than on reasonableness of use.²⁴⁵ The requirement that water be used "beneficially" creates few meaningful restrictions because the term is defined so broadly as to permit highly consumptive uses regardless of ecosystemic realities.²⁴⁶ In our view, a rational water policy of the type described by Milaré must acknowledge geographical constraints and allow flexibility to adapt to changing ecological realities including those

.pewclimate.org/federal/policy-solutions/climate-policy-memo/major-climate-and-energy-proposals-111th-congress, (last visited Jan. 22, 2011). *But see* PEW CENTER ON GLOBAL CLIMATE CHANGE, CONGRESSIONAL BILLS ADDRESSING CLIMATE CHANGE ADAPTATION: 111TH CONGRESS (July 2009), available at http://www.pewclimate.org/docUploads/Federal_Bills_Addressing_Adaptation_080210.pdf.

²⁴² See Édís MILARÉ, DIREITO DO AMBIENTE [THE LAW OF THE ENVIRONMENT] 227 (Malheiros Editores 2000) [2005] (Braz.).

²⁴³ See *id.*

²⁴⁴ See Noah D. Hall, Bret B. Stuntz & Roberto H. Abrams, *Climate Change and Freshwater Resources*, NAT. RES. & ENV'T, Winter 2008, at 30, 33–35.

²⁴⁵ See *supra* notes 72–74 and accompanying text.

²⁴⁶ See *supra* notes 83–85 and accompanying text.

presented by climate change. Water policy in the western United States falls short in both respects.

Riparian water law in the United States is also problematic. It aggregates water rights in the hands of those few who own land bordering a watercourse.²⁴⁷ However, under the contemporary "regulated riparian" regime wherein permits are apportioned based on reasonableness of use, the potential exists for the legal regime to adapt and respond to emerging geographical realities.²⁴⁸ The question for lawmakers and regulators will be what constitutes a reasonable use.

The United States water regime also faces a regulatory deficit as it struggles to define reasonable use (in the East) and beneficial use (in the West). Though most states now use a permitting system to regulate water use, demand already exceeds supply and that problem will only grow in coming decades.²⁴⁹ Climate models show that temperatures in the Western United States are expected to rise between two and five degrees Celsius.²⁵⁰ This will further dry the air in this already arid region, decreasing humidity and precipitation. This decrease in precipitation will diminish snowpack, lessen surfacewater flow, and decrease aquifer recharge; this combination will mean significantly less water for both human and nonhuman uses.²⁵¹

In the comparatively humid Eastern United States, problems also loom. As sea levels rise (due to melting of polar ice and thermal expansion of the oceans), saltwater will intrude inland into deltas and coastal aquifers.²⁵² Salinity problems will increase during times of highest water demand and, as freshwater levels drop, seawater intrusion will increase still more.²⁵³ Even the Great Lakes and surrounding region are forecast to experience dramatic impacts.²⁵⁴ Levels in Lake Huron and Michigan may drop as much as 1.38 meters and will lose most of their winter ice cover (causing increased evaporation).²⁵⁵ Overall, both stream runoff and

²⁴⁷ Each state's definition of "bordering" may differ, making this standard more or less restrictive in different parts of the country. See Butler, *supra* note 43, at 108–25.

²⁴⁸ See *supra* notes 49–52 and accompanying text.

²⁴⁹ See Hall, Stuntz & Abrams, *supra* note 244, at 32–33.

²⁵⁰ Philip W. Mote et al., *Declining Mountain Snowpack in Western North America*, 86 BULL. AM. METEOR. SOC'Y. 39, 48 (2005), available at <http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-86-1-39>.

²⁵¹ Hall, Stuntz & Abrams, *supra* note 244, at 30–33.

²⁵² *Id.* at 31–32.

²⁵³ *Id.* at 32.

²⁵⁴ *Id.*

²⁵⁵ *Id.* (citing Brent Lofgran, et al., *Evaluation of Potential Impacts on Great Lakes Water Resources Based on Climate Scenarios of Two GCMs*, 28 J. OF GREAT LAKES RES. 537, 546 (2002)).

baseflow (groundwater contributing to streamflow) may drop by as much as twenty percent by 2030.²⁵⁶ The impact of these shifts on both the ecosystem and the economy will be dramatic.

Traditionally, the United States' approach to water shortages has involved creating large scale diversionary projects to bring water wherever it was needed.²⁵⁷ In recent years, the unsustainability of this approach has become evident, but no workable replacement has yet emerged. If effective conservation measures are not built into water policies in both the West and the East, the energy demanded by efforts to sustain the traditional approach will fuel the same vicious cycle of energy expenditure to mitigate problems created by energy expenditure that is faced by Brazil. That cycle will also exacerbate water scarcity.

Breaking the cycle in the United States will require a multifaceted solution. First, it will involve conforming existing regulations to the new methodologies demanded by a nation facing a changed environment. Those methodologies include the precautionary approach, intergenerational equity, valuing ecosystem services, and promoting water conservation policies. As already mentioned, many of those principles and methodologies already exist in Brazilian law. Second, there must be a considered reevaluation at both the statutory and judicial level of the definitions and application of the terms "reasonable" and "beneficial." Neither term yet accounts for the realities of perpetual shortage and ever-increasing demand. Third, the enforcement model must adapt to emergent political and ecological realities in a manner that ensures continuing regulatory oversight while withstanding public pressures similar to those faced by regulators in Brazil.

For many years, the United States has led the world in environmental regulation and enforcement. Today, though its regulatory apparatus has not kept pace with changing realities, the nation's environmental enforcement continues to serve as a model worldwide. We suggest that interweaving some of the principles embedded in the Brazilian legal framework with United States' enforcement methods could fashion a sustainable, post-climate change water regime.

B. Brazil's Enforcement Dilemma

In Brazil, the legal regime has evolved considerably in recent decades. The classification of all waters as a public good, as well as the

²⁵⁶ *Id.*

²⁵⁷ See, e.g., *Water in Colorado—A Brief History*, THE WATER INFORMATION PROGRAM, <http://www.waterinfo.org/indian.html> (last visited Jan. 22, 2011).

principles embedded in the 1997 National Water Policy Act, demonstrate an emerging awareness at the governmental level that water management must adapt to modern environmental realities including climate change.²⁵⁸ Together with the 2009 National Climate Change Policy Act, principles such as the precautionary approach, intergenerational equity, multiple use, and risk assessment now infuse the Brazilian water regime.²⁵⁹

The permitting system created by the National Water Management Policy Act is laudably progressive. It gives the permitting authority significant discretion to incorporate risk assessment methodologies that include all of the principles mentioned above.²⁶⁰ Hence, Brazil's challenges lie less with rhetoric than with infrastructure and enforcement. Brazil derives more than seventy-five percent of its energy from hydroelectricity.²⁶¹ This infrastructure commitment requires enormous amounts of water. In a future of increasing temperatures and growing water scarcity, it is not at all clear from where the water for that energy will come.²⁶² Furthermore, as growing demographic pressures have increased competition for this water, the demand for power must now compete with other vital uses, including domestic consumption, industrial use, and agriculture.²⁶³

The country's dependence on hydroelectricity has created a serious policy dilemma. As Brazil has begun building more coal-fired power plants in order to wean the country from hydropower,²⁶⁴ it now confronts the same problem faced by the United States and many other nations: coal plants emit enormous amounts of carbon.²⁶⁵ Those emissions accelerate

²⁵⁸ See *supra* Part II.C.

²⁵⁹ See Lei No. 9.433, *supra* note 111, art. 1.; see also Lei No. 12.187, *supra* note 233.

²⁶⁰ See *id.* at art. 11–18.

²⁶¹ See Robert P. Walzer, *Brazilian Wind Power Gets a Boost*, NYTIMES.COM GREEN BLOG (Nov. 9, 2009, 8:17 AM), <http://green.blogs.nytimes.com/2009/11/09/brazilian-wind-power-gets-a-boost/>.

²⁶² See Hall, Stuntz & Abrams, *supra* note 244, at 34–35 (“Hydropower is highly sensitive to reductions in flow, and the same climate change impacts that will reduce water supplies will also diminish the output of hydropower plants.”).

²⁶³ Agriculture in both the United States and Brazil consumes large percentages of the respective nations' water resources. Current consumption rates are unsustainable. Any water policy must balance agricultural needs against competing uses. See Benjamin et al., *supra* note 119, at 2191–93. In Brazil, agriculture is responsible for sixty-one percent of the country's water consumption rates. See *Water Profile of Brazil*, THE ENCYCLOPEDIA OF EARTH (April 17, 2008, 2:53 PM), http://www.eoearth.org/article/Water_profile_of_Brazil.

²⁶⁴ Brazil is expected to expand significantly its reliance upon coal power plants in the next decades. See Sonal Patel, *Brazil: Latin America's Beacon*, POWER (Jan. 1, 2010), http://www.powermag.com/distributed_generation/Brazil-Latin-Americas-Beacon_2363_p4.html.

²⁶⁵ See Global Greenhouse Gas Data, U.S. ENVTL. PROT. AGENCY, available at

climate change—the very thing that is driving the looming water shortages. The chief challenge facing policymakers involves figuring out how to avoid this vicious circle. In Brazil, that challenge includes figuring out how to enforce the post-1988 legal paradigm shift.

Brazilian water law—like all of Brazilian environmental law—must address the problem that its statutes are strong, but enforcement is weak.²⁶⁶ This situation is partially due to a lack of resources and an accompanying lack of political will in the face of competing development priorities.²⁶⁷ In addition, although there is no way to measure it precisely, corruption remains a factor undermining the enforcement of environmental laws in Brazil.²⁶⁸

Challenges presented by climate change will further stress an already weakened enforcement regime. The United States enforcement mechanism, which mixes command and control with market-based approaches, may prove a useful model in this regard.²⁶⁹ Although a recent amendment to the 1981 Brazilian National Environmental Policy Act allowed for market-based mechanisms to be used as instruments of environmental policy, those mechanisms remain underutilized.²⁷⁰

In sum, water policies in both Brazil and the United States face a daunting future. The two countries are respectively strong where the other is weak. Brazil's regulatory apparatus has not yet caught up with its system of laws. The laws, including the National Climate Change Policy Act as well as the National Water Management Act, provide a

<http://www.epa.gov/climatechange/emissions/globalghg.html> (last updated Mar. 3, 2010). Determining the percentage of CO₂ emissions attributable to coal burning is extremely difficult due to a lack of hard data available from developing countries; however, at least twenty percent of global CO₂ emissions are likely coal-burning related. See *Coal and Climate Change Facts*, PEW CTR. ON GLOBAL CLIMATE CHANGE, <http://www.pewclimate.org/global-warming-basics/coalfacts.cfm> (last visited Feb. 6, 2011).

²⁶⁶ See LESLEY K. MCALLISTER, *MAKING LAW MATTER—ENVIRONMENTAL PROTECTION & LEGAL INSTITUTIONS IN BRAZIL* 20 (Stanford Univ. Press 2008) (“While Brazilian environmental laws are strong on the books, environmental enforcement has been limited in its effectiveness.”).

²⁶⁷ See generally *id.* (addressing some of the causes of lack of enforcement of Brazilian environmental laws).

²⁶⁸ See *Corruption Perceptions Index 2009*, TRANSPARENCY INTERNATIONAL, http://www.transparency.org/policy_research/surveys_indices/cpi/2009 (last visited Jan. 22, 2011).

²⁶⁹ See generally MCALLISTER, *supra* note 266, at 14 (comparing the regulatory regimes of Brazil and United States).

²⁷⁰ See Fiona Woolf, Vivek Gambhir, Ivan Londres, & Leo Simpson, *Brazil: Brazil's Electricity Market: A Successful Journey And An Interesting Destination*, MONDAQ (Feb. 11, 2010), <http://www.mondaq.com/article.asp?articleid=93780>.

sound framework upon which to build a regulatory state. The task now facing the nation involves fashioning an independent regulatory apparatus that can withstand campaigns to manipulate public opinion and undermine sound policymaking. Sound water policymaking in the post-climate change world requires acknowledging the principles and guidelines already in place in Brazilian laws despite the pressures and allures created by large-scale development projects that fail to account for the new water-scarce reality.²⁷¹

CONCLUSION

Even as the legal regimes of Brazil and the United States differ in many fundamental respects, the challenges they face are the same. These challenges include bringing the regimes of both countries closer together. As shortages loom, the notion of water as public good is coming more clearly into focus for both countries. This means increased regulatory oversight and incorporating progressive management principles into water policies.

In Brazil, the 1988 Constitution has enabled such a legal framework, yet it lacks enforcement capacity. In the United States, water law has progressed toward expanded regulatory oversight but remains constrained by ossified notions of reasonableness and beneficiality. As a result, it is ill-equipped to deal with the projected consequences of climate change.

As Brazil and the United States struggle to adapt their respective legal frameworks, they have much to learn from each other. Above all, both regimes must acknowledge the post-climate change reality and the legal challenges that it presents. For Brazil, this involves putting its ideas into practice. For the United States, it involves prodding its current laws toward a more coherent and sustainable paradigm.

²⁷¹ See Reese Ewing, *Brazil to Flood Amazon Rainforest for Hydroelectric Power*, MONGABAY.COM (Mar. 17, 2006), <http://news.mongabay.com/2006/0317-reuters.html> (regarding large scale hydroelectric power plants in the Amazon Rainforest). See generally NABUCO, *supra* note 227 (describing the San Francisco River diversion project).