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

David N. Cassuto
Rômulo S. R. Sampaio
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 

* David N. Cassuto is Professor of Law at Pace University School of Law and Director of the Brazil-American Institute for Law & Environment (BAILE). He is currently a Fulbright Fellow and Visiting Professor of Law at the Getulio Vargas Foundation School of Law in Rio de Janeiro, Brazil. Rômulo S. R. Sampaio is Professor of Law and Academic Coordinator of the Environmental Law Center at Getulio Vargas Foundation School of Law in Rio de Janeiro, Brazil. He is Director of International Services of BAILE and Adjunct Professor at Pace University School of Law. The authors gratefully acknowledge the invaluable research assistance of Joseph Edgar, Stephen Iannaccone, Mariana Monjardim, and Catarina Freitas.
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.

INTRODUCTION ........................................... 373
I. THE AMERICAN WATER LEGAL REGIME ................... 375
   A. Riparian Rights .................................... 378
      1. Natural Flow vs. Reasonable Use ............ 379
      2. Shifting from Riparianism to an Administrative Permit System .................. 380
   B. The Prior Appropriation Regime .................. 382
      1. Diversion, Beneficial Use, and Appurtenance ........................................... 383
      2. Limitations ...................................... 385
   C. Groundwater Is Legally Separate ............... 386
II. THE BRAZILIAN WATER LEGAL REGIME ................. 387
   A. Evolution of Brazilian Water Law .............. 388
   B. Water Law Prior to the 1988 Constitution ...... 391
      1. Private Ownership of Water ................. 392
      2. The Law’s Progression Toward Classifying Water as an Asset of Common Use .... 393
   C. Water Law in the Post-1988 Constitutional Regime ........ 395
      1. Public Domain Over Waters (Groundwater and the Issue of Takings) ............ 397
      2. Water as a Limited Natural Resource Endowed With Economic Value ............... 400
      3. The National Water Management System (Law 9,433/97) and its Fundamental Principles .... 401
   D. From Abundance to Emerging Water Poverty in Brazil ........................................... 403
III. CLIMATE CHANGE: IN SEARCH OF A LEGAL MODEL FOR Emerging WATER POVERTY .................. 405
    A. United States Water Law is Unequal to the Task ...... 407
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 Carson

B. Brazil’s Enforcement Dilemma

CONCLUSION
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

---

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.
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). One cannot effectively control or charge for access; there will always be “free riders.” Consequently, there exists no incentive on the part of users to invest in the maintenance or betterment of the resource. As a result, regulation—not the market—provides the most effective means of managing public goods. 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. As the United States expanded to the semi-arid western territories, a different “prior appropriation” water regime evolved. 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. For the most part, state law governs water management and allocation. However, there are

---

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 & ENVT'L 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, \textsuperscript{21} interstate rivers, \textsuperscript{22} navigation, \textsuperscript{23} reserved rights for federal land, \textsuperscript{24} and Native American Reservations\textsuperscript{25}) that interact with and can preempt state laws.\textsuperscript{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,\textsuperscript{27} however, increased consumption levels and imposed significant use pressures upon water reserves.\textsuperscript{28} Growing demand led to more stringent regulation, which led to greater litigation as tensions between market allocation and regulatory schemes became inevitable.\textsuperscript{29} The resulting systems of law in both


\textsuperscript{28} See Staudenmaier, \textit{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, \textit{Water Markets as a Tragedy of the Anticommons}, 33 WM. & MARY ENVTL. L. & POL’Y REV. 723, 724 (2009). See generally LAWRENCE J. MACDONNELL, \textit{FROM RECLAMATION TO SUSTAINABILITY: WATER, AGRICULTURE, AND THE ENVIRONMENT IN THE AMERICAN WEST} (2000).

\textsuperscript{29} See Ginette Chapman, Note, \textit{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. Only landowners whose property borders a river, stream or lake are permitted to make use of the water. Under the traditional “natural flow” doctrine, each riparian is entitled to receive water of undiminished quality and quantity. Furthermore, since water rights inhere in riparian property rights, they are not dependent on use. A riparian landowner could elect to not exercise her water right for years without any penalty.


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.\textsuperscript{36} Off-stream uses, necessary to sustain America’s growing agricultural and industrial demands, proliferated.\textsuperscript{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, \textit{Tyler v. Wilkinson},\textsuperscript{38} introduced the notion of “reasonable use.” \textit{Wilkinson} held that riparians could use water in ways that diminished quantity and quality, so long as that use was “reasonable.”\textsuperscript{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.\textsuperscript{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.\textsuperscript{41} Amongst non-domestic uses, however, it is less easy to predict how a court will determine which uses are the most reasonable.\textsuperscript{42} Furthermore, riparian

\textsuperscript{36} See Ausness, supra note 32, at 417–18.

\textsuperscript{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.”).

\textsuperscript{38} Tyler v. Wilkinson, 24 F.Cas. 472 (C.C.R.I. 1827) (No. 14,312).

\textsuperscript{39} Id.

\textsuperscript{40} Ausness, supra note 32, at 417–18.


\textsuperscript{42} See Dellapenna, \textit{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 municipalities 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. As a result of all these factors, riparian doctrine has evolved to become more statutory and regulated (discussed below). In addition, many states have enacted statutes giving priority to uses including municipal needs, irrigation, and hydropower.

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. As a result, a more proactive managerial system emerged, commonly known as "regulated riparianism." Regulated riparianism is based on a comprehensive administrative permit system and has been adopted by eighteen states.

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).


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.\(^{57}\)


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


\(^{54}\) Id. at 697.

\(^{55}\) See id. at 717–18.


more, cultural resistance to regulation, as well as entrenched suspicion of government interference in water allocation, 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, where the climate becomes steadily more arid before reaching a narrow humid zone along the Pacific Coast. Initially, settlers attempted to adapt riparian laws to the western territories. 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.

It became evident that the common law of riparianism was not practical in an arid region where much of the land was publicly owned (those occupying federal land did not own their holdings, thus making riparian rights unattainable). 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. Settlers established local water management and allocation authorities, which were then taken over by the government at the beginning of the twentieth century. 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.
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,\textsuperscript{68} the 1877 Desert Land Sales Act,\textsuperscript{69} and through the judiciary in numerous cases.\textsuperscript{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.\textsuperscript{71} Junior appropriators whose diversions disappear during times of shortage are simply out of luck.\textsuperscript{72} For purposes of determining seniority, the date on which the appropriator started the diversion project by taking the “first step”\textsuperscript{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.\textsuperscript{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.\textsuperscript{75} That additional right will be junior to all other appropriations completed prior to the date of the new appropriation.\textsuperscript{76}

1. Diversion, Beneficial Use, and Appurtenance

Two important terms in the doctrine of prior appropriation are “diversion” and “beneficial use.”\textsuperscript{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.\textsuperscript{78} As streams

\textsuperscript{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).
\textsuperscript{72} Id. at 97.
\textsuperscript{73} See 2 WATERS AND WATER RIGHTS § 12.02(b) (Robert E. Beck et al., eds., 1991).
\textsuperscript{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).
\textsuperscript{75} See 2 WATERS AND WATER RIGHTS, supra note 73, at § 12.02(b).
\textsuperscript{76} Id. at § 12.02(c).
\textsuperscript{77} Id.
\textsuperscript{78} Id. at § 12.02(c)(1).
became fully appropriated, problems relating to lack of instream flow came increasingly to the fore.\textsuperscript{79} As environmental sensitivity has grown, claims to instream flow have enjoyed growing judicial and statutory recognition.\textsuperscript{80} There remain, however, a number of states where the concept still has little or no legal purchase.\textsuperscript{81}

Even assuming a water right meets all other criteria for legal recognition, the claimed water must still be put to beneficial use.\textsuperscript{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.”\textsuperscript{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.\textsuperscript{84} This leaves room for considerable variability in efficiency depending on the region’s wealth and geography.\textsuperscript{85}

\textsuperscript{79} See Cassuto & Reed, supra note 21, at 16.

\textsuperscript{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).


\textsuperscript{82} See Thorson et al., supra note 27, at 414.

\textsuperscript{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).

\textsuperscript{84} See 2 WATERS AND WATER RIGHTS, supra note 73, § 12.02(c)(2).

\textsuperscript{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. 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.

2. Limitations

As in riparian jurisdictions, water rights under prior appropriation are solely usufructuary. Users do not own the water and uses are subject to limitations arising from conflicting governmental uses (municipal, state and federal, including interstate compacts). As with riparian rights, post-hoc limitations on water rights may be subject to compensation under the Takings Clause of the Constitution. 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. The simple hydrological truth of the matter is that most water in the western United States was appropriated long ago.

‘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.

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

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. 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. 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, and the various states have developed several different legal regimes for the management of groundwater. In addition, the law distinguishes between groundwater flowing in a defined underground stream and groundwater percolating without

---

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).
95 WILLIAM GOLDFARB, WATER LAW 37 (2d ed. 1989).
97 RESTATEMENT (SECOND) TORTS § 858 cmt. c (1979).
a defined path. Groundwater in a defined stream gets treated much the same as surface water. 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. 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. The American reasonable use approach modifies absolute ownership by requiring that captured water be put to reasonable use on the overlying tract. Correlative rights mandate that groundwater be equitably shared among overlying landowners, while the Restatement (Second) of Torts approach imposes liability upon those who unreasonably draw down the aquifer’s level. Finally, the prior appropriation doctrine mirrors the surface water doctrine of first in time, first in right.

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, and known in the United States as the Public Trust Doctrine, is found in Article 225 of the 1988

---

99 See RESTATEMENT (SECOND) TORTS, supra note 97, at cmt. c.
100 Id.
102 Id. at cmt. c.
103 RESTATEMENT (SECOND) TORTS, supra note 97, at cmt. b.
104 3 WATERS AND WATER RIGHTS, supra note 101.
105 Id. at cmt. e.
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
state governments were tasked with managing water resources but private ownership was still permissible. The 1916 Civil Code and 1934 Water Code 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. 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.

Decree Number 24,463 promulgated the Code of Waters (Código 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.


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

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, 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. Growing water scarcity resulting from poor environmental management, natural catastrophes (including climate change), and burgeoning population and water treatment issues has made compliance and enforcement a priority at every governmental level. As with the United States, 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 drafters 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.
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...
rights. Private ownership was restricted only when it interfered with navigability.

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. 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.

The 1934 law represented a significant shift toward the public trust approach even while maintaining the right of private ownership. Private rights were exclusive to springs within private property or to water bodies located entirely within or underneath a property’s boundaries. 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. 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.

138 See Laura Beck Varela, Das Semsmarias à Propriedade Moderna: Um Estudo de História do Direito Brasileiro [From Sesmarias 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 Cometti 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 Octubro de 1941, D.O.U. de 25.10.1941 (Braz.)
The focus on growing energy demands obscured growing demographic and socioeconomic pressures. During most of the 1900s, Brazil faced rapid and uncontrolled urban growth. The increasingly industrialized economy drove people to the cities in search of jobs. This concentration of population and industry created significant water allocation and quality problems which the law was slow to address.

The pre-1988 navigability and hydroelectric water regimes started to change with the 1965 Forest Code. This statute, amended and strengthened by Law 7,803 of 1989, protected areas riparian to rivers, lakes and springs throughout Brazil. In succeeding years, growing international and national concern with environmental issues compelled the government to enact sweeping legislation. The 1972
Stockholm Declaration on the Human Environment\textsuperscript{150} was particularly influential in Brazil.\textsuperscript{151}

The landmark statute of this environmental phase in Brazil is the 1981 National Environmental Policy Act.\textsuperscript{152} With the subsequent enactment of the 1988 Constitution,\textsuperscript{153} followed by the 1997 National Water Management Act and the 1998 Environmental Crimes Law,\textsuperscript{154} water management became entirely the province of the federal and state governments.\textsuperscript{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.”\textsuperscript{156} Water, as part of the

\begin{footnote}
\textsuperscript{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.
\textsuperscript{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).
\textsuperscript{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.
\end{footnote}
environment, is covered by this principle as well.\textsuperscript{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 use\textsuperscript{158} and Article 1 of the National Water Policy Act declares that water lies within the public domain.\textsuperscript{159} This powerful statutory combination replaced centuries of governmental indifference and lack of recognition of looming issues of water scarcity.\textsuperscript{160}

Along with the extension of public domain over water, the post-1988 Constitutional water regime enhanced the 1981 National Environmental Policy Act.\textsuperscript{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,”\textsuperscript{162} oversee “entities engaged in research and manipulation of genetic material,”\textsuperscript{163} identify and protect areas of special environmental significance,\textsuperscript{164} and to protect fauna and flora.\textsuperscript{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 value\textsuperscript{166} and requires that in shortage situations priority uses be those relating to human consumption and to animals.\textsuperscript{167} It further states that water policies should facilitate multiple uses\textsuperscript{168} and that local management authority should reside with river basin committees.\textsuperscript{169} The language of the statute codified

\begin{itemize}
\item \textsuperscript{157} See Passos de Freitas, supra note 153, at 131 (relating water policies to the environmental legal framework).
\item \textsuperscript{158} C.C. art. 99 (Braz.), available at http://www.planalto.gov.br/ccivil_03/Leis/2002/L10406.htm.
\item \textsuperscript{159} Lei No. 9.433, supra note 111, art. 1, I.
\item \textsuperscript{160} See Commetti et al., supra note 140, at 85 (noting the shift in paradigms towards water throughout the twentieth century).
\item \textsuperscript{162} CONSTITUIÇÃO FEDERAL [C.F.] [CONSTITUTION] art. 225, para. 1, 1–2 (Braz.).
\item \textsuperscript{163} Id. at art. 225, para. 1, 2.
\item \textsuperscript{164} Id. at art. 225, para. 1, 3.
\item \textsuperscript{165} Id. at art. 225, para. 1, 7.
\item \textsuperscript{166} Lei No. 9.433, supra note 111, art. 1, II.
\item \textsuperscript{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.
\item \textsuperscript{168} Id. at art. 1, IV.
\item \textsuperscript{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
\end{itemize}
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.\textsuperscript{170} While these new constitutional and regulatory principles represented a dramatic policy shift, they also raised significant challenges of implementation.\textsuperscript{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.\textsuperscript{172} It also extends jurisdiction over beaches and the territorial sea.\textsuperscript{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.\textsuperscript{174} Private water rights were abrogated, including rights over groundwater.\textsuperscript{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.\textsuperscript{176} Some still-valid 1934 Water...
Code provisions\textsuperscript{177} as well as the 2002 Civil Code section dealing with groundwater\textsuperscript{178} must therefore be construed in light of the governing constitutional principles and the National Water Act.\textsuperscript{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.\textsuperscript{180} While some scholars argue that the private water ownership provisions under the 1934 Act were not revoked by the 1988 Constitution,\textsuperscript{181} most agree that the water rights were in fact expropriated.\textsuperscript{182} The issue then becomes whether the owners are entitled to compensation.\textsuperscript{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.\textsuperscript{184} Property owners who have springs or wells on their property have not yet felt the impact of the nationalization of their water.\textsuperscript{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

\textsuperscript{177} 1934 Water Code, \textit{supra} note 137, art. 96–101.
\textsuperscript{178} C.C. art. 98–103 (Braz.), available at \url{http://www.planalto.gov.br/ccivil_03/Leis/2002/L10406.htm}.
\textsuperscript{179} See Benjamin et al., \textit{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.”).
\textsuperscript{180} \textit{Constituição Federal [C.F.] [Constitution]} art. 5, 24 (Braz.).
\textsuperscript{182} José Ribeiro, \textit{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.).
\textsuperscript{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 LEME MACHADO, \textit{Direito Ambiental Brasileiro [Brazilian Environmental Law]} 446 (Malheiros 16th ed., 2008).
\textsuperscript{184} See infra parts II.D and III.B.
\textsuperscript{185} See Ribeiro, \textit{supra} note 182.
seeking to operate wells on their land. 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. Article 8 states that water can be privately held but that ownership is conditional on the waters not being declared assets of common use. As the 1988 Constitution, Article 99 of the 2002 Civil Code and the 1997 Water Policy Act all declared water to fall under the category of common use, claims for compensation become murkier. The argument against compensation aligns with what Joseph Sax calls an “economy of nature,”

187 1934 Water Code, supra note 137, art. 8.
188 Id.
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. 2003/004839-9, 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.

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. 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.

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. 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. Yet, after twelve years with this policy in place, only 141 State and 8 Interstate River Basin Committees have been formed. 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.
tively instituted a system for charging for water use. When one considers Brazil’s size (nearly that of the continental United States), 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. It aims to 1) preserve water quality and quantity for, 2) present and future generations, and 3) protect the resource against critical hydrological events. Lawmakers recognized that sustainable development required a syncretic water policy that allowed for multiple uses including transportation. They also knew that sound management dictated precaution and planning for critical hydrological events, whether natural or anthropogenic in origin.

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

---

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 Politica 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.
207 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, 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. 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. By contrast, the Southeast—the most populated and industrialized region—contains only ten percent of the country’s water.

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. 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. These shortages arise in large part from decades of unplanned industrial development. In addition, municipal

---

217 Penalties range from warnings to fines and imprisonment. See id. at art. 49–50.
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.
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. 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. Long periods of drought are becoming more frequent, even in wet states in the South like Paraná and Rio Grande do Sul. 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.

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).


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.” It projects significant adverse impacts on agriculture, water supply, energy production and health. While dry regions will become drier, there will also be changes in rainfall patterns and runoff in traditionally humid zones that will increase floods. This will impact water availability and quality and present “challenges to society [and] physical infrastructure.” These projections, which apply to both countries, are already visible in southeastern Brazil as well as in many regions of the United States.

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. 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.

229 IPCC FOURTH ASSESSMENT REPORT, supra note 125, at 49.
230 Id.
231 Id.
234 The Federal Government enjoys concurrent authority with States and Municipal
Brazil is already struggling with the implementation of the post-1988 water regime. 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.

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. Some states have taken action either individually or in tandem with other states 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 Act and the agency has taken some tentative steps toward using the Clean Water Act, 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. 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.


240 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 Édis 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

---

243 See id.
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. 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. 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. Climate models show that temperatures in the Western United States are expected to rise between two and five degrees Celsius. This will further dry the air in this already arid region, decreasing humidity and precipitation. This decrease in precipitation will diminish snowpack, lessen surface water flow, and decrease aquifer recharge; this combination will mean significantly less water for both human and nonhuman uses.

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. Salinity problems will increase during times of highest water demand and, as freshwater levels drop, seawater intrusion will increase still more. Even the Great Lakes and surrounding region are forecast to experience dramatic impacts. 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).

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 supra notes 244 at 32–33.
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. 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. 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.
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. 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.

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. 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. 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. 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.

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, it now confronts the same problem faced by the United States and many other nations: coal plants emit enormous amounts of carbon. Those emissions accelerate...
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. This situation is partially due to a lack of resources and an accompanying lack of political will in the face of competing development priorities. In addition, although there is no way to measure it precisely, corruption remains a factor undermining the enforcement of environmental laws in Brazil.

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. 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.

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).


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

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.  

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.