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Evolution of Water Institutions in the Indus River Basin: Reflections from the Law of the Colorado River

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EVOLUTION OF WATER INSTITUTIONS IN THE INDUS RIVER BASIN: REFLECTIONS FROM THE LAW OF THE COLORADO RIVER

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Transboundary water institutions in the Indus River Basin can be fairly characterized as broken in key respects. International relations between India and Pakistan over the Indus Waters Treaty, as well as interprovincial relations within Pakistan over the 1991 Water Accord, speak to this sentiment. Stemming from research undertaken by the authors for the Harvard Water Federalism Project and the United States Agency for International Development (USAID), this Article seeks to spur the evolution of the Indus River Basin's water institutions by offering a comparative perspective from North America's most "institutionally encompassed" basin, the Colorado River Basin. Mindful of the importance of context for comparative water law and policy scholarship, the Article begins with overviews of the Colorado and Indus basins. In turn, the Article considers in greater detail major water-related challenges facing the latter basin, including climate change and overallocation. Against this backdrop, the Article ultimately turns to analysis and prescription. Examining a host of topics involving transboundary water allocation, conservation, and governance, the Article considers key institutions associated with these topics in the Colorado River Basin and reflects on how, if at all, they may serve as reference points for institutional evolution in the Indus Basin. Many of the proposals in the Article are expensive. But compared to military operations, they are quite modest in terms of expense and minimize the risk of loss of life and destruction of property. Still, the Article prioritizes solutions that maximize individual and local freedom to the greatest

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extent possible. This means relying upon voluntary market-based transfers that protect the vulnerable, favoring incentives rather than regulations, and creating a reward structure that includes benefits other than water.

INTRODUCTION

"Blood and water can't flow together at the same time." Indian Prime Minister Narendra Modi made this poignant declaration in September 2016.[1] Modi was getting "tough on Indus treaty" blared headlines[2]—referring to the Indus Waters Treaty of 1960 (IWT)[3]—

1. *Blood and Water Cannot Flow Together: PM Modi at Indus Water Treaty Meeting*, INDIAN EXPRESS (Sept. 27, 2016, 2:50 PM), http://indianexpress.com/article/india/india-news-india/indus-water-treaty-blood-and-water-cant-flow-together-pm-modi-pakistan-uri-attack/.

2. '*Blood and Water Can't Flow Together': PM Narendra Modi Gets Tough on Indus Treaty*, TIMES OF INDIA (Sept. 27, 2016, 3:39 AM), https://timesofindia.indiatimes.com/india/Blood-and-water-cant-flow-together-PM-Narendra-Modi-gets-tough-on-Indus-treaty/articleshow/54534135.cms.

and had chaired a high-level meeting declaring India's intent to "exploit to the maximum" the treaty's cooperative mechanism governing flows from the Indus River system to downstream Pakistan.[4] Several months later in January 2017, at an election rally in India's premier agricultural province of Punjab, Modi told farmers that if they voted the party to power, his government would divert to them what he characterized as "waste," referring to Indus waters flowing to Pakistan.[5] The IWT, of course, is no stranger to conflict. Originally, the World Bank stepped in to lead its fractious negotiations, and it has survived no fewer than four Indo-Pakistani wars.[6] Nonetheless, Modi's rhetoric—whether at official meetings in response to alleged attacks across the Line of Control,[7] the renamed original cease-fire line between the two countries, or at political rallies—poses a grave question: Has international cooperation on the Indus (albeit historically limited) reached a breaking point?

The IWT is not the sole instrument that inspires such a question. Interprovincial relations within Pakistan over water from the Indus River system are less politically charged, but only marginally less broken. In the decades since the signing of the interprovincial Water Accord in 1991,[8] recurring stalemates have been the norm on bread-and-butter issues such as provincial water shares, dam construction, and the roles of smaller federating units in transboundary water management. Contentious and circuitous claims and counter-claims continue to fill headlines: "Sindh Will Never Move Back from Getting 1991 Water Accord Enforced, [Provincial Assembly] Told,"[9] "Punjab Farmers Reject 1991 Water Accord With-

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3. Indus Waters Treaty 1960, Sept. 19–Dec. 23, 1960, 6032 U.N.T.S. 126, [hereinafter IWT], https://treaties.un.org/doc/Publication/UNTs/Volume%20419/volume-419-I-6032-English.pdf.

4. INDIAN EXPRESS, *supra* note 1.

5. *Assembly Elections 2017: PM Modi Mocks Cong's 'Opportunistic' Alliance with SP, Asks People Not to Vote for 'Sinking Ship,'* DNA INDIA (Jan. 27, 2017, 9:05 PM), http://www.dnaindia.com/india/report-punjab-elections-2017-pm-modi-mocks-cong-s-opportunistic-alliance-with-sp-asks-people-not-to-vote-for-sinking-ship-2296751.

6. MAJORITY STAFF OF S. COMM. ON FOREIGN RELATIONS, 112TH CONG., AVOIDING WATER WARS: WATER SCARCITY AND CENTRAL ASIA'S GROWING IMPORTANCE FOR STABILITY IN AFGHANISTAN AND PAKISTAN 7 (Comm. Print 2011), [hereinafter SENATE REPORT], https://www.foreign.senate.gov/imo/media/doc/Senate%20Print%20112-10%20Avoiding%20Water%20Wars%20Water%20Scarcity%20and%20Central%20Asia%20Afgahnistan%20and%20Pakistan.pdf.

7. An unofficial border between India and Pakistan that runs through the Kashmir region. *The Future of Kashmir?*, BBC NEWS, news.bbc.co.uk/2/shared/spl/hi/south_asia/03/kashmir_future/html/ (last visited Mar. 24, 2018).

8. Apportionment of the Waters of the Indus River System Between the Provinces of Pakistan, Mar. 21, 1991, [hereinafter Accord], http://www.pakirsa.gov.pk/WAA.aspx.

9. Habib Khan Ghori, *Sindh Will Never Move Back from Getting 1991 Water Accord Enforced, PA Told*, DAWN (Mar. 22, 2018), https://www.dawn.com/news/1311139.

out Kalabagh Dam,"[10] "Sindh Rejects Construction of Kalabagh Dam,"[11] and others echo the parade of horribles. Most recently, Pakistan's Supreme Court stepped into the fray with the Chief Justice vowing to see Kalabagh Dam built,[12] followed by the expected round of criticism of the court's constitutional role, as well as its backing for the particular project.[13] Reacting to the criticism, the Chief Justice was quick to clarify that the court did not intend to hurt the sentiments of any of the federation's provinces and was instead aiming to solve the country's water crisis.[14] The court then moved to support the construction of two other dams, seen as more acceptable alternatives to Kalabagh, as a way to sidestep the controversy and get some infrastructure built.[15]

It is this dysfunctional, sometimes volatile, environment surrounding the Indus River Basin's transboundary water institutions from which this Article stems. Douglass North's definition of "institutions" informs the usage of that term: "humanly devised constraints that structure political, economic, and social interaction."[16] The Article's thesis regarding the Indus Basin's water institutions is plain. Government officials tasked with implementing them in their current forms, as well as evolving successors better adapted to the twenty-first century, should reflect carefully and critically on transboundary water institutions in the Colorado River Basin as reference points. The rationale underlying this suggestion is straightforward. The Colorado River Basin is "institutionally encompassed" in the extreme.[17] It is also navigating an unprecedented drought, a precarious water supply-demand imbalance, and formidable climate change projections that implicate the lives and livelihoods of thirty-five to forty million U.S. residents.[18] By no

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10. *Punjab Farmers Reject 1991 Accord Without Kalabagh Dam*, BUSINESS RECORDER (Apr. 3, 2010), https://fp.brecorder.com/2010/04/201004031039261/.

11. *Sindh Rejects Construction of Kalabagh Dam*, DAWN (June 17, 2010), https://www.dawn.com/news/969905.

12. *Kalabagh Dam Will Be Built at any Cost, Remarks CJP Saqib Nisar*, NEWS (June 27, 2018), https://www.thenews.com.pk/latest/334447-kalabagh-dam-will-be-built-at-any-cost-remarks-cjp-saqib-nisar.

13. "*It Is Not Apex Court's Responsibility to Build Consensus on Kalabagh Dam: Khuhro*, EXPRESS TRIBUNE (June 11, 2018), https://tribune.com.pk/story/1732303/1-not-apex-courts-responsibility-build-consensus-kalabagh-dam-khuhro/.

14. *See Court Not Pushing for Kalabagh Dam: CJP*, NATION (June 10, 2018), https://nation.com.pk/10-Jun-2018/court-not-pushing-for-kalabagh-dam-cjp.

15. Haseeb Bhatti, *SC Asks Public to Donate Money for Construction of Diamer-Bhasha, Mohmand Dams*, DAWN (July 4, 2018), https://www.dawn.com/news/1417934.

16. Douglass C. North, *Institutions*, 5 J. ECON. PERSP. 97, 97 (1991), https://www.aeaweb.org/articles?id=10.1257/jep.5.1.97.

17. PHILIP L. FRADKIN, A RIVER NO MORE: THE COLORADO RIVER AND THE WEST 16 (1981).

18. U.S. BUREAU OF RECLAMATION, COLORADO RIVER BASIN STAKEHOLDERS MOVING FORWARD TO ADDRESS CHALLENGES IDENTIFIED IN THE COLORADO RIVER BASIN WATER SUPPLY

means are the Colorado River Basin's diverse water institutions panaceas—transboundary allocation schemes, governance arrangements, or otherwise. They are undeniably complex, however, and in breadth and intricacy offer truly bountiful food for thought regarding actual and potential options for institutional design. In no small measure, this referential value can be attributed to the dynamic, adaptation-forcing context in which the institutions have been situated over the past two decades of historic drought—a context involving sustained study and novel innovation at the international and interstate levels.[19] Thus, at the base of the framing of this Article is a belief in the importance of comparative water law and policy, and a view that such approaches to place-based water problems are essential for "rigorous comparison of water policy alternatives."[20] The Indus Basin may draw some benefit from this approach.

Part I begins by emphasizing place and context. It provides overviews of the Colorado and Indus basins aimed at illuminating salient features and associated differences and similarities. Part II, in turn, delves further into the Indus Basin, surveying major water-related challenges facing the basin, such as overallocation and climate change. It then introduces the basin's key transboundary water institutions, particularly the IWT and interprovincial Water Accord. Finally, Part III constitutes the Article's analytical and pre-prescriptive component. It is organized around two substantive categories: (1) transboundary water allocation and conservation, and (2) transboundary water governance. Each category encompasses a range of topics implicating particular water laws and policies in the Colorado River Basin, including shortage sharing in the former category and collaboration in the latter one. In relation to each topic, the discussion initially details relevant water laws and policies in the Colorado River Basin and then considers how these laws and policies might inform future evolution of the Indus Basin's water institutions. Part III maps out the suite of evolutionary ideas in full, and a synthesis of them appears in the Conclusion.

AND DEMAND STUDY, PHASE I REPORT 1-2–1-5 (2015) [hereinafter PHASE I REPORT], https://www.usbr.gov/lc/region/programs/crbstudy/MovingForward/Phase1Report/fullreport.pdf.

19. *See generally* Jason Anthony Robison, *The Colorado River Revisited*, 88 U. COLO. L. REV. 475 (2017) (discussing the composition and evolution of the basin's international and interstate water allocation framework).

20. *See* James L. Wescoat, Jr., *Comparative International Water Research*, 142 J. CONTEMP. WATER RES. & EDUC. 61, 61–63 (2009).

I. BASIN OVERVIEWS

Place is important. Institutions governing water resources reciprocally shape and are shaped by distinct conditions and values associated with the particular places in which the institutions are situated.[21] There are cultural, economic, environmental, legal, political, and social dimensions to this perspective.[22] It is an essential starting point. Any notion that water institutions in one context (the Colorado River Basin) may serve as reference points for institutional evolution in another (the Indus River Basin) necessarily must give due regard to contextual nuances. Disregard of this principle poses a significant risk of institutional imperialism. That is unacceptable. Proceeding on this basis, the discussion below conveys initial snapshots of the Colorado and Indus basins.

A. *Colorado River Basin*

The Colorado River has been aptly described as the "lifeline" of the region through which it flows.[23] Its basin encompasses approximately 244,000 square miles in the southwestern United States and northwestern Mexico (see Figure 1 below).[24] Pursuant to the Colorado River Compact, the basin is legally and politically bifurcated into an "Upper Basin" and "Lower Basin" at a dividing point called "Lee Ferry" in Northern Arizona.[25] Alpine peaks and high desert largely characterize the Upper Basin. It is there that the Colorado River's headwaters reside—in the majestic Rocky Mountains of Northern Colorado—making for a more than 1,450-mile journey to the river's mouth in the Gulf of California.[26] Major tributaries in the Upper Basin include the Green River and San Juan River, the former flowing from southwestern Wyoming's Wind River Range and the latter from southwestern Colorado's San Juan Range.[27] In contrast, the Lower Basin largely consists of low desert,

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21. *See, e.g.*, CHARLES F. WILKINSON, FIRE ON THE PLATEAU: CONFLICT AND ENDURANCE IN THE AMERICAN SOUTHWEST 81 (1999) ("Laws rise up from societies and the terrain . . . . 'For law is organic. Law is part of a time and a place, the product of a specific time and an actual place.' Law, in other words, has a habitat.") (quoting Cherokee legal historian Rennard Strickland).

22. *See generally id.*

23. Clarence A. Carlson & Robert T. Muth, *The Colorado River: Lifeline of the American Southwest* (1986), http://www.nativefishlab.net/library/textpdf/17416.pdf.

24. Lawrence J. MacDonnell, *Colorado River Basin*, *in* WATER AND WATER RIGHTS 6 (Amy K. Kelly ed. 2011).

25. COLO. REV. STAT. §§ 37-61-101, art. II(f)–(g) (2016) [hereinafter COMPACT].

26. Jason Robison et al., *Challenge and Response in the Colorado River Basin*, 16 WATER POL'Y 12, 20 (Mar. 2014).

27. *Cf.* PHASE I REPORT, *supra* note 18, at 1-3, fig.1-1.

although some mountainous areas exist. New Mexico's Black Range is the Gila River's headwaters, which is the Lower Basin's most significant tributary.[28]

From a transboundary perspective, the Colorado River Basin is a jigsaw puzzle. It is an international and interstate basin that encompasses portions of seven "basin states"—Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming—as well as Baja California and Sonora in Mexico. Within the U.S. portion of the basin, Colorado, New Mexico, Utah, and Wyoming are referred to as the "Upper Division" states, while Arizona, California, and Nevada are referred to as the "Lower Division" states.[29] Indigenous Peoples relied on the basin's life-giving waters for millennia prior to the formation of Mexico, the United States, and their subnational states.[30] In contemporary times, twenty-eight reservations occupied by American Indian tribal sovereigns exist within the basin states, including the Navajo Nation, the largest reservation in the United States.[31] Federal lands likewise pervade the basin in a variety of forms, ranging from national parks (such as the Grand Canyon), to national forests, to national recreation areas, to national wildlife refuges, and beyond.[32]

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28. AMERICAN RIVERS, *Gila River: The Origin of Wilderness* (May 4, 2018), https://www.americanrivers.org/river/gila-river/.

29. COMPACT, *supra* note 25, art. II(c)–(d).

30. *See Hohokam Canals: Prehistoric Engineering*, ARIZONA EXPERIENCE, http://arizonaexperience.org/remember/hohokam-canals-prehistoric-engineering (last visited Mar. 23, 2018).

31. For an Indian reservations map, see BUREAU OF RECLAMATION, U.S. DEP'T OF INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, TECHNICAL REPORT C C-40, fig.C-17 (2012), https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20C%20-%20Water%20Demand%20Assessment/TR-C-Water_Demand_Assessmemt_FINAL.pdf.

32. For a federal lands map, see U.S. GEOLOGICAL SURVEY, U.S. DEP'T OF INTERIOR, FEDERAL LANDS AND INDIAN RESERVATIONS (2005), https://nationalmap.gov/small_scale/printable/images/pdf/fedlands/fedlands3.pdf.

FIGURE 1. COLORADO RIVER BASIN AND EXPORT AREAS[33]

Water institutions in the Colorado River Basin mirror the transboundary relations just discussed in scope and complexity. These institutions generally fall into intertwined categories of legal and policy infrastructure and physical infrastructure.

The "Law of the River" is the colloquial term for the former category.[34] Subsumed within it is a body of laws and policies that has accumulated mind-bending mass over the past century.[35] A nested

33. PHASE I REPORT, *supra* note 18, at 1-3, fig.1-1.

34. For a useful survey of the Law of the River, see MacDonnell, *supra* note 24.

35. For a discussion of the composition and evolution of this framework, *see* Robison, *supra* note 19.

international and interstate allocation framework exists within the Law of the River made up of (1) an international treaty between the United States and Mexico (U.S.-Mexico Treaty (1944));[36] (2) two interstate water compacts (Colorado River Compact (1922), Upper Colorado River Basin Compact (1948));[37] and (3) a United States Supreme Court decree issued in the seminal litigation of *Arizona v. California* (*Arizona v. California* Decree (1963)).[38] The Law of the River's allocation framework is inextricably connected with a trio of federal statutes that brought into being and continue to govern operation of the basin's vast storage infrastructure described below—namely, the Boulder Canyon Project Act (1928),[39] the Colorado River Storage Project Act (1956),[40] and the Colorado River Basin Project Act (1968).[41] Entering the scene after the allocation framework and infrastructural legislation had been put into place is an overlay of environmental laws addressing subjects like salinity control (Colorado River Basin Salinity Control Act (1974))[42] and biodiversity and ecosystem protection (Endangered Species Act (1973), Grand Canyon Protection Act (1992)).[43] A wide range of federal and federal-state bodies are charged with administering different aspects of the Law of the River's allocational, infrastructural, and environmental components. Examples include the International Boundary and Water Commission,[44] U.S. Bureau of Reclamation,[45] and Upper Colorado River Commission.[46] Part III will elaborate on further attributes of the Law of the River.

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36. Treaty for the Utilization of Waters of Colorado and Tijuana Rivers and of the Rio Grande, Mex.-U.S., Feb. 3, 1944, T.S. No. 994 [hereinafter Treaty], (entered into force Nov. 8, 1945).

37. Upper Colorado River Basin Compact, ch. 48, 63 Stat. 31 (1949) [hereinafter Upper Basin Compact]; COMPACT, *supra* note 25, §§ 37-61-101 to -104.

38. Arizona v. California, 547 U.S. 150 (2006) [hereinafter Decree] (consolidated decree).

39. Boulder Canyon Project Act, ch. 42, 45 Stat. 1057 (1928) [hereinafter BCPA].

40. Colorado River Storage Project Act, 43 U.S.C. §§ 620–620o (2012) [hereinafter CRSPA].

41. Colorado River Basin Project Act 43 U.S.C. §§ 1501–1556 (2012) [hereinafter CRBPA].

42. 43 U.S.C. §§ 1571–1599 (2016).

43. Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544 (2016); Grand Canyon Protection Act of 1992, Pub. L. No. 102-575, 106 Stat. 4600 (1992).

44. *History of the International Boundary and Water Commission*, U.S. SECTION, INT'L BOUNDARY AND WATER COMM'N, https://www.ibwc.gov/About_Us/history.html (last visited Mar. 23, 2018) [hereinafter IBWC History].

45. *About Us*, U.S. DEP'T OF INTERIOR, BUREAU OF RECLAMATION, LOWER COLO. REGION, https://www.usbr.gov/lc/aboutus.html (last visited Feb. 15, 2018); *About Us*, U.S. DEP'T OF INTERIOR, BUREAU OF RECLAMATION, UPPER COLORADO REGION, https://www.usbr.gov/uc/aboutus/ (last visited Feb. 15, 2018).

46. *UCRC Home*, UPPER COLO. RIVER COMM'N, [hereinafter *UCRC*], http://www.ucrcommission.com/index.html (last visited Feb. 15, 2018).

From a social-engineering versus physical-engineering standpoint, it is difficult to say which is more nuanced: the Law of the River itself or the plumbing system the legal framework has implanted within the Colorado River Basin. No doubt the latter is diffuse and intricate. Glen Canyon Dam and Lake Powell are the elephants in the room within the Upper Basin, while Hoover Dam and Lake Mead are their counterparts within the Lower Basin.[47] Taken together, these Goliaths contribute slightly over fifty-three million acre-feet (maf) of the basin's more than sixty maf in storage capacity.[48] One acre-foot equals 325,851 gallons.[49] They exist alongside a host of large-scale diversion projects—both in-basin and transbasin—such as the Central Utah Project, Colorado-Big Thompson Project, and San Juan-Chama Project within the Upper Basin, as well as the Central Arizona Project and Colorado River Aqueduct within the Lower Basin.[50]

An imbalance between water supply and demand currently exists in the Colorado River Basin that affects thirty-five to forty million people reliant on its water—roughly equivalent to between one-in-eight and one-in-nine U.S. residents.[51] Water demand has exceeded water supply on average across the past decade,[52] resulting in a precipitous drawdown of reservoir storage. For example, Lake Mead's storage plummeted from 22.4 maf to 9.8 maf from 2000 to 2015.[53] On the demand side, agriculture consumes the lion's share of the basin's flows (approximately seventy percent),[54] yet the flows also supply major metropolitan areas in each basin state, including Denver, Salt Lake City, Albuquerque, and Cheyenne within Upper Basin export areas, and Los Angeles, Phoenix, and Las Vegas within the Lower Basin proper or export areas.[55]

Turning to the supply side, the basin has been in a historic drought since 2000, with natural flows at Lee Ferry, the Upper Basin-Lower Basin dividing point, dropping to levels that are lower than any in a century of recordkeeping and some of the lowest

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47. PHASE I REPORT, *supra* note 18, at 1-3, fig.1-1.

48. Robison et al., *supra* note 26, at 32–33.

49. *Water Science Glossary of Terms*, U.S. DEP'T OF INTERIOR, U.S. GEOLOGICAL SURVEY, https://water.usgs.gov/edu/dictionary.html (last modified Apr. 19, 2017).

50. Robison et al., *supra* note 26, at 33.

51. *Compare* PHASE I REPORT, *supra* note 18, at 1 (estimating absolute size of affected population as of May 2015) *with U.S. and World Population Clock*, U.S. CENSUS BUREAU, https://www.census.gov/popclock/ (last visited Feb. 15, 2018) (estimating overall U.S. population as of February 15, 2018).

52. PHASE I REPORT, *supra* note 18, at 1-5, fig.1-2.

53. Robison, *supra* note 19, at 539 tbl.6 (showing reservoir depletion for this period).

54. PHASE I REPORT, *supra* note 18, at 1-2.

55. *Id.* at 1-3, fig.1-1. Many of these urban centers have grown at staggering rates over the past few decades. Robison, *supra* note 19, at 494 tbl.4.

over the past 1,200 years based on paleo records.[56] Average surface air temperature in the basin has increased by 2.5 degrees Fahrenheit (1.39 degrees Celsius) since around the turn of the twentieth century.[57] Precisely how the basin's climate will change going forward remains to be seen, but the Bureau of Reclamation has projected a mean decrease of 8.7 percent in Lee Ferry flows by 2060,[58] and researchers have suggested reductions ranging from six percent to forty-five percent by mid-century.[59]

In a nutshell, the Colorado River Basin can be characterized as an intensely relational, institutionalized, and utilized transboundary basin encompassing some of the most austere, breathtaking terrain in North America. It is also a basin facing a daunting water supply-demand imbalance and a host of associated challenges. As outlined in Part III, the past two decades have seen a wide range of innovative approaches to the Law of the River's foundational instruments in conjunction with the historic drought.[60] These adaptive efforts, as well as the instruments themselves, offer valuable food for thought in other settings around the world.

B. *Indus River Basin*

Like the Colorado River, the Indus River is also its region's lifeline. That region extends from where the river rises in Tibet, in the upper reaches of the Himalayas, through Indian-administered Jammu and Kashmir (an area in which the United Nations (U.N.) continues to monitor a ceasefire between India and Pakistan).[61] Further downstream, it finally enters its most dependent area, across the international boundary into downstream Pakistan through the fertile alluvial plains of Punjab and Sindh. The Indus

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56. *Drought in the Colorado River Basin*, U.S. DEP'T OF THE INTERIOR, https://www.doi.gov/water/owdi.cr.drought/en/ (last visited Feb. 13, 2018).

57. U.S. BUREAU OF RECLAMATION, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, TECHNICAL REPORT B B-16 fig.B-7 (2012), https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20B%20-%20Water%20Supply%20Assessment/TR-B_Water_Supply_Assessment_FINAL.pdf.

58. *Id.* at B-65.

59. Letter from Victor R. Baker, Regents' Professor of Hydrology and Water Res., Univ. of Ariz., to Sally Jewell, Sec'y of the Interior 1 (Oct. 12, 2015), www.livingrivers.org/pdfs/LetterToJewell13October2015Final.pdf [hereinafter Baker Letter]. For an excellent article addressing climate change's historical and projected impacts on basin-wide flows, see Bradley Udall & Jonathan Overpeck, *The Twenty-First Century Colorado River Hot Drought and Implications for the Future*, 53 WATER RESOURCES RES. 2404 (2017).

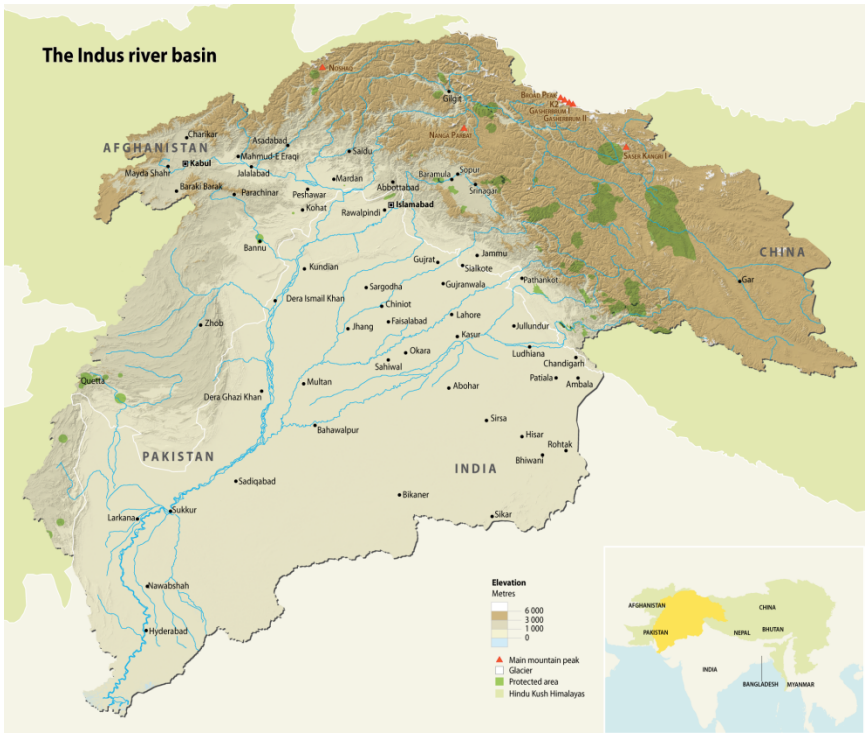
60. *See generally* Robison, *supra* note 19 (addressing adaptation of allocation framework).

61. *Observing the Ceasefire in Jammu and Kashmir*, U.N. MILITARY OBSERVER GROUP IN INDIA AND PAKISTAN, https://peacekeeping.un.org/en/mission/unmogip (last visited Feb. 15, 2018).

River ultimately drains into the Arabian Sea via the Indus Delta.[62] The rivers that make up the Indus River system encompass portions of China, India, Pakistan, Afghanistan, and the disputed region of Kashmir (see Figure 2 below).

The Indus Basin accounts for seventy-one percent of Pakistan's territory, spanning across four provinces: Punjab, Sindh, and Khyber Pakhtunkhwa in their entirety, as well as eastern parts of Balochistan.[63] In terms of sheer scale, interlinked uses, massive human dependence on river water, and geopolitical complexity, the basin is unmatched.

FIGURE 2. INDUS RIVER BASIN[64]



Habitation along the river system increases the farther downstream one proceeds. This pattern means that human reliance on

62. *See generally* Azra Meadows & Peter Meadows, *Introduction to* THE INDUS RIVER: BIODIVERSITY, RESOURCES, HUMANKIND (Azra Meadows & Peter Meadows eds., 1999).

63. GITANJALI BAKSHI & SAHIBA TRIVEDI, STRATEGIC FORESIGHT GROUP, THE INDUS EQUATION 3 (2011), www.strategicforesight.com/publication_pdf/10345110617.pdf.

64. International Centre for Integrated Mountain Development (ICIMOD), The Himalayan Climate and Water Atlas 59 (2015), https://gridarendal-website-live.s3.amazonaws.com/production/documents/:s_document/20/original/HKHwateratlas2016_screen.pdf?1483646266.

the river is greatest in downstream Pakistan, in the heavily settled provinces of Punjab and Sindh, because of the vast network of irrigation canals built by the British under colonial rule starting in the nineteenth century.[65] British canal development made Punjab the granary of British India.[66] Perhaps ironically for such extensive agricultural development, "[a]round [ninety-two] percent of the country's area is classified as semi-arid to arid, facing extreme shortage of precipitation."[67]

The network of irrigation canals has only grown since the Partition of the sub-continent and Independence in 1947, making the Indus Basin in Pakistan the largest contiguous irrigation network in the world.[68] Today, it extends over approximately forty-five million acres.[69] Given the country's dependence on this vast irrigation network, it is difficult to overemphasize the importance of the Indus River system to Pakistan. The constructed and built geography of the Indus Basin has shaped the country's actions and continues to affect its calculus of safety, as explored further below. In addition to the vast economic dependence on irrigated agriculture, which is responsible for close to a quarter of the country's gross domestic product and employs nearly half of its labor force,[70] there is growing reliance on groundwater for irrigation, with attendant problems of deteriorating water quality.

The most significant addition to the Indus Basin's water infrastructure occurred as a result of the IWT between India and Pakistan brokered by the World Bank over nearly a decade of negotiations.[71] This Article explores the institutional basis underlying the IWT, as well as the overall institutional framework of the basin and its attendant rules for water management, in later sections. Rele-

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65. For an excellent history of the development of the canal colonies of the Punjab, see IMRAN ALI, THE PUNJAB UNDER IMPERIALISM, 1885–1947 (2003).

66. Indermit Gill, *What's In Store for India's Punjab?*, BROOKINGS (Mar. 3, 2017), https://www.brookings.edu/blog/future-development/2017/03/03/whats-in-store-for-indias-punjab/.

67. *Pakistan, Geography, Climate and Population*, FOOD AND AGRIC. ORG. OF THE UNITED NATIONS, http://www.fao.org/nr/water/aquastat/countries_regions/Profile_segments/PAK-GeoPop_eng.stm (last visited Feb. 15, 2018). For a U.S. National Aeronautics and Space Administration image depicting the basin's climate, see https://eoimages.gsfc.nasa.gov/images/imagerecords/62000/62558/Indus.A2002274.0610.250m.jpg.

68. FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, IRRIGATION IN SOUTHERN AND EASTERN ASIA IN FIGURES 6 (2011), http://www.fao.org/nr/water/aquastat/basins/indus/indus-CP_eng.pdf [hereinafter FAO].

69. *Indus Basin Irrigation System of Pakistan*, TRIPLE BOTTOM LINE MAG., http://www.tbl.com.pk/indus-basin-irrigation-system-of-pakistan/ (last visited Feb. 15, 2018).

70. JOHN BRISCOE & USMAN QAMAR, WORLD BANK, PAKISTAN'S WATER ECONOMY: RUNNING DRY xxv (Oxford Univ. Press 2005), http://documents.worldbank.org/curated/en/989891468059352743/pdf/443750PUB0PK0W1Box0327398B01PUBLIC1.pdf [hereinafter BRISCOE & QAMAR].

71. See *generally* IWT, *supra* note 3.

vant here, the IWT spawned a massive infrastructural program, the Indus Basin Replacement Works, that led to the construction of two large dams, five barrages, and eight link canals that move water from the three western rivers to lands previously irrigated by the three eastern rivers allocated to India under the IWT.[72] To manage these extensive works, Pakistan established a national parastatal organization, the Water and Power Development Authority (WAPDA), in 1958.[73] However, by the terms of the Government of India Act 1935—the primary legislative structure of the departing colonial government that was the primary foundation of further constitutional development in both India and Pakistan after independence[74]—the country retained water management as a provincial subject. It is against this complex backdrop that the discussion turns to the challenges that water managers in the basin have faced and the institutions they have evolved within this multi-layered division of authority.

II. WATER CHALLENGES AND INSTITUTIONS IN THE INDUS RIVER BASIN

Water managers will not lack for work in the Indus Basin in coming decades, as they confront overallocation, climate change, and a host of associated challenges. The same can be said about governmental officials working at the international and interprovincial levels on the basin's legal and policy water infrastructure. Both prognoses grow out of the material below. In the course of shedding light on salient water-related challenges and institutions in the Indus Basin, the discussion further elucidates the rationale for this Article's core thesis: The Colorado River Basin may serve as a useful reference point for navigating the Indus Basin's future.

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72. For insightful discussions of the IWT and Indus Basin water infrastructure, see ALOYS ARTHUR MICHEL, THE INDUS RIVERS: A STUDY OF THE EFFECTS OF PARTITION (1967); DAVID GILMARTIN, BLOOD AND WATER: THE INDUS RIVER BASIN IN MODERN HISTORY (2015); DANIEL HAINES, RIVERS DIVIDED: INDUS BASIN WATERS IN THE MAKING OF INDIA AND PAKISTAN (2016); IJAZ HUSSAIN: INDUS WATERS TREATY: POLITICAL AND LEGAL DIMENSIONS (2018).

73. PAK. WATER & POWER DEV. AUTHORITY, http://www.wapda.gov.pk/ (last visited Mar. 24, 2018) [hereinafter WAPDA].

74. The Government of India Act 1935 was the primary governing statute of British India. *See Constitutional History of India*, INT'L INST. FOR DEMOCRACY AND ELECTORAL ASSISTANCE, http://www.constitutionnet.org/country/constitutional-history-india (last visited Mar. 24, 2018). The Constituent Assemblies of both successor countries, India and Pakistan, took it as a foundation for their subsequent drafting of the countries' respective constitutions.

A. *Overallocation, Climate Change, and Associated Challenges*

Perhaps most pressing in the realm of challenges is the basin's overallocation. There simply is not enough water for all existing uses, much less projected needs. Total water withdrawal was estimated to be 149 maf in 2008, which is an overdraft of approximately eighteen maf.[75] According to another estimate, water demands have outstripped supplies in the basin by eleven to twelve maf annually, and this imbalance is projected to get much worse.[76] As plainly described roughly a decade ago, Pakistan is "close to using all of the available surface water and groundwater, yet it is projected that over [thirty] percent more water will be needed over the next twenty years to meet increased agricultural, domestic, and industrial demands."[77] Whether solutions come from adding more water (difficult to do), increased savings and efficiency (also difficult, but perhaps more desirable and feasible), or some combination of the two approaches, is a matter considered below that ultimately rests with policymakers and water users.

The shortfall in water supplies is exacerbated by unsustainable groundwater pumping[78] coupled with the twin menaces of rising salinity and waterlogging—a function of canal irrigation on low-lying lands with inadequate drainage. This intertwined problem of canal irrigation, groundwater overdraft, and rising salinity and waterlogging has a long history in the basin. As part of the United States' engagement with Pakistan's water sector, President Kennedy appointed the White House-Department of Interior Panel on Waterlogging and Salinity (White House Panel) to study the problem.[79] While the White House Panel recommended expanding ver-

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75. BAKSHI & TRIVEDI, *supra* note 63, at 3.

76. *Id.* at 5.

77. BRISCOE & QAMAR, *supra* note 70, at 29.

78. Frank Van Steenbergen & Mohammed Shamshad Gohar, *Groundwater Development and Management in Pakistan, Background Paper #11*, *in* JOHN BRISCOE & USMAN QAMAR, WORLD BANK, BACKGROUND PAPERS, PAKISTAN'S WATER ECONOMY: RUNNING DRY 444, 446 (2005) [hereinafter BACKGROUND PAPERS], http://documents.worldbank.org/curated/en/278641468098987847/pdf/529140WP0Box341University0Press2006.pdf (offering overview of reliance on groundwater coupled with its lack of regulation and systematic development).

79. *See generally* WHITE HOUSE-DEPARTMENT OF INTERIOR PANEL ON WATERLOGGING AND SALINITY IN WEST PAKISTAN, REPORT ON LAND AND WATER DEVELOPMENT IN THE INDUS PLAIN (1964). The central tension that the White House Panel shed light on was that, while using tubewells to lower the water table was certainly a useful technical fix to Pakistan's problem, if the country continued relying on its extensive irrigation network, trying to get the groundwater balance right was ultimately an unreliable way in which to approach the task. At the time, it was clear that the country relied too heavily on groundwater for irrigation and, perhaps, that it was time to consider reducing the acreage under cultivation. Essentially, reducing the cultivated acreage (which would be politically difficult) would have eliminated the need for perpetual groundwater balancing, even if balancing groundwater were technically possible.

tical drainage and implementing a coordinated program to sink "tubewells" to lower the water table and leach salts below the root zone of plants, it recognized that the remedy of greater groundwater use to control waterlogging and salinity may not work in isolation.[80] Thus, as part of a broader assault on the problem, the panel also recommended potentially reducing the total irrigated area—a radical suggestion given the scale of the country's political economy built up around irrigated agriculture.[81]

Moving forward a half century, the Indus Basin is rife with unsustainable groundwater mining. The aquifer underlying the basin covers 16.2 million hectares.[82] Recent satellite data, however, ranked the Indus Basin as one of the most overstressed groundwater basins in the world.[83] This is disturbing news for Pakistan's farmers. In Punjab, sixty percent of the water for irrigation comes from groundwater.[84] And yet, "although there is clear evidence that groundwater is being over-exploited, tens of thousands of additional wells are being put into service every year."[85] This trend is especially troublesome because irrigated agriculture is critical to the nation's economy, accounting for a quarter of Pakistan's gross domestic product and employing about half the labor force.[86] When it comes to the use of groundwater for irrigation, the number of tubewells in the subcontinent has grown exponentially.[87] It is estimated that there are approximately one million tubewells in Pakistan that pump between one-third to nearly one-half of irrigation water used annually—approximately fifty maf, a massive quantity.[88] The negative externalities of the sheer extent of unregulated groundwater pumping merit treatment beyond the scope of this Article. It is worth emphasizing, however, that the Pakistani gov-

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80. *Id.* at 64.

81. *Id.*

82. BAKSHI & TRIVEDI, *supra* note 63, at 3.

83. ALEXANDRA S. RICHEY, ET AL., QUANTIFYING RENEWABLE GROUNDWATER STRESS WITH GRACE, 51 WATER RES. RES. 5217, 5225–26 (NASA Pubs. ed. 2015) (Jul. 14, 2015), https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1159&context=nasapub.

84. BRISCOE & QAMAR, *supra* note 70, at 16; Madison Condon et al., *Challenge and Response in the Indus Basin*, 16 WATER POL'Y 58, 63 (2014).

85. BRISCOE & QAMAR, *supra* note 70, at xvi.

86. *Id.* at xxv.

87. This pattern is to be expected in the absence of any regulatory authority to oversee private parties' tubewell development and the growing need for irrigation water.

88. Condon et al., *supra* note 84, at 63; *see also* Steenbergen & Gohar, *supra* note 78, at 444, 446 (offering overview of reliance on groundwater coupled with its lack of regulation and systematic development); Shahid Ahmad, *Water Balance and Evapotranspiration*, *Background Paper #5*, *in* BACKGROUND PAPERS, *supra* note 78, at 156, 160 (arguing for water balance approach in country's agro-ecological zones); Shahid Ahmad, *Land and Water Resources of Pakistan—A Critical Assessment*, 46 PAKISTAN DEVEL. REV. 911, 927 (2007) (providing comprehensive overview of uses and projected demands of land and water resources) [hereinafter *Critical Assessment*].

ernment is aware of this unsustainable reliance on groundwater and its associated problems and has noted, with concern, that since the advent of canal irrigation, the water table in half of the country's irrigated area has risen to within thirteen feet (four meters) of the surface.[89] Before the advent of canal irrigation, recharge of the aquifer was relatively balanced with withdrawals, and the water table hovered at an approximate depth of 100 feet from the surface.[90] Significant threats to the long-term sustainability of irrigated agriculture in the basin stem from the rising water table and attendant problems of waterlogging (about twenty-eight percent of the total irrigated area is affected)[91] and salinity (twenty-five percent of irrigated land), which limit overall agricultural productivity.[92] Unfortunately, there is no real solution in sight to help the country cope with and repair the unprecedented damage to its water and land resources because of the sheer scale of irrigated agriculture.[93]

Reservoirs in the Indus Basin are also plagued with siltation. While figures vary, both the Mangla and the Tarbela dams are estimated to have lost between twenty and thirty-two percent of their storage capacity to sediment deposition.[94] This pattern forced the Pakistani government to raise the water level in the Mangla Dam to increase its capacity, but any additional gain will also eventually be lost. According to a United Nations report, "[t]here is an urgent need for storage just to replace capacity that has been lost because of sedimentation."[95] Yet, replacing storage-diminished reservoirs with large new storage infrastructure is no small feat and may not be the best solution for the problem of siltation, which largely results from a combination of the intensity of rainfall and deforestation in the upper reaches of the dams' watersheds.[96] Tarbela Dam was built in 1976, and Pakistan has struggled in the decades since

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89. PLANNING COMMISSION, GOVERNMENT OF PAKISTAN, NINTH FIVE YEAR PLAN (1998-2003), REPORT OF THE WORKING GROUP ON WATER RESOURCES DEVELOPMENT 15 (1997) [hereinafter NINTH FIVE YEAR PLAN].

90. FAO, *supra* note 68, at 4.

91. Kaiser Bengali & Nafisa Shah, *Introduction*, *in* THE POLITICS OF MANAGING WATER xiii (Kaiser Bengali ed., 2003).

92. Waqar A. Jehangir & Nazim Ali, *Salinity and Sustainability of Agricultural Productivity in Irrigated Areas, in id.* at 17.

93. NINTH FIVE YEAR PLAN, *supra* note 89, at 19. *See generally* WHITE HOUSE-DEPARTMENT OF INTERIOR PANEL ON WATERLOGGING AND SALINITY IN WEST PAKISTAN, REPORT ON LAND AND WATER DEVELOPMENT IN THE INDUS PLAIN (1964).

94. BAKSHI & TRIVEDI, *supra* note 63, at 7; BRISCOE & QAMAR, *supra* note 70, at xiii–xiv; Mohsin Jamil Butt et al., *Sediment Deposition due to Soil Erosion in the Watershed Region of Mangla Dam*, 181 ENVTL. MONITORING & ASSESSMENT 419, 419 (2011) (estimating twenty-percent loss of capacity).

95. FAO, *supra* note 68, at 9.

96. Butt et al., *supra* note 94, at 425–26.

to initiate new surface reservoirs for the purposes of replacing, as well as adding to, storage capacity.[97] The country's farmers turned to groundwater to fill the water supply-demand gap, as discussed above.[98]

The Indus Basin also has significant water quality problems. Perhaps as much as forty-four percent of Pakistan's population does not have access to clean drinking water.[99] As described by a U.N. report,

> Indiscriminate and unplanned disposal of effluents (including agricultural drainage water, municipal and industrial wastewater) into rivers, canals and drains is causing deterioration of water quality in downstream parts . . . . The polluted water is also being used for drinking in downstream areas, causing numerous water-borne diseases.[100]

Increased use of pesticides and fertilizers in agriculture causes "large-scale uncontrolled pollution of surface water and groundwater."[101]

Salinity issues are also significant. Percolation from the irrigation system in Pakistan has resulted in increased salinity levels.[102] In many areas, soil is encrusted with salt. "[B]y the end of the 1950s[,] almost [thirty] percent of all Indus Basin farmland was negatively affected by salinity."[103] An estimated fifteen million tons of salt accumulates in the basin every year.[104] According to one study, 6.8 million hectares of irrigated land have been compromised by salinity.[105] The problem is worst in Sindh, where half the irrigated land is compromised due to salt buildup.[106] Although increased groundwater use alleviated salinity issues somewhat, this "solution," as noted earlier, led to overdependence on groundwater.[107] Further, while the greater use of groundwater has increased the total water supply, farmers still need to mix groundwater with canal supplies to neutralize the higher salinity content of pumped water through tubewells, particularly in the dryer winter (*rabi*) planting

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97. BRISCOE & QAMAR, *supra* note 70, at 66.
98. BRISCOE & QAMAR, *supra* note 70, at xvi.
99. BAKSHI & TRIVEDI, *supra* note 63, at 10.
100. FAO, *supra* note 68, at 5.
101. BRISCOE & QAMAR, *supra* note 70, at xvi.
102. FAO, *supra* note 68, at 5.
103. Condon et al., *supra* note 84, at 62–63.
104. BRISCOE & QAMAR, *supra* note 70, at xv, 47–49.
105. BAKSHI & TRIVEDI, *supra* note 63, at 10.
106. Kaiser Bengali, *Water Management Under Constraints: The Need for a Paradigm Shift*, *in* BRISCOE & QAMAR, *supra* note 70, at 55.
107. BRISCOE & QAMAR, *supra* note 70, at 15–16.

season when canal flows are approximately half those of summer (*kharif*) months.[108] In addition, studies in several areas suggest increases in groundwater salinity. This is partly the result of sinking wells at deeper depths and partly the consequence of nearly five decades of pumping. Over time, pumping has churned and mixed salts to variable degrees in different irrigation zones and caused saline groundwater intrusion in fresh groundwater zones.[109] Unfortunately, little is understood about the hydrological changes within the basin from the increasingly integrated use of groundwater and surface water for irrigation. At the end of the day, as John Briscoe highlighted, "salinity management is the biggest and most fundamental environmental challenge in the Indus Basin."[110]

Finally, there is the specter of climate change—a grave concern for many river systems throughout the world, including the Colorado River system, as discussed above.[111] The population of Pakistan will be "profoundly affected" by climate change.[112] Precisely what the impacts will be, however, is unclear. Warming could increase glacial melt and exacerbate flooding.[113] It could also reduce precipitation and eventually reduce water supply.[114] Although data on actual impacts are mixed and do not show consistent patterns across the region, most models suggest the following pattern in the Indus Basin: Increased glacial melting will result in flooding for a period of years. Flooding will be followed by "dramatic decreases in river flows . . . conceivably by a terrifying [thirty] percent to [forty] percent."[115] Clearly, "the Indus is vulnerable to climate change because snowmelt and glacier melt from the Western Himalayas comprise a significant portion of its water supply."[116] The threshold issue of overallocation that began this discussion of challenges must be considered in light of these projected impacts.

B. *Institutions*

The preceding challenges implicate a host of water institutions in the Indus Basin. While commonly focused on various aspects of administration, allocation, and infrastructural operation and man-

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108. *See Critical Assessment*, *supra* note 88, at 912-3, 920, 927.
109. Steenbergen & Gohar, *supra* note 78, at 446.
110. BRISCOE & QAMAR, *supra* note 70, at 52.
111. *See supra* notes 56–59.
112. SENATE REPORT, *supra* note 6, at 10.
113. *Id.* at 9–10.
114. *Id.*
115. BRISCOE & QAMAR, *supra* note 70, at 27.
116. Condon et al., *supra* note 84, at 74.

agement, these institutions are diverse in form. Although Pakistan and India have a common constitutional origin that laid the basis for water sharing within the two nations, they have evolved very different mechanisms to manage their respective water resources since Partition in 1947. The main difference between the countries' institutions is that India has a greater number and range of bargaining and dispute-resolution mechanisms (albeit time-consuming and imperfect) compared to the relative inflexibility of Pakistan's institutional mechanisms to apportion water and resolve disputes.[117] This broad distinction generally refers to the capacity of India's institutions to adjust claims of different parties across time versus the greater rigidity of Pakistan's institutions to make such adjustments. For the sake of brevity, this Article is limited to the IWT at the international level and to Pakistan's federal and interprovincial institutions.

1. "World's Most Successful Water Treaty"

Signed in 1960 after nearly a decade of negotiation, the IWT is "considered the world's most successful water treaty, having remained relatively intact for [fifty] years and having withstood four Indo-Pakistani wars."[118] The key to the treaty is that it partitioned the Indus Basin into two halves, with the eastern rivers (the Sutlej, Beas, and Ravi) going to India, and the western rivers (the Indus, Chenab, and Jhelum) going to Pakistan.[119] India has specific flow obligations to Pakistan, as it is the upper riparian on the western rivers that flow through the disputed territory of Kashmir it controls.[120] Notably, there are some exceptions to the basin partition for upstream uses by India in Kashmiri territory it controls.[121] These specific uses, particularly hydropower generation, are the greatest source of tensions between the two nations. Nonetheless, the IWT's division of the Indus Basin along a political boundary resembles the Colorado River Compact's bifurcation of that basin's

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117. *See generally* Alan Richards & Nirvikar Singh, *Water and Federalism: India's Institutions Governing Inter-State River Waters* (1996) (discussing India's federal water institutions and its use of tribunals in interstate water disputes), https://people.ucsc.edu/~boxjenk/water dom.pdf; http://pakbrary.com/council-common-interest-pakistan/. For a fuller discussion see Erum Khalid Sattar, Water as Power: The Law and Politics of Federalism in the Indus Basin (May 25, 2017) (unpublished S.J.D. dissertation, Harvard University) (on file with author), 23–104.

118. SENATE REPORT, *supra* note 6, at 7.

119. IWT, *supra* note 3, at Arts. II(1) and III(1).

120. *Id.* at Art. III(2).

121. *Id.*

Upper Basin and Lower Basin.[122] Although such partitioning may be politically expedient (or necessary) in certain contexts, it can pose serious complications for integrated basin-wide water management. Indeed, in 1951, David Lilienthal, the famed chairman of the Tennessee Valley Authority, proposed integrated management of the Indus Basin in a memorable article published in *Collier's*.[123] The IWT negotiations ruled out that possibility—"the Indus Waters Treaty reversed [the] principles that David E. Lilienthal had set out in 1951"[124]—and, as Lilienthal had anticipated, many contemporary problems facing the treaty stem from partitioning the basin "for the purposes of large-scale irrigated agriculture"[125] and along political lines.

The IWT's partitioning of the Indus Basin had significant domestic implications for water management in Pakistan. With substantial external financial and technical assistance, Pakistan built the Mangla and the Tarbela dams on the Jhelum and Indus rivers, respectively, to "mitigate the effect of diverting the three eastern rivers by India and to increase agricultural production in the [Indus Basin Irrigation System]."[126] This added storage, coupled with several new connecting canals (link canals), made the treaty palatable to Pakistan. At the same time, however, the country's acceptance of the IWT exacerbated an interprovincial rivalry over the basin's water. Downstream Sindh suffered because the link canals took water from the Indus mainstem to areas of upstream Punjab that were previously irrigated by the eastern rivers allocated to India by the treaty. Prior to Partition in 1947, a draft Sindh-Punjab Agreement between the chief engineers of the two provinces of British India alloted Sindh seventy-five percent of the flow of the Indus mainstem and Punjab ninety-four percent of the five Punjab rivers.[127] This agreement, although never "ratified for want of a settlement of the financial issue," represented the provinces' bilateral understanding regarding the rightful apportionment of the rivers.[128]

As mentioned earlier, the World Bank played a pivotal facilitative role in IWT negotiations and secured the necessary financial

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122. *See supra* notes 24–25.
123. David Lilienthal, *Another Korea in the Making?*, COLLIER'S (Aug. 4, 1951).
124. HAINES, *supra* note 72, at 151.
125. *Id.*
126. FAO, *supra* note 68, at 6.
127. Hasan Mansoor, *Water Wars: Sindh's Struggle for Control of the Indus*, 15 HIMAL 31, 32 (2002).
128. *See* Indus River System Authority, Government of Pakistan, *Apportionment of Indus Waters (Promise and Prospects), in* Apportionment of Waters of Indus River System Between the Provinces of Pakistan, Agreement (A Chronological Expose) 17, 19 (1991).

assistance from friendly governments for the IWT's implementation. In these endeavors, the Bank enjoyed the full support of the United States.[129] Notably, the IWT is an embodiment of Pakistan's loss of its legal claim to waters from the eastern rivers that previously flowed to lands it was allotted at Partition.[130] During the course of the IWT negotiations, it became clear to Pakistani negotiators that they would not be able to sustain their claims to these waters because India, as the upstream riparian, asserted its right to ownership of the waters as a corollary of its control of territory.[131] At that juncture, the negotiators switched their position to demand financial compensation for replacement and development works that the country would have to construct to bring water from the Indus mainstem to Punjab's irrigated areas.[132] Subsequently, Pakistan's negotiators shifted their strategy from claims of legal rights to water to the scope of a foreign aid package not limited to replacement works. The change in negotiation tactics was justified domestically as delivering a significant element of "development" of new water infrastructure financed under the IWT. In short, the availability of foreign aid made the deal palatable to Pakistan. Thus, as Aloys Michel noted in his masterful *The Indus Rivers*, the final treaty was appropriately "published as an Annexure to the Development Fund Agreement rather than vice versa," reflecting the notion that "the Bank and the 'friendly Governments,' chiefly the United States, had actually purchased an agreement."[133]

Delving a bit further into the IWT's allocation of Indus River system water: Although Pakistan received seventy-five percent of the flows, India is free to develop hydropower on the upper reaches of the western rivers that travel through the disputed territory of Kashmir—subject to the obligation that such infrastructure does not adversely affect the timing or quantity of flows for downstream uses in Pakistan, including the flow obligations noted above.[134] Although this critical sense of "security" for downstream Pakistan was crucial to the IWT's "bifurcation" of the eastern and western rivers, this aspect of the IWT has been a vitriolic point of contention.[135] As far as Pakistan's negotiators were concerned, hardwiring the permissible form of infrastructure design into the IWT was meant to be the country's chief protection against India's potential misuse

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129. GILMARTIN, *supra* note 72, at 214; *see also* HUSSAIN *supra* note 72; Lilienthal, *supra* note 123; MICHEL, *supra* note 72, at 219.
130. MICHEL, *supra* note 72, at 219.
131. *Id.* at 236; HAINES, *supra* note 72, at 43.
132. *Id.* at 240.
133. *Id.* at 254.
134. IWT, *supra* note 3, at Art. III(2)(d), Annexure D, Annexure E.
135. HAINES, *supra* note 72, at 151.

of upstream waters in India-controlled Kashmiri territory of the three western rivers the treaty allocated to Pakistan. Pakistan reluctantly accepted a limited notion of water security based on the treaty's limitations on India's ability to hold back waters of the western rivers because the IWT addressed some of Pakistan's very real apprehensions. Still, the treaty left Pakistan's fundamental concerns about territorial vulnerability untouched, as India controls the watersheds of the western rivers via its control of Kashmiri territory.[136] In the intervening years since the treaty was enacted, a host of factors—imprecise and changing notions of safety, advancements in engineering design, climate change, and India's growing demand for electricity—have diminished Pakistan's already-limited sense of security. What was missing at the time of the IWT's formation was flexibility on the part of both countries to adjust to changing conditions and interests surrounding the critical shared resource of water. Fundamentally, deep mistrust has always shaped the conflict.

When the IWT divided the Indus River system, Pakistan and India acquired a semblance of water peace and certainty to develop more assured supplies. The IWT's attendant monitoring structure, the Permanent Indus Commission, is composed of a commissioner from each country who interacts with the water bureaucracy within the respective governments.[137] Planners should look to strengthen the commission's technical capacity within the countries in ways that will lead to better compliance with the treaty's existing requirements, including data exchange, a general inspection tour by the commissioners every five years, and at least one annual meeting. More generally, however, the commission's enhanced status and capacity will enable it to assume a proactive role in devising basin-wide solutions. These suggestions are further addressed in Part III. For present purposes, the commission is flagged as an institutional actor that may benefit from comparative insights.

A host of tensions surround the IWT in contemporary times. Demands on the Indus River system keep growing, in part due to growing populations in both countries and their burgeoning expectations for electricity and economic development. A related complication elaborated below concerns India's increasing development of projects on the three western rivers that flow through the territory of Kashmir it controls. This brings into stark relief the aspirational claims of a long-deprived third party: the Kashmiri people, who feel left out of the protracted dialogue between the

136. *See id.* at 76.
137. IWT, *supra* note 3, at Art. VIII.

two countries and the course of the future development of the Indus.[138] This upstream advantage, even in relation to run-of-the-river projects without the consumptive use that is barred by the IWT,[139] gives India the potential capacity to control both the quantity and, crucially, the timing of flows into downstream Pakistan. It is a dynamic that poses formidable challenges for the mechanisms of the IWT aimed at addressing the precise misgivings Pakistan expressed at the negotiations.[140] The IWT was negotiated between India and Pakistan in a manner that evaded mention of Kashmir's disputed status, while at the same time allowed for agricultural uses and hydroelectric development within prescribed limits by India in Kashmiri territory it controls.[141]

Perhaps unsurprisingly given these tensions, both India and Pakistan have criticized the IWT in recent years, including issuing calls for possibly abrogating the treaty and warnings that its potential abrogation will have dire consequences.[142]

In 2005, the Indus Water Commissioners were, for the first time in the IWT's history, unable to reach an agreement on an important issue: the design of the Baglihar Dam, a hydropower project in India on the Chenab River.[143] A "neutral expert" provided for by the treaty mediated the disagreement, but conflicts continue.[144] In 2010, Pakistan filed a case with the International Court of Arbitration over a new hydropower dam, the Kishanganga project, being built by India along a tributary of the Jhelum River.[145] A Pakistani official warned that the conflict could lead to military confrontation.[146] The conflict continues to expand, most recently to encompass the Kishanganga and Ratle projects, the latter under construction by India on the Chenab River.[147] In September 2016,

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138. *See* Zubair Ahmad Dar, *Power Projects in Jammu & Kashmir: Controversy, Law and Justice,* LIDS Working Papers 2011-2012, HARV. L. & INT'L DEV. SOC'Y, 4 (2011), https://orgs.law.harvard.edu/lids/files/2011/11/LIDS-WP-1112-Dar.pdf.

139. IWT, *supra* note 3, at Arts. III(2)(b).

140. HAINES, *supra* note 72, at 76.

141. IWT, *supra* note 3, at Annexure C, Annexure D.

142. From the Pakistani perspective, Ijaz Hussain notes the occasional calls within Pakistan that India is stealing its water. HUSSAIN, *supra* note 72, at 355. In turn, there is more pressure from the Indian perspective: "The water issue has triggered a long-simmering backlash in the Indian part, where many at the grassroots feel alienated from mainstream India, and prompted its elected legislature to call for revision or abrogation of the treaty." BRAHMA CHELLANEY, WATER, PEACE, AND WAR: CONFRONTING THE GLOBAL WATER CRISIS 193 (2013).

143. Condon et al., *supra* note 84, at 69–70.

144. *Id.*

145. Lidia Polgreen & Sabrina Tavernise, *Water Dispute Increases India-Pakistan Tension*, N.Y. TIMES, July 20, 2010, http://www.nytimes.com/2010/07/21/world/asia/21kashmir.html.

146. CHELLANEY, *supra* note 142, at 54.

147. *Indus Water Dispute going to Arbitration Again*, THIRD POLE, July 18, 2016, https://www.thethirdpole.net/2016/07/18/indus-water-dispute-going-to-arbitrators-again/. The World Bank has hosted talks between the two countries about the projects. *Statement on*

amid talk in India that the treaty no longer served the country's interests, Pakistani officials said that treaty abrogation would be considered "an act of war."[148]

It bears reiterating that which is at stake with the IWT to emphasize the gravity of this discourse. As described above, one reason for the treaty's significance is that the Indus River is the lifeline of Pakistan's agricultural economy. Irrigated agriculture accounts for ninety-seven percent of the country's freshwater use,[149] and the Indus Basin Irrigation System is the largest contiguous irrigation system in the world, supplying ninety-five percent of Pakistan's irrigated cropland.[150] In turn, as just illustrated, an additional reason for the IWT's import is that the Indus River is viewed as a significant part of the solution to both countries' energy shortfalls. The potential for hydropower development is a key component in the river's management, and Pakistan's downstream position leaves it most vulnerable in this regard. Even with the treaty's safeguards, as a consequence of India's rising energy requirements and the push by the current government to fast-track hydropower development upstream in disputed Kashmiri territory,[151] Pakistan will continue to face threats to its water supplies, on which vast developed interests depend. Our examination of the Colorado River Basin as an institutional reference point stems from these concerns. Before picking up this lens, however, the discussion must turn to Pakistan's federal and interprovincial institutions.

2. Pakistani Federal and Interprovincial Institutions

Mirroring the situation surrounding the IWT at the international level, the institutional structure of water management in Pakistan is a source of ongoing contestation that produces significant

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the Indus Waters Treaty Meetings, WORLD BANK, Press Release, Aug. 1, 2017, http://www.worldbank.org/en/news/press-release/2017/08/01/world-bank-statement-on-the-indus-waters-treaty-meetings; *Clarification: World Bank Statement on the Indus Waters Treaty Meetings*, WORLD BANK, Press Release, Aug. 2, 2017, http://www.worldbank.org/en/news/press-release/2017/08/02/clarification-world-bank-statement-on-the-indus-waters-treaty-meetings.

148. *Pakistan Warns of "Water War" with India if Decades-Old Indus Water Treaty Violated*, ECONOMIC TIMES, Sept. 27, 2016, http://economictimes.indiatimes.com/news/politics-and-nation/pakistan-warns-of-water-war-with-india-if-decades-old-indus-water-treatyviolated/articleshow/54548970.cms.

149. SENATE REPORT, *supra* note 6, at 6.

150. FAO, *supra* note 68, at 6–7.

151. Neha Dasgupta & Sanjeev Miglani, *Troubled Waters? India Fast-Tracks Hydro Projects in Disputed Kashmir*, REUTERS (Mar. 16, 2017, 4:52 AM), https://in.reuters.com/article/india-pakistan-water/troubled-waters-india-fast-tracks-hydro-projects-in-disputed-kashmir-idINKBN16N0XE.

mistrust among the federation's co-sharers.[152] To begin with, during the long course of the IWT negotiations, it became clear to all involved that the young country of Pakistan lacked an adequate federal institutional structure for the massive undertaking of building the large-scale infrastructure agreed to under the treaty.[153] Given these circumstances, the international development community pushed for the creation of a sufficiently large national organization that spanned provincial boundaries and would be able to attract foreign funding, domestic engineering talent, and international expertise. The Water and Power Development Authority was created to help the young country build what would be "the largest single irrigation project in history."[154] WAPDA's creation was a milestone in Pakistan's development history, one that further strengthened the heavy infrastructure paradigm and reinforced the country's economic dependence on an irrigation vision for the Indus Basin.[155]

WAPDA swiftly overtook all other institutional actors in the water sector. Starting with the Government of India Act 1919 and continuing under the Government of India Act 1935, the devolved power sharing model provided that irrigation and agriculture were provincial subjects under the constitution of British India.[156] But the creation of WAPDA and its responsibility for infrastructure development meant that the already inadequately funded provinces were left further behind. The financial capacity of the provincial departments, both pre- and post-Partition in 1947, was stagnant, and the departments were incapable of attracting the most qualified engineers or managers to run the mainstay of the country's rural areas—the irrigation system. The federal-provincial imbalance in the water sector continues to have wide ramifications.

In a climate of stagnation, WAPDA was nothing short of a behemoth. Not only was it a national organization with the ability to cut across provincial borders, but, crucially, it was an entity with the ability to fund its ambitious plans. James Wescoat describes WAPDA as "one of the largest river basin planning organizations in the world—a Tennessee Valley Authority (TVA) on a national

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152. For an excellent source illuminating these tensions from the perspectives of the various co-sharers, see ISLAMABAD POLICY RESEARCH INSTITUTE, PROBLEMS AND POLITICS OF WATER SHARING AND MANAGEMENT IN PAKISTAN (Pervaiz Iqbal Cheema et al. eds., 2007).

153. SAIYID ALI NAQVI, INDUS WATERS AND SOCIAL CHANGE—THE EVOLUTION AND TRANSITION OF AGRARIAN SOCIETY IN PAKISTAN 339 (2013).

154. MICHEL, *supra* note 72, at 270.

155. GILMARTIN, *supra* note 72, at 229.

156. *See* K.K. Lahiri, *Indian River and River Systems—The Genesis of Article 262 of the Constitution of Indian and the Inter-State River Water Dispute Act*, 1956 1 INDIAN L.J. (2008), http://www.indialawjournal.org/archives/volume1/issue_3/article_by_lahiri.html.

scale," particularly as "massive construction projects dominated water sector programs."[157] As early as 1961, it had contracted for "the services of [twenty-eight] foreign consulting firms."[158] In addition to its disproportionately greater powers and foreign financial backing, WAPDA's twin roles of water management and development for both irrigation and hydropower make it a formidable institution in Pakistan. This observation is especially true vis-à-vis the four Provincial Irrigation Departments and the Indus River System Authority (IRSA), a coordinating body with federal and provincial representation created to operate the interprovincial Water Accord.[159] By enhancing the provinces' roles in decision-making, IRSA aims to temper the federal government's overwhelming presence in water-sector decision-making and operations.

Pakistan's Water Accord is the chief instrument governing provincial water shares in the country's portion of the Indus Basin.[160] Given flow variability,[161] however, delivering fixed quantities of water remains a challenge. To cope with this dynamic, IRSA has devised several heavily contested allocation measures—as distinct from the accord's shares—that keep the accord operational on its face yet contradict its text, mechanism, and intent. These measures include: (1) a three-tier allocation formula that protects historical uses in different water-availability scenarios over the accord's pro rata water sharing formula,[162] and (2) an exemption from shortage sharing for smaller provinces.[163]

The Council of Common Interests, the relevant constitutional body, agreed to the accord in 1991.[164] Nevertheless, despite the "agreement," the meaning of the accord's text and its omissions has been a significant source of controversy. The ongoing disagreements about the parties' original intent continue to cause

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157. James Wescoat, *The Historical Geography of Indus Basin Management: A Long-Term Perspective*, 1500-2000, in AZRA MEADOWS & PETER MEADOWS, THE INDUS RIVER: BIODIVERSITY, RESOURCES, HUMANKIND 416, 424 (1999).

158. EDWIN BOCK & ALBERT GORVINE, A SCIENTIFIC PANEL IN FOREIGN AFFAIRS: THE REVELLE REPORT 5 (1962).

159. For a more detailed study of this competing institutional structure, see generally Sattar, *supra* note 117.

160. *See id.* at 28.

161. For example, summer monsoon and glacial melt combine to yield about eighty-five percent of annual basin-wide flows. Condon et al., *supra* note 84, at 74.

162. The three-tier allocation formula primarily privileges developed, upstream uses in Punjab. Muhammad Idris Rajput, *Water Problem: Perspective from Sindh*, *in* PROBLEMS AND POLITICS OF WATER SHARING AND MGMT. IN PAKISTAN, 117–27 (Pervaiz Iqbal Cheema et al. eds., 2007). For a detailed study of this competitive interpretation, see Sattar, *supra* note 117.

163. "Smaller" in terms of a province's relative share and use of Indus Basin waters. It includes the very large province of Balochistan, as well as the Khyber Pakhtunkhwa (KPK) province. For further discussion of these measures, see Sattar, *supra* note 117, at 64–68.

164. *Id.*

enormous friction, resulting in an ever-present atmosphere of controversy with merely episodic and unstable workarounds that keep the system running.[165] As one expert observed, "[u]nity and cohesion among federating units is important for national security. Any discord and disunity is harmful for Pakistan's survival. However, interprovincial water issues crop up frequently."[166]

To take just one instance of the accord's unstable operation, WAPDA is supposed to operate under IRSA's authority to implement the accord. For example, IRSA tells WAPDA to release water from reservoirs as part of IRSA's authority to apportion water among the provinces.[167] The accord prioritizes irrigation over all other uses, including hydropower production.[168] Although the latter is a non-consumptive use, it has potentially significant impacts on flow timing, which is a critical issue in irrigation that can affect the accord's operation during any ten-day period of *warabandi* (time allocation of water) for farmers.[169] Illustrating the tension between hydropower and irrigation vis-à-vis the accord, IRSA comes under immense political pressure from the federal Ministry of Water and Power (as it was then called)[170] to "authorize" WAPDA to release more water for hydropower production despite the accord's irrigation priority, particularly during power shortages/blackouts (loadshedding) that can last eighteen hours per day at summer's peak.[171] Overall, the institutional arrangement gives rise to serious tensions. Instead of promoting better outcomes, institutional operations place pressures on different actors in the system, with the greatest pressure falling on institutions designed to enhance the provinces' role in decision-making. This interagency tension hampers the robust operation of federalism that the institutions have been designed to promote.[172]

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165. For further discussion of the accord, see *id.* at 23–104.

166. Muhammad Idris Rajput, *Pakistan Institute of Legislative Development and Transparency, Inter-Provincial Water Issues in Pakistan* 9 (draft 2011), http://www.pildat.org/publications/publication/WaterR/Inter-ProvincialWaterIssuesinPakistan-BackgroundPaper.pdf.

167. *See* WAPDA, *supra* note 73. *But see* Accord, *supra* note 8.

168. Accord, *supra* note 8, at ¶14.c.

169. As discussed above, in the international context, India's construction of hydropower schemes, even without storage, leads to similar feelings of vulnerability in downstream Pakistan.

170. The twin functions of the Ministry of Water and Power were devolved to two separate newly-created ministries in August 2017, with the "water" component being assigned to the Ministry of Water Resources and the "power" component to the new Ministry of Energy. *Pakistan PM Creates New Ministries*, GULF TIMES (Aug. 6, 2017, 12:12 AM), http://www.gulf-times.com/story/559153/Pakistan-PM-creates-new-ministries.

171. *See e.g.*, More Dam Water Released to Cut Loadshedding, Dawn, Oct. 4, 2010, https://www.dawn.com/news/851820/more-dam-water-released-to-cut-loadshedding.

172. *See* Sattar, *supra* note 117, at 23–105.

In light of the preceding example and others, such as the enormous amount of friction and drag associated with operating infrastructure like water-transporting link canals,[173] there are calls to update the accord, including to allow trading across provincial boundaries, which the government has not heeded.[174] With increasing uncertainty about the amount and timing of flows given climate change's effects on headwater glaciers, it is clear that Pakistan must move towards a more flexible system across interprovincial boundaries. Further, the current approach of forging temporary resolutions to particular problems does not move the parties toward a long-term, stable working relationship. It also does not foster trust or create capacity to envision solutions aimed beyond immediate fights over provincial water shares.

Claims about the meaning of the accord's text have been rattled like sabers by the interested parties. This includes competing claims about what was meant by the text at the time of the accord's adoption, as well as competing claims about what was meant to be included within that text but was not for various reasons having to do with complex politics. Taken together, all of this continues to destabilize interpretations of the accord's express language. These controversies and mistrust run squarely contrary to official rhetoric regarding the accord at the time of its adoption, when effusive language was used to describe its significance:

> 21st March, 1991, will go down in the history of Pakistan as a pivotal breakthrough in its leap towards the 21st century and turning point in its march towards national consolidation. On that day, a dispute unraveled that had been festering in this part of the subcontinent for the past seventy years.[175]

More than a quarter of a century later, this aspiration remains just that—aspirational.

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173. Ramzan Chandio, *Sindh Objects to Water Release in CJ Canal*, NATION, Mar. 6, 2011, http://nation.com.pk/national/06-Mar-2011/Sindh-objects-to-water-release-in-CJ-Link-Canal.

174. Arif Anwar, *Pakistan's Provincial Water Disputes: A Way Forward*, THETHIRDPOLE.NET, July 28, 2016, https://www.thethirdpole.net/2016/07/28/pakistans-provincial-water-disputes-a-way-forward/.

175. *See* Accord, *supra* note 8, at pmbl.

III. REFLECTIONS FROM THE LAW OF THE COLORADO RIVER

The Colorado River Basin and Law of the River now reenter the scene. An enormous body of literature exists in this domain, and a dizzying number of ideas and proposals for solving water management problems in the basin have been generated over the nearly 100 years since the Colorado River Compact was signed.[176] Some of these proposals have become law, some are currently being implemented, and some have yet to be accepted as part of the accumulated institutional mass constituting the Law of the River. It is the complexity and diversity of this institutional mass—coupled with the adaptation-forcing circumstances in which it is currently situated—that underlie its referential value for transboundary water law and policy.

More precisely, the discussion below is framed around a handful of allocation- and conservation-related topics, complemented by explanations of a few governance counterparts. It is aimed at identifying key aspects of the Law of the River's evolution. The past two decades are the primary (though not exclusive) timeframe, as the historic drought's onset in 2000 has made it a "mother of invention" in numerous ways. Underpinning the entire discussion is an earnest hope that the selective, non-exhaustive reference points from the Colorado River Basin may bear fruit of some sort within the Indus Basin. Each section is composed accordingly, initially discussing laws and policies associated with the Law of the River, and then considering how the particular subject matter may spark contextually tailored innovations within the Indus Basin.

A. *Transboundary Water Allocation and Conservation*

1. Allocational Flexibility

Rivers are dynamic systems.[177] They change in fundamental ways, ranging from seasonal to millennial.[178] Thus, the optimal transboundary water allocation frameworks are those that have built-in flexibility enabling the particular distributional scheme to adjust equitably to changes in conditions, such as precipitation, temperature, evapotranspiration, and runoff, as well as associated values.[179]

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176. *See* MacDonnell, *supra* note 24.
177. STANLEY A. SCHUMM, RIVER VARIABILITY AND COMPLEXITY 4 (2005).
178. *Id.*
179. *See* Jason A. Robison & Douglas S. Kenney, *Equity and the Colorado River Compact*, 42 ENVTL. L. 1157, 1179 (2012) (discussing principle of flexibility as aspect of water apportionment schemes' substantive equity).

Climate change is a key concern for the Colorado and Indus basins implicating these considerations.[180] The Law of the River offers a curious reference point for allocational flexibility—a statement that holds true at the international and interstate levels.

Most notable in the international arena is Article 10(b) of the U.S.-Mexico Treaty.[181] It provides for augmentation of treaty deliveries to Mexico when surplus water exists and delivery reductions in the event of an "extraordinary drought or serious accident to the irrigation system in the United States."[182] Serious ambiguities and implementation issues plague the provision's text—for example, it does not provide a definition of "extraordinary drought."[183] Yet it nonetheless shows that the drafters gave some modicum of thought to the international apportionment's flexibility.

Further illustrations appear at the interstate level in the United States. Although it is inflexible in several ways,[184] the Colorado River Compact does espouse flexibility in Article III(d).[185] This provision prohibits the Upper Division states from causing the Colorado River's flow at Lee Ferry to be depleted below seventy-five maf during any consecutive ten-year period.[186] The decadal nature of this obligation provides the states with flexibility to respond to annual hydrological variability.[187]

The Upper Colorado River Basin Compact (Upper Basin Compact) offers a second example. Its apportionment scheme for the Upper Division states is percentage-based. The states' apportionments hinge on applying specific percentages to the collective amount of consumptive water use "apportioned in perpetuity to[,] and available for use each year by[,]" the Upper Basin under the Colorado River Compact.[188] As this proverbial collective pot of water contracts or expands, so do the states' apportionments.

A final illustration comes from the U.S. Supreme Court's decision in *Arizona v. California* and its Lower Colorado River apportionment. It involves a three-tier scheme.[189] The Lower Division states' collective and individual consumptive uses of Lower Colora-

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180. *See supra* Part I.A (Colorado) and Part II.A (Indus).
181. Treaty, *supra* note 36, at Art. 10(b).
182. *Id.*
183. Robison, *supra* note 19, at 503–505.
184. Robison & Kenney, *supra* note 179, at 1199–1201.
185. COMPACT, *supra* note 25, at Art. III(d).
186. *Id.*
187. Robison & Kenney, *supra* note 179, at 1201.
188. Upper Basin Compact, *supra* note 37, at Art. III(a)(2). The states' percentage-based apportionments are Colorado (51.75 percent); New Mexico (11.25 percent); Utah (23 percent); and Wyoming (14 percent). *Id.* Although not an Upper Division state, Arizona is apportioned 50,000 acre-feet of consumptive use annually. *Id.* at Art. III(a)(1).
189. *See* Decree, *supra* note 38, at Art. II(B)(1)–(3).

do River water depend upon the Secretary of the Interior's annual determination of whether normal, surplus, or shortage conditions exist.[190] This determination circumscribes the apportionments. Further, the *Arizona v. California* Decree authorizes the Secretary to reallocate water apportioned to, but unused in, one Lower Division state to other Lower Division states on a yearly basis.[191]

Looking beyond the Law of the River's allocation framework proper, several measures adopted in response to the historic drought provide additional examples of integrating flexibility into the framework's nested international and interstate apportionments. Two instruments are most salient as sources of these measures: Minute 323 to the U.S.-Mexico Treaty[192] and the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (Interim Guidelines).[193] The shortage sharing section below takes up these instruments and their respective measures.

Reflecting on the foregoing aspects of the Law of the River vis-à-vis the Indus Basin, the IWT might benefit from a variable-deliveries scheme addendum—that is, a treaty addendum creating a scheme to introduce variation in expected flows when certain conditions arise. India has specific flow obligations to Pakistan under the treaty.[194] The countries could create a scheme that accommodates flow variability. This would be particularly useful as a way for Pakistan to be financially compensated in the event that India materially alters flow timing due to hydropower generation—the source of current tensions.[195] Subsidies or payments could abet this scheme to ensure all parties get something out of the deal. It is worth remembering here the funding conditions described earlier surrounding the IWT's formation: Led by the United States, India and a host of foreign governments compensated Pakistan for the Indus Basin Replacement Works program that was constructed to tap alternate sources for the waters of the eastern rivers granted to

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190. *Id.*

191. *Id.* at Art. II(B)(6).

192. *See* INT'L BOUNDARY & WATER COMM'N, MINUTE NO. 323: EXTENSION OF COOPERATIVE MEASURES AND ADOPTION OF A BINATIONAL WATER SCARCITY CONTINGENCY PLAN IN THE COLORADO RIVER BASIN, U.S.-MEX., (Sept. 21, 2017) https://www.ibwc.gov/Files/Minutes/Min323.pdf [hereinafter MINUTE 323].

193. *See* U.S. DEP'T OF THE INTERIOR, COLORADO RIVER INTERIM GUIDELINES FOR LOWER BASIN SHORTAGES AND COORDINATED OPERATIONS FOR LAKE POWELL AND LAKE MEAD (Dec. 2007), http://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf [hereinafter Interim Guidelines ROD].

194. IWT, *supra* note 3, at Art. III(2)(a)–(d). These provisions require India to let the waters of the western rivers flow to Pakistan without interference.

195. *See India to Fill Up Kishanganga Reservoir This Year,* NEW INDIAN EXPRESS (June 21, 2017), http://www.newindianexpress.com/nation/2017/jun/21/india-to-fill-up-kishanganga-reservoir-this-year-1619039.html.

India.[196] Overseeing this program was a neutral organization established to monitor fund releases per agreed upon schedules. In short, notwithstanding the difficulty and complexity of current relations, these earlier developments may be luminaries for a potential variable-deliveries scheme addendum to the IWT.

In envisioning the composition and implementation of such a scheme for the treaty, it may be prudent to initially focus on the interprovincial Water Accord and its contemplated flexible operation in response to changing hydrological conditions.[197] If Pakistan can begin operating a flexible scheme among its provinces—one involving proportionate sharing of surpluses and shortages instead of the current three-tier system that protects and privileges historical upstream uses[198]—the country may gain valuable experience for developing a transparent and trustworthy analogue under the IWT. As described earlier, in recognizing that the accord's fixed water deliveries cannot be met because of inherent flow variability, IRSA's so-called "three-tier" scenario allows it to adjust provincial deliveries.[199] Unlike the Colorado River Basin, where formal measures have been forged for variability-based adjustments at the international and interstate levels, IRSA's functional interpretation of the IWT has a long history of contestation and operation that breeds mistrust.[200] Instead of devising a practical working formula and adhering to it transparently, IRSA's operations sow discontent with charges that the lower riparian has been deprived of its due share under the accord, especially at key planting times.[201] Planners should formulate a better approach and devise working norms that bring all parties together. Greater collaboration within Pakistan's federal system may create learning opportunities for the best way to undertake similar processes across the international border—as happened in the Colorado River Basin.[202] The uncertainty posed by projected climate-change impacts and increased water demands in the Indus Basin dictates that planners need to consider new ways of developing adaptive systems proactively now rather than being forced to do so reactively later.

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196. IWT, *supra* note 3, at Art. V.
197. *See, e.g.*, Accord, *supra* note 8, ¶ 14.b.
198. Rajput, *supra* note 162, at 117–27; Sattar, *supra* note 117, at 64–68.
199. Rajput, *supra* note 162, at 117–27.
200. *Id.* at 120–23.
201. Mohammad Hussain Khan, *Why There Is a Shortage of Irrigation Water in Sindh*, HERALD (July 24, 2017, 10:48 AM), http://herald.dawn.com/news/1153816/why-there-is-a-shortage-of-irrigation-water-in-sindh.
202. This pattern is evident in the evolution of shortage sharing schemes developed under the Interim Guidelines (domestic) and Minute 323 (international) in 2007 and 2017, respectively.

In sum, the Law of the River's institutional precedents involving allocational flexibility are directly relevant to potential flexibility-oriented water sharing schemes in the Indus Basin, both under the IWT as well as the accord. Transparency in collaborative modification of existing agreements is absolutely necessary in order to reach agreement among affected parties.

2. Shortage Sharing

We now turn to the intertwined topic of shortage sharing and begin with a sobering truth: The Colorado River Compact was based on faulty hydrological data.[203] Negotiators relied on erroneously high flow estimates when they crafted the Compact's apportionment scheme.[204] This historical reality is problematic given the quantity-based—rather than percentage-based—nature of the scheme's apportionments and flow obligations.[205] Suffice it to say that the historic drought's onset in 2000 has posed serious challenges for the scheme's implementation and that climate change projections suggest these challenges are a harbinger of what lies ahead.[206] It is one of several situations surrounding different components of the Law of the River that speaks to the conjoined topics of overallocation, water supply-demand imbalance, and ultimately shortage sharing. To say these topics are relevant in the Indus Basin would be soft-pedaling.

As mentioned above, Minute 323 of the U.S.-Mexico Treaty is a key instrument in this realm. The treaty apportions 1.5 maf of Colorado River water to Mexico annually.[207] Although treaty deliveries may be reduced if an "extraordinary drought or serious accident to the irrigation system in the United States" occurs,[208] this clause is rife with ambiguities and implementation issues, as noted earlier.[209]

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203. COLORADO RIVER GOVERNANCE INITIATIVE, RETHINKING THE FUTURE OF THE COLORADO RIVER: DRAFT INTERIM REPORT OF THE COLORADO RIVER GOVERNANCE INITIATIVE 70 (2010), http://www.waterpolicy.info/wp-content/uploads/2015/09/CRGI-Interim-Report.pdf.

204. *Id.*

205. The Compact apportions to the Upper Basin and Lower Basin, respectively, the beneficial consumptive use of 7.5 maf and 8.5 maf of Colorado River system water annually. COMPACT, *supra* note 25, at Art. III(a)–(b). The Compact also prohibits the Upper Division states from depleting flows at Lee Ferry below 75.0 maf during any consecutive ten-year period. *Id.* at Art. III(d). In addition, the Compact contemplates the Upper Basin and Lower Basin fulfilling a 1.5 maf annual flow obligation to Mexico. *Id.* at Art. III(c); Treaty, *supra* note 36, at Art. 10(a).

206. *See supra* notes 56–59 and accompanying text. *See generally* JAMES LAWRENCE POWELL, DEAD POOL: LAKE POWELL, GLOBAL WARMING, AND THE FUTURE OF WATER IN THE WEST (2008).

207. Treaty, *supra* note 36, at Art. 10(a).

208. *Id.* at Art. 10(b).

209. Robison, *supra* note 19, at 503–05.

Forged in 2017, against the backdrop of a formative predecessor, Minute 319,[210] Minute 323 fills this vacuum. While leaving the treaty's "escape clause" intact,[211] Minute 323 establishes a shortage sharing regime for the international apportionment that will remain effective until December 31, 2026.[212] In short, this regime calls for annual treaty delivery reductions of 50,000, 70,000, or 125,000 acre-feet depending upon Lake Mead's projected elevation.[213] Complementing Minute 323's shortage sharing regime is a "Binational Water Scarcity Contingency Plan" requiring each country "to save specified volumes of water at certain low reservoir elevations for recovery at a later date when reservoir conditions improve."[214] At the time of this writing, this plan has not yet taken effect, as its implementation hinges on formation of a pending domestic Lower Basin Drought Contingency Plan in the United States.[215]

Parallel measures have emerged domestically in the United States under the Interim Guidelines.[216] Adopted in 2007, several years after the beginning of historic drought, the guidelines established a coordinated operating regime for Lake Powell and Lake Mead that serves to implement the Colorado River Compact's apportionment scheme. More precisely, the regime implements flow obligations to Mexico and the Lower Division states imposed by the Compact's scheme.[217] A nuanced relationship exists between these flow obligations and the regime.[218] Broadly speaking, however, the

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210. INT'L BOUNDARY & WATER COMM'N, MINUTE 319: INTERIM INTERNATIONAL COOPERATIVE MEASURES IN THE COLORADO RIVER BASIN THROUGH 2017 AND EXTENSION OF MINUTE 318 COOPERATIVE MEASURES TO ADDRESS THE CONTINUED EFFECTS OF THE APRIL 2010 EARTHQUAKE IN THE MEXICALI VALLEY, BAJA CALIFORNIA (2012), https://www.ibwc.gov/Files/Minutes/Minute_319.pdf [hereinafter MINUTE 319].

211. *See* MINUTE 323, *supra* note 192, at 22 (disclaiming any effect on Article 10(b)'s interpretation or application).

212. *Id.*

213. *Id.* at 4. *See also* MINUTE 319, *supra* note 210, at 6 (establishing a shortage sharing regime in 2012 involving the same treaty-delivery reductions and elevation tiers).

214. MINUTE 323, *supra* note 192, at 6–8. The countries' respective savings requirements are set forth in a graduated, standardized manner tethered to Lake Mead's projected elevation. *Id.* at 7.

215. *Id.* at 8.

216. Interim Guidelines ROD, *supra* note 193. For useful scholarship on the guidelines' formation, see generally Douglas Grant, *Collaborative Solutions to Colorado River Water Shortages: The Basin States' Proposal and Beyond*, 8 NEV. L.J. 964 (2008); Patricia Mulroy, *Collaboration and the Colorado River Compact*, 8 NEV. L.J. 890 (2008); W. Patrick Schiffer et al., *From a Colorado River Compact Challenge to the Next Era of Cooperation Among the Seven Basin States*, 49 ARIZ. L. REV. 217 (2007).

217. *See* COMPACT, *supra* note 25, at Art. III(c)–(d) (imposing flow obligations).

218. *See* Robison, *supra* note 19, at 517–20 (examining relationship between Articles III(c) and (d) of Compact, § 602(a) of Colorado River Basin Project Act, Long-Range Operating Criteria, and Interim Guidelines' coordinated operating regime).

volume of annual releases from Lake Powell hinges on the relative elevations of (and thus storage in) that reservoir and Lake Mead.[219]

Downstream of Lee Ferry, the Interim Guidelines also established an operating regime for Lake Mead that implements the *Arizona v. California* Decree's Lower Colorado River apportionment.[220] This regime was the predecessor to Minute 323's shortage sharing regime,[221] and thus their similar composition makes sense. In its current iteration, the guidelines' domestic regime insulates California from sharing shortages,[222] but calls for Arizona and Nevada to reduce their consumptive use of Lower Colorado River water by prescribed amounts related to Lake Mead's projected elevation.[223] The elevation "triggers" for these reductions mirror Minute 323's.[224]

The Law of the River's shortage sharing regimes bring benefits. They promote conservation through rationing, create predictability through tiered delivery-reduction schedules, and, to some degree, generate comity and equity in international and interstate relations over the Colorado River system. Similar approaches might resonate within the Indus Basin.

Initially, the development of a joint scarcity-management plan would not require renegotiating the IWT. Rather, India and Pakistan would agree to an addendum authorizing specific responses in each country when low flows make it impossible to meet established needs. Such a plan would foreseeably dovetail with the variable-deliveries scheme mentioned in the allocational-flexibility section. Key tenets of the scarcity-management plan would include equitable sharing of shortage-based hardships, predictable guidelines for shortage adaptations (that is, delivery reductions), and clearly delineated processes for implementing adaptive measures. From a temporal perspective, creating such a plan before actual shortages occur would obviously be preferable to ad hoc, spontaneous, and uncoordinated responses. That alternative is a potential recipe for disaster.

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219. Interim Guidelines ROD, *supra* note 193, at 49–53.

220. *Id.* at 34–37, 59.

221. *See* MINUTE 323, *supra* note 192, at 3–6. This regime was also the predecessor to Minute 319's shortage sharing regime adopted in 2012. MINUTE 319, *supra* note 210, at 6–7.

222. The Lower Basin drought contingency plan currently under discussion contemplates California sharing in Lower Colorado River shortages. Robison, *supra* note 19, at 543.

223. Interim Guidelines ROD, *supra* note 193, at 36–37. The guidelines' regime calls for reductions of 320,000, 400,000, or 480,000 acre-feet for Arizona, and 13,000, 17,000, or 20,000 acre-feet for Nevada. *Id.* These reduction amounts are based upon the states' respective apportionments under the *Arizona v. California* Decree during normal conditions. Decree, *supra* note 38, at Art. II(B)(1).

224. *Id.*; MINUTE 323, *supra* note 192, at 4.

As for interprovincial shortage sharing within Pakistan, the Water Accord provides a solid basis for working toward greater clarity at the interprovincial level and facilitating a potential analogue for the IWT. As mentioned above, the accord calls for pro rata shortage sharing at the national level based upon adjustments to individual canal and barrage systems.[225] Currently, however, instead of providing a collaborative and transparent basis for pro rata adjustments, the relevant provision is victim to opaque interpretations and implementation by IRSA. These discrepancies aim to protect and privilege historical upstream uses over equitable arrangements in which all parties receive water proportionate to their shares according to overall water availability.[226] Pakistan has a valuable opportunity to move beyond these tensions, to operationalize the accord, as per the intent of its framers, and to adjust to variable flow conditions. Yet, doing so will require bold leadership and a willingness to confront existing privileged interests. If institutions such as IRSA can become adaptive learners in coping with variability and uncertainty associated with climate change and other dynamic factors—and do so collaboratively with all actors—it will help both IRSA and other parties become key sources of knowledge generation and dissemination. By developing such working norms within its boundaries, Pakistan would also develop a wealth of operational knowledge that would help in any future IWT negotiations with India to create a joint scarcity-management plan.

3. Demand Management vs. Structural "Solutions"

Many experts view demand management as the best future source of additional water supplies.[227] A host of options exist for water conservation in the agricultural, municipal, and industrial sectors.[228] Demand management becomes even more compelling

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225. Accord, *supra* note 8, at para. 14(b). In contrast, surplus sharing is done according to specified percentage allocations for the provinces. *Id.* at para. 4.

226. Sattar, *supra* note 117, at 68–69.

227. *See, e.g.*, James Wescoat, *Water Shortages and Water-Conserving Urban Design in Pakistan*, *in* RUNNING ON EMPTY: PAKISTAN'S WATER CRISIS 129, 139–42 (Michael Kugelman & Robert M. Hathaway eds., 2009) (addressing how water shortages currently harm, and will continue to harm, rapidly increasing urban populations). *See generally* JULIET CHRISTIAN-SMITH & PETER GLEICK, TWENTY-FIRST CENTURY U.S. WATER POLICY (2012); ROBERT GLENNON, UNQUENCHABLE: AMERICA'S WATER CRISIS AND WHAT TO DO ABOUT IT (2009); Robert Evans & John Sadler, *Methods and Technologies to Improve Efficiency in Water Use*, 44 WATER RESOURCES RESEARCH 1 (2008); SANDRA POSTEL, LAST OASIS: FACING WATER SCARCITY (1997).

228. *See, e.g.*, U.S. BUREAU OF RECLAMATION, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, TECHNICAL REPORT F – DEVELOPMENT OF OPTIONS AND STRATEGIES F-38 to -

when considering the externalities of structural solutions. All dams have an engineered lifespan and must be replaced—an expensive endeavor. Canal systems typically have significant operation and maintenance costs. All reservoir sites fill with sediment, rendering them useless and creating the enormous problem of what to do with a sediment-filled reservoir on a river. And there are other, less obvious but perhaps more inimical problems: "Most transboundary water conflicts arise not over natural supplies but over human interventions to manage them. Dams, irrigation diversions, and other infrastructure alter both hydrological relations, affecting the quantity, quality, and timing of downriver flows, but also relations between upstream and downstream riparians."[229] The Indus Basin epitomizes this quote.

Structural solutions were the dominant water management paradigm in the Colorado River Basin for much of the twentieth century. Congress enacted a slew of federal water infrastructure legislation during the middle of the century, resulting in basin-wide storage capacity of more than sixty maf.[230] As identified earlier, these laws included the Boulder Canyon Project Act (1928),[231] Colorado River Storage Project Act (1956),[232] and Colorado River Basin Project Act (1968).[233] The first statute brought into existence Hoover Dam and Lake Mead,[234] while the second statute did the same for Glen Canyon Dam, Lake Powell, and a trio of accompanying large-scale dams and reservoir projects in the Upper Basin (Flaming Gorge, Navajo, and Aspinall).[235] As for the third statute, its polestar was not a landmark dam and reservoir, but rather an extensive, expensive canal system called the Central Arizona Project (CAP).[236] Authorized in 1968, and reaching "substantial completion" in 1993,[237] the CAP is the last major federal water project

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53 (2012) (evaluating agricultural and municipal and industrial water conservation options in Colorado River Basin), http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20F%20-%20Development%20of%20Options%20and%20Stategies/TR-F_Development_of_Ops&Strats_FINAL.pdf [hereinafter TECHNICAL REPORT F].

229. STIMSON CTR., FRESH WATER FUTURES: IMAGINING RESPONSES TO DEMAND GROWTH, CLIMATE CHANGE, AND THE POLITICS OF WATER RESOURCE MANAGEMENT BY 2040 4 (2010), https://www.stimson.org/sites/default/files/file-attachments/StimsonCenterConfWaterReport_1.pdf.

230. Robison et al., *supra* note 26, at 32–33.

231. BCPA, *supra* note 39.

232. CRSPA, *supra* note 40.

233. CRBPA, *supra* note 41.

234. BCPA, *supra* note 39, at § 1 ("Boulder Dam" was the original name of Hoover Dam).

235. CRSPA, *supra* note 40, at § 1 ("Curecanti" was the original name of the Aspinall unit).

236. CRBPA, *supra* note 41, at § 1521.

237. JENNIFER ZUNIGA, U.S. BUREAU OF RECLAMATION, THE CENTRAL ARIZONA PROJECT 34–35 (2000).

to have been built within the basin. "No substantial reclamation projects have been authorized" over roughly the past half century.[238]

In lieu of structural solutions and their attendant drawbacks, demand management has emerged as a top policy priority within the Colorado River Basin during recent decades, undoubtedly spurred by the historic drought. Released in 2012, the U.S. Bureau of Reclamation's extensive Colorado River Basin Water Supply and Demand Study (Basin Study) and its *Moving Forward* effort offer a testament to this idea.[239] The Basin Study identified the potential for substantial water conservation in the agricultural, municipal, and industrial sectors.[240] The *Moving Forward* effort, in turn, has largely focused on these priorities.[241] According to its Phase I Report, agricultural productivity in areas receiving Colorado River water has increased about twenty-five percent since 1980, while water use and acreage have remained relatively constant. In part, this pattern is due to improved water management.[242] Likewise, a host of future conservation measures were outlined in the Phase I Report, as well as an estimate from the Basin Study regarding additional water conservation and fallowing that could potentially yield 1.0 maf in annual savings by 2060.[243] In the municipal and industrial sector, the Phase I Report similarly noted that per capita water use rates had decreased by twelve percent, to thirty-eight percent overall, since 1990 in major metropolitan areas that receive Colorado River water—an annual water savings of 1.7 maf as of 2010.[244] It also described major water providers' plans for more than 700,000 acre-feet of additional water conservation and 400,000 acre-feet of additional water reuse, annually by 2030.[245]

Examining the Indus Basin through this lens, neither India nor Pakistan have invested significantly in demand-management solutions, even though they may offer the cheapest per-gallon source of water available—much cheaper than expensive new dams and diversions. For instance, the World Bank estimated a lending pro-

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238. *Id.* at 52.

239. For another recent example of the prioritization of demand management in the Colorado River Basin, see *Pilot System Conservation Program*, U.S. BUREAU OF RECLAMATION, https://www.usbr.gov/lc/region/programs/PilotSysConsProg/pilotsystem.html (last visited April 5, 2018).

240. TECHNICAL REPORT F, *supra* note 228, at F-38 to -53.

241. PHASE I REPORT, *supra* note 18, at 3-1 to -66, 4-1 to -44.

242. *Id.* at 4-14.

243. *Id.* at 4-43.

244. *Id.* at 3-62.

245. *Id.* The report outlines nearly a dozen future opportunities for increasing municipal and industrial water conservation and reuse. *Id.* at 3-63.

gram totaling $1.2 billion in 2005,[246] while a more recent international consortium of partners to Pakistan's water sector estimated an investment program of more than $30 billion, mainly focused on large dam construction.[247] These are huge figures, and a country should think carefully before undertaking such actions, especially given the downsides of large-scale infrastructure identified above. In contrast, the potential for demand-side savings is greatest in systems where a significant portion of water is wasted, as is the case in Pakistan. One study found that Pakistan's canal system loses twenty-five percent of its water to line waste and leakage.[248] Meanwhile, the total volume of conveyance losses in the surface irrigation system is colossal—an estimated seventy-three maf annually.[249] Further, cropping intensity in some canal commands along the length of a canal is double at the heads as compared to the tails, meaning that farmers at the end of the length of a canal may be getting half the amount of water that farmers closer to the source of supply receive. This disparity indicates both massive conveyance losses as well as inequities in canal water distribution.[250] In light of these figures, a recent United States Senate Report noted: "[M]any experts agree that these countries [i.e., Pakistan] must start shifting their focus from increasing the supply of water to decreasing their demand for it."[251] The report outlined a variety of demand-management methods: "installing water gauges, collecting groundwater use and recharge, promoting water reuse, improving efficiencies in delivery, and trainings on how to budget water among users."[252] While there is much room for improvement, these methods reflect the policy trends in the Colorado River Basin, and they also should in the Indus Basin.

Unfortunately, India and Pakistan still believe that building more dams will offer a solution. India has had thirty-three multipurpose dams under construction or planned in recent years.[253] Pakistan's WAPDA, meanwhile, also has a long list of dam projects under construction or in the planning stages. While the bulk of projects focus on hydropower development, adding storage dams

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246. BRISCOE & QAMAR, *supra* note 70, at 123–25.

247. A PRODUCTIVE AND WATER-SECURE PAKISTAN, THE REPORT OF THE WATER SECTOR TASK FORCE OF THE FRIENDS OF DEMOCRATIC PAKISTAN (2013), http://metameta.nl/wp-content/uploads/2013/11/FoDP-WSTF-Report-Final-09-29-12.pdf [hereinafter TASK FORCE].

248. BAKSHI & TRIVEDI, *supra* note 63, at 6.

249. SARFRAZ KHAN QURESHI, *Water, Growth and Poverty in Pakistan*, *in* BACKGROUND PAPERS, *supra* note 78, at 15.

250. Ahmad, *Water Balance and Evapotranspiration*, *in* BACKGROUND PAPERS, *supra* note 78, at 23.

251. SENATE REPORT, *supra* note 6, at 2.

252. *Id.* at 17.

253. *Id.* at 9.

and extending attendant irrigation infrastructure remain priorities. In total, WAPDA lists thirty-eight projects under headings of "under construction," "ready for construction," or "future" projects.[254] WAPDA's plans include its flagship multi-purpose Diamer Bhasha Dam along the Upper Indus, with a gross storage capacity of 8.1 maf that will enable it to supplement water supplies to existing irrigated areas, as well as generate an additional 4,500 mw of electricity for the national grid.[255] More recently, Pakistan's Supreme Court has taken the lead in ensuring that the Diamer Bhasha and Mohmand dams are constructed on a priority basis, and the country's Chief Justice has ordered the creation of a national collection fund to finance the construction.[256]

Pakistan should pay serious attention to striking a different balance between demand management and structural solutions. As Bengali describes: "The obsession with engineering/civil works projects has been so all-encompassing that little or no attention has been accorded to an alternative sociocentric paradigm that would incorporate elements of development, management, and conservation of water resources."[257] There are many policy tools to improve water efficiency and conservation. Some are focused on agriculture: lining conveyance canals, laser leveling fields, switching to less water-intensive crops, using drip irrigation instead of flood irrigation, paying farmers to conserve, eliminating subsidies, and metering water.[258] Other solutions are aimed at municipal and industrial users: establishing tiered water rates, replacing inefficient water appliances with high-efficiency models, using water barrels and roof-top cisterns to collect rainwater, removing water-intensive vegetation, and replacing aging, leaking delivery pipes.[259] Taken together, these methods can dramatically reduce water use.

For Pakistan to prioritize demand management, it will undoubtedly require a fundamental shift in thinking, an earnest mustering of political will, and quite possibly considerable funding (including international and/or bilateral assistance). But given that just a single dam, Diamer Bhasha, is expected to cost upwards of fourteen

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254. Descriptions of these projects can be accessed via the "projects" link at WAPDA, *supra* note 73.

255. *Diamer Basha Dam*, WAPDA, http://www.wapda.gov.pk/index.php/projects/hydropower/ready-for-construction/diamer-basha-dam (last visited Nov. 20, 2017).

256. Bhatti, *supra* note 15.

257. Bengali, *supra* note 106, at 46.

258. *See generally* MICHAEL COHEN ET AL., PACIFIC INST., WATER TO SUPPLY THE LAND: IRRIGATED AGRICULTURE IN THE COLORADO RIVER BASIN (2013) (discussing policy tools), http://pacinst.org/app/uploads/2013/05/pacinst-crb-ag.pdf; Evans & Sadler, *supra* note 227.

259. *See generally* CHRISTIAN-SMITH & GLEICK, *supra* note 227 (discussing policy tools); GLENNON, *supra* note 227; Wescoat, *supra* note 227.

billion dollars and take approximately a decade to complete, the country should earnestly explore adopting demand management techniques.[260] Indeed, this shift appears essential if Pakistan's irrigated empire is to continue to exist.

4. Water Banking

Water banking is a relatively new approach to water management. It is something akin to a savings account for water. During years of surplus flows, or due to effective conservation measures, a water-using jurisdiction and water users therein can "bank" unused water, either in a reservoir or an underground aquifer, to be accessed during times of scarcity. In some areas, "[w]ater banks promote efficient water use by facilitating agreements between users who can reduce water consumption cheaply (sellers) and those who cannot (buyers)."[261] Water banking can be pursued through many different arrangements.

Water banking has emerged in recent decades as an important aspect of the demand-management policy trend in the Colorado River Basin, particularly since the beginning of the historic drought. Several illustrations exist at the international and interstate levels.[262]

In addition to its shortage sharing regime discussed earlier, Minute 323 to the U.S.-Mexico Treaty contains three innovative programs that allow Mexico to defer treaty deliveries and store unused flows in Lake Mead.[263] These programs are *not* labeled international water banking programs; however, they operate in this way. Specifically, Minute 323 permits Mexico to store intentionally unused treaty water in Lake Mead when Mexico is unable to utilize the flows due to potential emergencies (earthquakes, conveyance-

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260. Shahbaz Rana, *Pakistan Stops Bid to Include Diamer-Bhasha Dam in CPEC*, EXPRESS TRIBUNE (Nov. 15, 2017), https://tribune.com.pk/story/1558475/2-pakistan-stops-bid-include-diamer-bhasha-dam-cpec/.

261. REED WATSON & BRANDON SCARBOROUGH, PROP. AND ENV'T RESEARCH CTR., COLORADO RIVER WATER BANK: MAKING WATER CONSERVATION PROFITABLE at 4 (2010), https://www.cbd.int/financial/pes/usa-peswatercolorado.pdf.

262. Although omitted for the sake of brevity, intrastate water banking schemes have also emerged, or are emerging, within the basin states. The Arizona Water Banking Authority cannot go unmentioned. *Background*, ARIZONA WATER BANKING AUTHORITY, http://www.azwaterbank.gov/Background/ (last visited Nov. 20, 2017). It banked more than 3.4 maf of Arizona's Lower Colorado River apportionment from 1997 to 2016. *AWBA Intrastate Report: Statewide Deliveries & Long Term Storage Credits*, ARIZONA WATER BANKING AUTHORITY, http://www.azwaterbank.gov/Ledger/Report_1.aspx (last visited Nov. 20, 2017).

263. MINUTE 323, *supra* note 192, at 8–11.

system failures, etc.),[264] or Mexico is able to rely on water yielded from conservation projects (such as canal lining) or augmentation projects (such as desalination plants) in lieu of treaty water.[265] Deferred deliveries in the former category are referred to as "emergency storage," while those in the latter category bear the label "Intentionally Created Mexican Allocation" (ICMA).[266] In addition, Minute 323 establishes a "Revolving Account" that allows Mexico to store water in the United States up to a volume of 366,136 acre-feet.[267] Taken together, Minute 323 references the waters associated with these three programs as "Mexico's Water Reserve" and imposes various limitations on their storage and delivery.[268] Collectively, the programs enable Mexico to bolster Lake Mead's elevation so as to stave off shortage-based treaty delivery reductions.[269]

There have been similar developments at the interstate level along the Lower Colorado River. Three programs are in play there, all of which interface with the Supreme Court's *Arizona v. California* Decree, yet leave its apportionment scheme intact.[270]

Perhaps most noteworthy is an "Intentionally Created Surplus" (ICS) program established by the Interim Guidelines in 2007.[271] This program is the domestic predecessor of Minute 323's ICMA program. It is composed in a similar manner, allowing parties entitled to receive Lower Colorado River water to forego such deliveries and, instead, to rely on water yielded from conservation or augmentation activities, such as canal lining, land fallowing, and desalination programs.[272] These parties create and store ICS in Lake Mead and later request delivery of the ICS from the Secretary

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264. *Id.* at 8. This program has antecedents in both Minute 319 and Minute 318. MINUTE 319, *supra* note 210, at 4; INT'L BOUNDARY & WATER COMM'N, MINUTE 318: ADJUSTMENT OF DELIVERY SCHEDULES FOR WATER ALLOTTED TO MEXICO FOR THE YEARS 2010 THROUGH 2013 AS A RESULT OF INFRASTRUCTURE DAMAGE IN IRRIGATION DISTRICT 014, RIO COLORADO, CAUSED BY THE APRIL 2010 EARTHQUAKE IN MEXICALI VALLEY, BAJA CALIFORNIA (2010), https://www.ibwc.gov/Files/Minutes/Min_318.pdf.

265. MINUTE 323, *supra* note 192, at 8. This program stems from a predecessor in Minute 319. MINUTE 319, *supra* note 210, at 7–10.

266. MINUTE 323, *supra* note 192, at 8.

267. *Id.* The volumetric limit is based upon Mexico's cumulative deferred deliveries under Minute 319 and Minute 318. *Id.*

268. *Id.* at 8–11.

269. MINUTE 323, *supra* note 192, at 8–9. For information about Mexico's use of deferred deliveries programs between 2011 and 2015 (i.e., pursuant to Minute 319 and Minute 318), see Robison, *supra* note 19, at 508.

270. *See supra* notes 189–191 and accompanying text. Article II(B)(6) of the Decree underpins the programs.

271. Interim Guidelines ROD, *supra* note 193, at 38–43. For information about water users' use of the ICS program, see Robison, *supra* note 19, at 547–48.

272. These activities fall into four ICS categories: Extraordinary Conservation ICS, Tributary Conservation ICS, System Efficiency ICS, and Imported ICS. Interim Guidelines ROD, *supra* note 193, at 38–39.

of the Interior. Limitations apply to both ICS creation and retrieval.[273]

Worth noting alongside the ICS program is a "Developed Shortage Supply" (DSS) program that was also implemented under the Interim Guidelines.[274] In a nutshell, it resembles the ICS program on a smaller scale by enabling parties entitled to Lower Colorado River water to create DSS in and to request DSS deliveries from Lake Mead, albeit with stricter limitations on both creation and delivery.[275]

Finally, there has been an interstate program focusing on water banking in groundwater aquifers and off-stream reservoirs—rather than in Lake Mead—in the Lower Basin since 1999, predating the Interim Guidelines by almost a decade.[276] "Storage and Interstate Release Agreements" (SIRAs) are the program's centerpieces.[277] SIRAs generally contemplate a "storing entity" banking Lower Colorado River water in groundwater aquifers or off-stream reservoirs and developing "Intentionally Created Unused Apportionment" (ICUA).[278] In turn, at a later date, the storing entity relies on this banked water and asks the Secretary of the Interior to release the ICUA from Lake Mead for use by a "consuming entity" in a different Lower Division state.

Despite major contextual differences between the Colorado and Indus basins with regard to the feasibility of designing and implementing water banks,[279] such institutions may nonetheless prove quite beneficial in ameliorating allocation tensions in the Indus Basin. While banking requires a relationship of trust and collaboration between an investor and a bank, an effective banking scheme has similar advantages to a large storage dam. It mediates dramatic variations in flow by evening out wet and dry seasons so that water users have a dependable supply. Likewise, a water bank can incentivize conservation and alleviate drought impacts or other fluctuations in flow. Furthermore, a water bank can be a source of revenue for the banker—the entity that agrees to store water.

Implicit in the recognition of these benefits is a suggestion informed by the policy trends in the Colorado River Basin. There

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273. *See id.* at 40–43 (prescribing ICS creation and delivery rules).
274. *Id.* at 44–46.
275. *Id.*
276. 43 C.F.R. §§ 414.1–414.6 (2016). For information about water users' use of the Lower Basin interstate water banking program, see Robison, *supra* note 19, at 544–45.
277. *See* 43 C.F.R. §§ 414.2, 414.3(a)(1)–(18) (2016) (detailing SIRA features and defining "storing entity" and "consuming entity").
278. *Id.* § 414.2.
279. Telephone Conversation with Peter Rogers, Gordon McKay Professor of Environmental Engineering and Professor of City and Regional Planning, Harvard University (July 26, 2017).

should be studies in the Indus Basin to assess potential designs and implementation strategies for transboundary water banks.[280] Such studies would function as feasibility studies and address a variety of design- and implementation-related matters. Legal authority is a threshold issue. To what extent, if any, do the IWT's and Water Accord's provisions, in their current forms, allow for international or interprovincial water banks? Notably, the accord's provisions provide some measure of optimism on this question.[281] Another pivotal subject is infrastructure. It is essential to evaluate existing or future storage options for water banking.[282] In light of the commentary above regarding demand management and drawbacks of large-scale infrastructure, Indus Basin water-banking infrastructure might be qualitatively different than that utilized for the Law of the River's ICS and DSS programs and may instead prioritize off-stream reservoirs or even aquifers. In turn, dovetailing with these infrastructural matters are a host of topics that deserve attention, such as funding mechanisms and water-bank administration. As with the recommendations for allocational flexibility and shortage sharing, sequencing should be considered. Initial feasibility studies for interprovincial water banks within Pakistan may generate valuable capacity for subsequent endeavors at the international level.

5. Water Marketing

Closely connected to water banking is water marketing. The latter refers to the voluntary act of selling, leasing, or trading water and related resources and services.[283] Multiple benefits can flow

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280. Although this material focuses on interprovincial water banks, this Article relies on the accord to suggest that provinces should also investigate potential schemes within their jurisdictions. The accord places no restrictions on provinces developing water banks that keep within respective provincial shares. Accord, *supra* note 8, at para. 8.

281. Two provisions should be noted in this regard. First, paragraph 14(e) commits parties to make efforts to avoid wastage and allows a province to use the share of another province without establishing any rights to the water used. *Id.* at ¶ 14(e). These terms could be understood as opening the possibility for a province to store its water in another province through a voluntary agreement. Second, paragraph 4 allocates surplus shares to provinces—that is, shares of both flood supplies, as well as future storage—as percentages of total supplies. *Id.* at ¶ 4. Given that this provision points to surpluses, its utility is only realizable if infrastructural means exist for storing and using such water in the future—e.g., water banking.

282. *See* BRISCOE & QAMAR, *supra* note 70, at xix (explaining that the Indus Basin's storage capacity in 2005 was equivalent to approximately thirty days of average river flows, while Colorado River Basin's storage capacity approximated more than 800 days).

283. *See generally* WESTERN GOVERNORS' ASS'N & WESTERN STATES WATER COUNCIL, WATER TRANSFERS IN THE WEST: PROJECTS, TRENDS, AND LEADING PRACTICES IN VOLUNTARY WATER TRADING (2012), https://www.westgov.org/images/dmdocuments/Water_Transfers_in_the_West_2012.pdf [hereinafter WGA]; *see generally* Lawrence MacDonnell, *Transferring Water Uses in the West*, 43 OKLA. L. REV. 119, 122 (1990).

from such transactions, including "allocating water to new high-value uses, incentivizing efficiency and avoiding political or regulatory water allocation decisions."[284] Water marketing often involves exchanges between individual water users as willing sellers and buyers, but it can also be accomplished through innovative partnerships between governments and corporate entities to increase efficiency and cost savings.[285] To be sure, water marketing can be controversial, primarily due to third-party impacts.[286] With an appropriate set of guidelines to protect third parties, however, water marketing can generate widespread benefits.[287]

Water marketing is an important, but somewhat dichotomous, policy topic in the Colorado River Basin. The dichotomy comes from policymakers' views about the jurisdictional scale at which water markets should exist, be it intrastate or something broader.

On one hand, water transfer schemes exist at the intrastate level within all of the basin states,[288] and the foregoing benefits of these schemes are widely recognized, as are the risks of third-party impacts and the concomitant need for protective guidelines.[289] The Colorado River Basin is actually the site of "the largest agricultural-to-urban water transfer in United States history."[290] Contained within the 2003 Quantification Settlement Agreement, this transfer entails 300,000 acre-feet of Lower Colorado River water being transferred annually from agricultural to urban areas in Southern Cali-California.[291]

Expanding beyond the intrastate level, however, it is fair to say that jurisdictionally broader water marketing schemes have been lightning rods for controversy in the Colorado River Basin since at

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284. WGA, *supra* note 283, at 3.

285. RACHEL BROMBAUGH, MCKINSTRY, TAPPING THE POWER OF THE MARKET: ENERGY SAVINGS, WATER CONSERVATION, AND NEW REVENUE STREAMS THROUGH PERFORMANCE CONTRACTING IN THE COLORADO RIVER BASIN STATES 11–17 (2015), http://westernresourceadvocates.org/publications/tapping-the-power-of-the-market/.

286. *See generally* Joseph L. Sax, *Understanding Transfers: Community Rights and the Privatization of Water*, 14 HASTINGS W.-N.W. J. ENVTL. L. & POL'Y 33 (2008).

287. *See id.* at 38.

288. For a recent comparative analysis of the basin states' schemes with regard to environmental water rights transfers, see LEON SZEPTYCKI & DAVID PILZ, STANFORD WOODS INST. FOR THE ENV'T, COLORADO RIVER BASIN ENVIRONMENTAL WATER TRANSFERS SCORECARD (2017), http://waterinthewest.stanford.edu/sites/default/files/Co_River_Basin_Env_Transfers_Scorecard.pdf.

289. *See generally* WGA, *supra* note 283.

290. Jason A. Robison, *Colorado River Water in Southern California: Evolution of the Allocation Framework, 1922–2015*, 27 W. LEGAL HIST. 139, 165 (2014) (quoting Quantification Settlement Agreement Cases, 201 Cal. App. 4th 758, 788 (2011)).

291. *See id.* at 162–76 (discussing QSA's genesis, composition, post-formation litigation, and intertwined future with federal and state efforts to restore Salton Sea).

least the 1980s.[292] Notwithstanding advocacy by commentators and several proposals of different types[293]—including in conjunction with the U.S. Bureau of Reclamation's Basin Study[294]—there are no full-fledged water markets at the basin-wide scale or sub-basin scale at this time. Arguably the closest approximation of such schemes stems from the Lower Basin interstate water banking program described above. It enables non-federal parties to a SIRA to assign their interests in the agreement, in whole or part, to authorized entities.[295] Neither Minute 323's programs involving Mexico's Water Reserve, nor the Interim Guidelines' ICS and DSS programs, appear to contain analogous terms. These measures expressly address the retrieval of water stored in Lake Mead by parties that have undertaken such storage, rather than market-based transfers of the stored water by such parties.

As in the Colorado River Basin, there could be enormous potential for water marketing in the Indus Basin—again, notwithstanding salient contextual differences. Because water marketing is effectively a contractual partnership between water-using entities, ranging from national government to subnational governments to private parties, one can envision a wide range of water marketing scenarios.[296]

As just one example at the international level, if an Indian hydropower entity were interested in holding back water on one of the western rivers to increase hydropower production, it could contract with farmers downstream in Pakistan to, in effect, purchase the portion of their crops that would be lost due to decreased water deliveries. Such a deal would foreseeably provide

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292. For an insightful survey of this trajectory, see COLORADO RIVER GOVERNANCE INITIATIVE, CROSS-BOUNDARY WATER TRANSFERS IN THE COLORADO RIVER BASIN: A REVIEW OF EFFORTS AND ISSUES ASSOCIATED WITH MARKETING WATER ACROSS STATE LINES OR RESERVATION BOUNDARIES (2013), http://scholar.law.colorado.edu/cgi/viewcontent.cgi?article=1003&context=books_reports_studies.

293. See *id.* at 48–52 for a useful compilation of primary and secondary sources in this area.

294. A proposal for a basin-wide "Water Banking Transfer Scheme" was submitted in conjunction with the Basin Study. *Id.* at 40. This proposal can be accessed as Record No. 101 in U.S. BUREAU OF RECLAMATION, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDIX F2: OPTIONS SUBMITTED TO THE STUDY F2-12 (2012), https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20F%20-%20Development%20of%20Options%20and%20Stategies/Appendix%202%20-%20Options%20Submitted%20to%20the%20Study/Appendix%20F2%20-%20Options%20Submitted%20to%20the%20Study.pdf.

295. 43 C.F.R. § 414.3(d). "Authorized entities" are entities authorized under state law to enter into SIRAs. *Id.* at § 414.2(1).

296. Although the material below focuses on international and interprovincial scenarios, water marketing on an intraprovincial basis also may hold promise—for example, water marketing among agricultural and municipal water users in the same province. Given current relations between India and Pakistan, as well as mistrust among Pakistan's provinces, such intraprovincial transfers may pave the way for the sequenced growth of water markets.

high-value energy to India and secure a market for Pakistani farmers' crops at an attractive rate. This scenario would not inherently mean that the contracted farmers could not produce the crop: They could change to a low-water crop, invest in a more efficient irrigation system, or cut back on acreage. In such a situation, the farmers would actually receive more monetarily from the exchange than if their crops had been grown and sold. Likewise, the Indian hydropower entity could use the additional water at precisely the times that would provide the most benefit to its customers and maximize economic returns. While this scenario is neither relationally realistic at present, nor permitted by the IWT's existing terms,[297] it nonetheless illustrates the ways in which potential transactions might be crafted if institutions were to move in this direction.

Other potential scenarios exist at the interprovincial level. For instance, as explained in Part II, IRSA has exempted the two smaller provinces from the terms of the accord so that they do not have to share proportionately in shortages and receive their full accord shares when water availability is reduced.[298] Even though this practice does not affect their allocated shares, they are still unable to use these shares because budget constraints both limit their developed infrastructure and create an additional grievance in the shortage sharing province. As already noted, this policy continues, even though it is hotly contested.[299] To reiterate, in this scenario, planners should consider devising a mechanism that creates a win-win and moves beyond current practices. If select provinces are to receive full shares regardless of water availability, then IRSA could create an explicit mechanism to compensate co-sharers who give up portions of their shares during shortages. In a collaborative, transparent manner, planners could create a fee-generating mechanism by which the provinces that enable such "shortage insulation" can also gain from that policy, instead of feeling as though they are subject to inequitable decisions made without their input.

Notably, in the 1980s and 1990s, the World Bank promoted a vision of water management in the Indus Basin that was guided by a belief that increased water trading via explicit recognition of prop-

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297. IWT, *supra* note 3, at Art. III(1)–(2) (providing "Pakistan shall receive for unrestricted use all those waters of the Western Rivers which India is under obligation to let flow," except for certain defined and restricted uses).

298. Rajput, *supra* note 162, at 121–22. The rationale offered is that, as the smaller provinces use less irrigation water in the overall context of interprovincial water use, they should be exempt from shortage sharing. Meanwhile, Sindh claims that its interests are disproportionately harmed by this decision, as it is the only province in this situation that bears the burden of shortages.

299. *See supra* notes 160–164 and accompanying text.

erty rights could be more efficient.[300] Two processes were instrumental: creating farmer organizations and water user associations and transforming the irrigation bureaucracy nested in the provincial administrative domain into an authority capable of enabling trades between private irrigators. The goal was to transition from highly bureaucratized and centralized water management towards a user-managed system open for trading. The transition was incentivized by offering funds for watercourse rehabilitation to farmers who came together in the new cooperative forms. Unfortunately, however, when the funds for physical infrastructure rehabilitation and upgrade were depleted, farmers no longer had an incentive to participate.[301] Planners must find other ways to incentivize such cooperative user behavior, and enabling users to trade water in the Indus should be a priority.

Certain important preconditions inhered in the World Bank's envisioned system, and they deserve careful attention from policymakers contemplating future water markets in the Indus Basin. As an initial matter, the tradability of water allocations depends in large part on the certainty of their existence and composition. Entitlements to water require enough certainty for market mechanisms to be able to price them. Policymakers will need to ensure the reliability of water allocations in order to enable functional market-based systems. Related to the certainty precondition is an infrastructural one that overlaps with water banking issues. Adequate storage and delivery infrastructure must exist to enable water markets. As an example, in gravity flow irrigation systems such as the Indus Basin's canal network, farmers have a timed allocation of flow (*warabandi*), which, in theory, means that they are guaranteed particular volumes of water.[302] In practice, however, this premise is severely unrealistic, as it erroneously assumes canals have an even height and consistent flow rate. This disparity means that time allocations actually do *not* guarantee users particular volumes of water—not all turns are equal.[303] The effects go far beyond simple in-

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300. *Pakistan—On-Farm and Command Water Management and Irrigation Systems Rehabilitation Projects*, INDEP. EVALUATION GRP., THE WORLD BANK GRP., http://lnweb90.worldbank.org/oed/oeddoclib.nsf/DocUNIDViewForJavaSearch/07A8B67C8A94D0EE852567F5005D3A1E (last visited Nov. 20, 2017).

301. *See generally* Arshad Ali & Mohammad Afzaal Khan, *The Actual and Potential Roles of Water Users' Associations in Irrigated Agriculture*, *in* SUSTAINABLE DEV. POLICY INST., WATER AND COMMUNITY – AN ASSESSMENT OF ON-FARM WATER MANAGEMENT PROGRAMME 126, 127 (Chaudhry Inayatullah ed., 1996).

302. ROBERT CHAMBERS, MANAGING CANAL IRRIGATION – PRACTICAL ANALYSIS FROM SOUTH ASIA xxvi (1988).

303. Faizul Hasan & Don Blackmore, *Water Rights and Entitlements*, *in* BACKGROUND PAPERS, *supra* note 78, at 230.

equitable impacts on farmers at the tail ends of canals.[304] In this situation and others, the takeaway is that adequate storage and delivery infrastructure must exist for trading to occur.

Notwithstanding these conjoined issues of water-allocation certainty and facilitative infrastructure—coupled with equally pressing needs for market administration and third-party protections—establishing water markets in Pakistan appears feasible and warrants consideration by policymakers.[305] This outlook for surface-water transactions is grounded in current practices in Pakistan's portion of the basin—namely, existent groundwater transactions between users who can afford to supplement their surface water supplies by purchasing water from neighbors who have installed tubewells with adequate pumping capacity.[306] Such transactions utilize existing surface-water infrastructure for transport between buyers and sellers.[307] Given the modest scope of this infrastructure, trading is limited to small distances, usually to neighboring land holders and certainly within provincial boundaries. Nonetheless, this precedent could offer valuable lessons for policymakers looking to design more formal and far-reaching water markets.

B. *Transboundary Water Governance*

1. Technical Capacity, Transparency, and Independent Evaluation

Water management cannot occur without reliable technical data. Government agencies must have capacity to generate such data. Further, as the resource for which such agencies are responsible is inherently public in nature, notwithstanding contractual relationships among private parties, transparent dissemination of technical data is essential. Independent entities capable of evaluating the data, as well as conducting research on similar subject matter, are likewise crucial.

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304. D.J. Bandaragoda & Saeed ur Rehman, International Irrigation Management Institute, Warabandi in Pakistan's Canal Irrigation Systems: Widening Gap Between Theory and Practice xi (1995), http://pdf.usaid.gov/pdf_docs/PNABY457.pdf.

305. *See generally* Agha Ali Akram, *Is a Surface-Water Market Physically Feasible in Pakistan's Indus Basin Irrigation System?*, 38 WATER INT'L 552 (2013).

306. *See* Bandaragoda & Rehman, *supra* note 304, at xi (describing how surface-water turns on a watercourse are commonly traded while groundwater is more commonly purchased).

307. These groundwater markets highlight the inadequacy of surface water supplies and the concomitant need to move toward conjunctive management of groundwater and surface water. For a useful discussion of this topic, see Frank van Steenbergen et al., *Key Challenges and Opportunities for Conjunctive Management of Surface and Groundwater in Mega-Irrigation Systems: Lower Indus, Pakistan*, 4 RESOURCES 831 (2015).

These principles stem from hard-learned lessons in U.S. water policy. Perhaps most memorable vis-à-vis the Colorado River Basin and more broadly are episodes during the mid-twentieth century where the U.S. Bureau of Reclamation and U.S. Army Corps of Engineers produced skewed cost-benefit analyses to justify water projects. One illustrative, highly visible epic involved the Bureau's unsuccessful attempt to construct the Echo Park Dam inside Dinosaur National Monument within the Upper Colorado River Basin in the 1950s.[308] Federal law was eventually changed to authorize external cost-benefit analyses and avoid built-in bias.[309] Reflection upon these episodes is *not* meant to prosecute the past, but rather to show that a good deal of thought has been, and continues to be, given to data reliability in the Colorado River Basin.

Data collection related to the Colorado River system occurs via the efforts of an array of government agencies in the United States and Mexico. Increasingly, these agencies make their work product publicly accessible online, albeit with time delays in certain cases.

The International Boundary and Water Commission (IBWC), a joint body composed of United States and Mexican sections, is responsible for administering the U.S.-Mexico Treaty.[310] Among other duties, the IBWC is charged with constructing, operating, and maintaining gaging stations and other measuring devices to monitor flows and treaty deliveries, as well as compiling and exchanging such data.[311] The IBWC publishes the data in annual bulletins—though recent copies are not available on the IBWC website[312]—and the U.S. Bureau of Reclamation incorporates the data into annual water accounting reports for the Lower Colorado River.[313]

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308. A seminal source on this dam controversy is MARK W.T. HARVEY, A SYMBOL OF WILDERNESS: ECHO PARK AND THE AMERICAN CONSERVATION MOVEMENT (1994).

309. DANIEL MCCOOL, RIVER REPUBLIC: THE FALL AND RISE OF AMERICA'S RIVERS 42–50 (2012).

310. IBWC History, *supra* note 44.

311. Treaty, *supra* note 36, at Arts. 12(d), 24(f). *See also Colorado River Boundary Section*, INT'L BOUNDARY & WATER COMM'N: UNITED STATES SECTION, https://www.ibwc.gov/Water_Data/Colorado/Index.html (last visited April 5, 2018).

312. The most recent annual bulletin accessible on the IBWC's website is from 2006. UNITED STATES SECTION, INTERNATIONAL BOUNDARY & WATER COMMISSION, WATER BULLETINS, https://www.ibwc.gov/Water_Data/water_bulletins.html (last visited Nov. 20, 2017). The IBWC also posts environmental reports and studies. UNITED STATES SECTION, INTERNATIONAL BOUNDARY & WATER COMMISSION, REPORTS AND STUDIES, https://www.ibwc.gov/EMD/reports_studies.html (last visited April 5, 2018).

313. *See, e.g.*, U.S. BUREAU OF RECLAMATION, COLORADO RIVER ACCOUNTING AND WATER USE REPORT: ARIZONA, CALIFORNIA, AND NEVADA 29–30 (2016), https://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2016/2016.pdf (providing annual and monthly accounting of treaty deliveries).

Turning to the domestic side in the United States, the Bureau is the primary[314] federal agency with technical duties related to the Colorado River system. Organized into an Upper Colorado Region and a Lower Colorado Region, the Bureau generates a broad scope of data and reports regarding the basin's hydrology and flows, consumptive uses and diversions, and infrastructure conditions and operations.[315] The Bureau recently launched a pilot Reclamation Water Information System enabling public access to its data.[316] Traditional technical documents produced and disseminated by the agency—all mandated by federal law—include: (1) five-year consumptive uses and losses reports for the Colorado River system (often delayed in release);[317] (2) annual water accounting reports for Lower Colorado River diversions, return flows, and consumptive uses as identified above;[318] and (3) annual operating plans for basin reservoirs.[319] The Upper Colorado River Commission (UCRC) consults with the Bureau on the consumptive uses and losses reports. It is an interstate agency composed of federal and state representatives responsible for administering the Upper Basin Compact.[320] The UCRC bears a host of responsibilities for generating technical data on flows, storage, consumptive uses, and diversions, and produces associated annual reports.[321] In addition, each basin state has at least one water resource agency with technical ob-

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314. The U.S. Geological Survey is also a key federal agency in this realm. *See, e.g.*, *Colorado River Basin Focus Area Study*, USGS, https://water.usgs.gov/watercensus/colorado.html (last visited April 5, 2018).

315. *Water Operations*, UPPER COLORADO REGION, U.S. BUREAU OF RECLAMATION, https://www.usbr.gov/uc/water/index.html (last visited April 5, 2018); *Lower Colorado River Operations*, LOWER COLORADO REGION, U.S. BUREAU OF RECLAMATION, https://www.usbr.gov/lc/riverops.html (last visited April 5, 2018).

316. *Reclamation Water Information System*, U.S. BUREAU OF RECLAMATION, https://water.usbr.gov/ (last visited April 5, 2018).

317. *Colorado River System Consumptive Uses and Losses Reports*, U.S. BUREAU OF RECLAMATION, https://www.usbr.gov/uc/library/envdocs/reports/crs/crsul.html (last visited April 5, 2018). Unfortunately, the most recent report providing Lower Basin data is from 2005. *Id.*; U.S. BUREAU OF RECLAMATION, COLORADO RIVER BASIN CONSUMPTIVE USES AND LOSSES REPORT 2001–2005 (2012), https://www.usbr.gov/uc/library/envdocs/reports/crs/pdfs/cul2001-05.pdf.

318. *Lower Colorado River Water Accounting*, U.S. BUREAU OF RECLAMATION, https://www.usbr.gov/lc/region/g4000/wtracct.html#decree (last visited April 5, 2018).

319. *Annual Operating Plans*, U.S. BUREAU OF RECLAMATION, https://www.usbr.gov/uc/water/rsvrs/ops/aop/ (last visited April 5, 2018).

320. Upper Basin Compact, *supra* note 37, at Art. VIII; *UCRC*, *supra* note 46.

321. Upper Basin Compact, *supra* note 37, at Art. VIII(d). Although currently limited to the past five years, electronic copies of the UCRC's annual reports can be accessed on the UCRC website. *Reports and Studies*, UPPER COLORADO RIVER COMMISSION, http://www.ucrcommission.com/RepDoc/RS.html (last visited April 5, 2018).

ligations pertaining to the state's portion of the Colorado River system.[322]

Independent evaluation of technical data generated and, hopefully, publicly disseminated by the agencies above is, of course, another part of the equation. The same can be said about independent entities wielding the capacity to produce freestanding research on Colorado River Basin water management. Even extensive, pathbreaking work such as the U.S. Bureau of Reclamation's Basin Study stands to benefit from respectful yet critical analyses and supplementary studies by external organizations.[323] In the academic realm, the National Academy of Sciences is exemplary in this vein, having published a major study entitled *Colorado River Basin Water Management* in 2007.[324] Likewise, a cadre of academic entities focused on water-related technical and policy issues in the basin exists within and outside the basin states.[325] There is also exceptional capacity in the non-governmental sector.[326]

A host of issues involving lack of technical capacity, transparency, and independent evaluation loom large in the Indus Basin at the international and interprovincial levels. Given the broad sweep of governance reforms that may be warranted (or are arguably necessary), this Article suggests priorities that deserve attention as a starting point. They are cornerstones for the allocation- and conservation-related suggestions above.

With respect to the IWT, there is currently enormous distrust between India and Pakistan regarding technical information about existing and proposed projects. "[T]he treaty's long-term stability

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322. *See, e.g.*, *Colorado Water Conservation Board*, COLORADO WATER CONSERVATION BOARD, DEPARTMENT OF NATURAL RESOURCES, http://cwcb.state.co.us/about-us/about-the-cwcb/Pages/main.aspx (last visited April 5, 2018).

323. *See, e.g.*, Baker Letter, *supra* note 59 (requesting National Academy of Sciences review of Colorado River programs associated with 2009 Secure Water Act and Basin Study and its *Moving Forward* effort).

324. NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMIES, COLORADO RIVER BASIN WATER MANAGEMENT: EVALUATING AND ADJUSTING TO HYDROCLIMATIC VARIABILITY (2007), https://www.nap.edu/read/11857/chapter/1.

325. *See, e.g.*, *Center for Colorado River Studies*, UTAH STATE UNIVERSITY DEPARTMENT OF WATERSHED SCIENCES, https://qcnr.usu.edu/wats/colorado_river_studies/ (last visited April 5, 2018); *Colorado River Governance*, CENTER FOR NATURAL RESOURCES & ENVIRONMENTAL POLICY, UNIVERSITY OF MONTANA, http://naturalresourcespolicy.org/projects/archives/colorado-river-governance.php (last visited April 5, 2018); *Colorado River Research Group*, COLORADO RIVER RESEARCH GROUP, http://www.coloradoriverresearchgroup.org/ (last visited April 5, 2018); *Colorado Water Institute*, COLORADO WATER INSTITUTE, COLORADO STATE UNIVERSITY, http://www.cwi.colostate.edu/default.asp (last visited April 5, 2018); *Ruth Powell Hutchins Water Center*, COLORADO MESA UNIVERSITY, http://www.coloradomesa.edu/watercenter/index.html (last visited April 5, 2018).

326. Examples of non-governmental organizations conducting work on the Colorado River system include Audubon Society, Carpe Diem West, Environmental Defense Fund, Glen Canyon Institute, Living Rivers/Colorado Riverkeeper, Pacific Institute, The Nature Conservancy, Utah Rivers, and Western Resource Advocates.

is threatened by a lack of trust between [the] two countries."[327] Among other remedial measures, relying on an external entity for technical work might allay fears of manipulation. The role of data generation, analysis, and dissemination could be performed by an entity such as the U.N.'s inter-agency program, U.N. Water,[328] federal water agencies, or a university consortium from outside the region. This is not to suggest that external actors are superior to in-country entities, or that external actors might permanently supplant in-country entities. Ultimately, however, both countries need reliable data that is worthy of their trust and shared openly. Allocating this function to a third party for an interim period could potentially meet these goals. Doing so could also foreseeably bring relationship- and capacity-building benefits that would be integral over the longer time horizon to enable the external entity to, by design, work itself out of a job.

Such an approach might also be beneficial for data generation and dissemination, as well as fostering trust, among Pakistan's provinces. At present, Pakistan lacks "publicly available access to consistent and comparable data on water supply, flow, and usage."[329] As a result, "[t]he country is literally flying blind into a very hazardous future."[330] Although WAPDA is entrusted with the bulk of data generation, the agency has a conflict of interest because it is also responsible for infrastructure construction. Further, to the extent that provincial agencies gather their own data, they suffer from a lack of capacity and mistrust from peers in other provinces. Provincial irrigation officials and, by implication, provincial members of IRSA are often viewed as compromised because they must uphold their respective provinces' points of view, thus making them suboptimal generators or custodians of impartial and independently verifiable data. In short, an external technical entity might add much value within Pakistan's portion of the Indus Basin, injecting diversity and integrity to these activities, as well as possibly balancing an overwhelmingly technocratic engineering perspective of water management. Yet again the prospect of sequencing from the interprovincial to the international levels is worth highlighting.

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327. SENATE REPORT, *supra* note 6, at 9.

328. *About United Nations Water*, U.N. WATER, http://www.unwater.org/about-unwater/ (last visited Nov. 20, 2017).

329. SENATE REPORT, *supra* note 6, at 2.

330. BRISCOE & QAMAR, *supra* note 70, at xviii.

2. Collaboration

Finally, the discussion turns to a subject that is not only implicit in the preceding material regarding generation, dissemination, and independent evaluation of technical data, but also pervasive in the topics covered in the transboundary allocation and conservation section: allocational flexibility, shortage sharing, demand management, water banking, and water marketing. The Colorado River Basin is far from a utopia regarding these important aspects of water law and policy. However, advances made in these areas in recent decades—particularly throughout the historic drought—simply would not have been possible without a sustained commitment to collaboration among basin stakeholders.[331] Water law and policy are by nature *relational* pursuits. Adversity breeds adversity and can lay waste to the best laid plans of mice and men. Yet the converse, of course, is also true.

One does not have to look far and wide for adversity in the Law of the River's evolution. A primer can be found in three unsuccessful U.S. Supreme Court lawsuits filed by Arizona in the 1930s. The lawsuits challenged different aspects of the formation and interpretation of the Colorado River Compact and Boulder Canyon Project Act.[332] This litigation served as the preface of the tome that was the U.S. Supreme Court's principal *Arizona v. California* decision in 1963.[333] Filed in 1952,[334] it took eleven years for the Court to render its decision, and another forty-three years for the Court to issue a consolidated decree in 2006.[335] The litigation's tone could not be conveyed more pitch-perfectly than by the late Charles Meyers in his firsthand account of the trial's commencement: "[A]n air of Armageddon pervaded the room—though of course there was sharp disagreement over the identity of the forces of Good and Evil."[336]

In contrast, recent decades have seen remarkable growth in collaborative efforts surrounding Colorado River Basin water man-

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331. *See generally* JOHN FLECK, WATER IS FOR FIGHTING OVER AND OTHER MYTHS ABOUT WATER IN THE WEST (2016).

332. Arizona v. California, 298 U.S. 558 (1936); Arizona v. California, 292 U.S. 341 (1934); Arizona v. California, 283 U.S. 423 (1931).

333. 373 U.S. 546 (1963). *See generally* Lawrence J. MacDonnell, *Arizona v. California: Its Meaning and Significance for the Colorado River and Beyond After Fifty Years*, 4 ARIZ. J. ENVTL. L. & POL'Y 88 (2014), http://www.ajelp.com/articles/macdonnell-arizona-v-california-its-meaning-and-significance/.

334. MacDonnell, *supra* note 333, at 95.

335. Decree, *supra* note 38.

336. Charles J. Meyers, *The Colorado River*, 19 STAN. L. REV. 1, 42 (1966). Meyers served as a law clerk for Simon H. Rifkind, the Special Master who presided over the trial. A. Dan Tarlock, *Tribute*, 29 NAT. RES. J. 327, 328 (1989).

agement. It would be disingenuous to present these efforts as panaceas, or to suggest that the parties involved have been oblivious to the Law of the River's framework and the associated prospect of having to "duke it out" in adversarial settings such as litigation. Nonetheless, there has been a marked trend toward inclusivity, open communication, and compromise in international and interstate relations. Illustrations include Minute 323's shortage sharing regime, binational water scarcity contingency plan, and programs involving Mexico's Water Reserve.[337] Whereas Mexico agreed via the first and second measures to share in Lower Colorado River shortages alongside the Lower Division states, the United States agreed via the third measure to allow Mexico to store unused treaty water in Lake Mead.[338] A similar picture emerges at the interstate level with the Interim Guidelines. Prior to the guidelines' formation, the historic drought's impact on reservoir storage triggered interpretive conflicts over the Colorado River Compact and related laws that "brought the basin closer to multi-state and interbasin litigation than perhaps any time since adoption of the Compact."[339] Instead of a repeat *Arizona v. California*-like proceeding, however, the basin states engaged with other stakeholders in a National Environmental Policy Act process led by the Secretary of the Interior.[340] The guidelines were the fruit of this labor, bringing into existence their shortage sharing regimes, ICS and DSS programs, and a complementary Basin States' Agreement. This Agreement recognizes that "judicial or administrative proceedings are not preferred alternatives to the resolution of claims or controversies concerning the [L]aw of the [R]iver" and expresses the basin states' collective commitment "to pursue a consultative approach to the resolution of any claim or controversy."[341]

The collaborative trend within the Colorado River Basin, not easily achieved and inched toward over a long period, is absolutely critical as a reference point for the Indus Basin. Before reflecting

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337. These measures are discussed *supra* Part III.A.2 (shortage sharing regime, binational water scarcity contingency plan) and Part III.A.4 (Mexico's Water Reserve programs).

338. Minute 323 also implements an environmental flows program for the Colorado River Limitrophe and Delta that illustrates collaboration. MINUTE 323, *supra* note 192, at 15–18. *See also* MINUTE 319, *supra* note 210, at 11–14 (establishing predecessor environmental flows program).

339. Interim Guidelines ROD, *supra* note 193, at 11.

340. *See generally* COLORADO RIVER INTERIM GUIDELINES FOR LOWER BASIN SHORTAGES AND COORDINATED OPERATIONS OF LAKES POWELL AND MEAD, FINAL ENVIRONMENTAL IMPACT STATEMENT, U.S. BUREAU OF RECLAMATION, https://www.usbr.gov/lc/region/programs/strategies/FEIS/ (last visited April 5, 2018).

341. U.S. BUREAU OF RECLAMATION, AGREEMENT CONCERNING COLORADO RIVER MANAGEMENT AND OPERATIONS 10 (Apr. 23, 2007), http://www.usbr.gov/lc/region/programs/strategies/DEIScomments/State/BasinStates.pdf. This agreement appears as attachment A of the linked document.

in greater detail on the implications of possible collaboration and its potential blooming internationally and/or interprovincially, it is worth taking stock of the relationship between collaboration and contestation. Working in the shadow of the law has a remarkable ability to encourage parties to develop more cooperative norms, as they presume an adjudicator with integrity will not hesitate to impose undesirable outcomes and are spurred to avoid this situation.[342] In the main, if a decision-maker is neutral and adequately empowered—that is, possesses integrity—contestation in the form of litigation can be expected to lead to more just results, to uphold the rule of law, and to motivate collaboration. In the Indus Basin, however, this neutral, empowered adjudicator is precisely what is missing at both the international and interprovincial levels.[343] Drawing attention to this institutional vacuum does not diminish the value added by collaborative processes—quite the opposite—but rather simply illuminates the vacuum. Ideally, the Indus Basin needs both types of institutions: ones that promote collaboration, as well as ones in which parties can agree to compete, such as courts, that thereby lead to an overall collaborative atmosphere.

Turning to collaboration proper, creating an atmosphere of trust as a relational starting point for Pakistan and India is a difficult challenge at the international level. As briefly addressed in Part II, the history of the IWT negotiations, coupled with the weighty pressures encumbering the treaty in contemporary times, present formidable obstacles for collaborative approaches.[344] That said, the IWT's institutional mechanism of the Permanent Indus Commission presents the best channel for this turn. For collaboration to occur, however, both countries will need to empower their respective commissioners, as well as the commission as a collective body, to assume much broader roles than their current remit of simply operationalizing the IWT with mandated data exchanges and site visits.[345] In this regard, the IWT itself lights the way, expressly calling for future cooperation in Article VII[346]: "The two Parties recognize that they have a common interest in the optimum development of the Rivers, and, to that end, they declare

342. *See generally* Robert H. Mnookin & Lewis Kornhauser, *Bargaining in the Shadow of the Law: The Case of Divorce*, 88 YALE L.J. 950 (1979).

343. Moreover, the development of such institutional capacity may not be favorable to powerful parties' interests in the basin, and weaker parties may lack necessary resources to pursue such an undertaking.

344. *See* Armin Rosencranz & Merlin Elizabeth Joseph, *By Building the Sawalkot Dam, Is India Using Water as a Weapon Against Pakistan?*, THE WIRE, Mar. 20, 2017, https://thewire.in/117410/sawalkot-dam-india-pakistan/.

345. *See* IWT *supra* note 3, at Art. VIII.

346. *Id.* at Art. VII.

their intention to co-operate, by mutual agreement, to the fullest possible extent."[347] This provision can be read to constitute a "reset button" for relations to escape from the clutches of tit-for-tat, zero-sum norms that have been allowed to fester through the decades and more so recently. These words of the IWT should be realized, and the express wishes and goodwill of the treaty's framers should be built upon through novel mechanisms informed by the Law of the River and other transboundary reference points.

Regarding interprovincial collaboration, a key institution is the Council of Common Interests (CCI) established by Article 153(1) of the 1973 Constitution of Pakistan.[348] Headed by the Prime Minister and composed of the chief ministers of the provinces and relevant civil servants appointed by the federation, the CCI is charged with resolving disputes between the federation and provinces as well as interprovincial conflicts.[349] Article 155 empowers the CCI as the exclusive body for reviewing complaints about water supplies.[350] The CCI is not precluded, however, from setting up a commission to advise it. With one lone caveat, the CCI is an ideal forum for fostering interprovincial collaboration in water planning and development, both for internal purposes within Pakistan as well as for external purposes at the international level. Concerning the caveat, as the CCI is a political body, its decisions are always reported as consensus discussions and subject to the perception that they are reached through politically expedient negotiations, rather than being representative of actual issues raised by groups opposing the dominant developmentalist narrative.[351] In light of this concern, if the CCI can develop more transparent norms for cooperative decision-making, perhaps including, but not limited to, public hearings, it appears to be an ideal institution for enabling interprovincial collaboration. Likewise, its decisions will have the added advantage of bearing the imprimatur of the country's politicians—a great starting point for broader-based and informed democratic participation in a hitherto overly-technocratic and closed-off water sector.

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347. *Id.* at Art. VII(1).
348. Sattar, *supra* note 117.
349. *Id.*
350. Const., art. 155 (Pak.) (amended 2010). The Eighteenth Amendment to the Constitution amended Article 155 to include within the CCI's purview complaints about supplies from "reservoirs." Constitution (Eighteenth Amendment) Act 2010 (Pak.), http://www.pakistani.org/pakistan/constitution/amendments/18amendment.html. By implication, the CCI's exclusive role dictates that the country's Supreme Court is not available to resolve water supply-related disputes between parties, including provincial and federal institutions.
351. *See* Sattar, *supra* note 117, at 96–101 (discussing federal dispute resolution procedures within CCI).

CONCLUSION

Millions of peoples' lives and livelihoods depend upon the Indus Basin's waters and the institutions governing them. Enshrined among these diverse entities and instruments are foundational transboundary institutions, such as the IWT and Pakistan's interprovincial Water Accord. While it is a hard pill to swallow, dysfunction and disarray undoubtedly capture the current state of these institutions. From economic, environmental, political, and social perspectives, the institutions inadequately serve Indian and Pakistani society, the disputed region of Kashmir, the emergent demand on the basin in Afghanistan, and the basin itself. One can imagine the daunting plight of farmers in this regard, placed at the mercy of erratic weather, climate change, and overallocation on one hand and unreliable institutions and bureaucrats on the other. As described by one farmer: "Rains have declined drastically and we have to irrigate our fields with underground water. This has increased the cost of cultivating crops. With poor rains, the underground water level has also decreased by three to four feet during the last three to four years."[352] Seeking to understand the water institutions that produce such uncertainty and demand so much in the form of non-virtuous adaptive coping has motivated this comparative study.

Unequivocally, the Indus and Colorado basins are different *places*. This observation has spatial and temporal dimensions that, together, reflect the fundamental point of contextuality as it bears on comparative water law and policy. There remain salient differences and similarities between the basins in regard to their geographies, histories, and water laws, policies, and associated institutions. Likewise, this Article has attempted to be mindful of the Law of the River's complex, compelling yet ultimately imperfect nature.

Notwithstanding the import of contextuality and institutional imperfection as threshold considerations, the Article's core thesis remains. Government officials tasked with implementing existing water institutions in the Indus Basin and evolving successors to these institutions should reflect in a critical, diligent manner on the Law of the River. Put differently, the diverse and complex water institutions that have come into being across the preceding century within North America's most "institutionally encompassed"[353] basin—institutions subject to rigorous study and novel innovations over the past two decades during the unprecedented,

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352. Saleem Sheikh, SciDev.Net, *Pakistani Farmers Confounded by Erratic Weather*, YOUTUBE (Sept. 5, 2013), https://www.youtube.com/watch?v=Yy6ETXTDO8U.

353. FRADKIN, *supra* note 17, at 16.

adaptation-forcing drought—should be regarded and harnessed as valuable reference points for institutional design within the Indus Basin and other contexts of transboundary water law and policy. This broad-based prescription applies across the board to the topics canvassed in Part III.

In the realm of transboundary water allocation and conservation, existing international and interstate instruments in the Colorado River Basin—for example, the *Arizona v. California* Decree and Minute 323's shortage sharing regime and binational water scarcity contingency plan—suggest the prospect of counterparts in the Indus Basin, including an IWT variable deliveries scheme addendum or an equitable, functional pro rata shortage sharing regime among Pakistan's provinces.[354] The same can be said about demand management as a policy priority in the Colorado River Basin. To what extent, if any, have policymakers and water managers in the Indus Basin given due consideration to such approaches in lieu of the structural "solutions" of costly additional dams and reservoirs with attendant drawbacks? The unfortunate answer appears to be: not much.[355] Water banking and marketing are illustrative in a similar way. While water markets have not yet taken root in the Colorado River Basin beyond the intrastate level, transboundary water banks exist in several forms along the Lower Colorado River, including the ICS program at the domestic level and Minute 323's trio of programs addressing Mexico's Water Reserve at the international level. Contextually tailored transboundary water banks and markets seemingly also hold promise in the Indus Basin, and preliminary attention should be paid to basic design and implementation matters like administrative structures and processes, certainty of entitlements, facilitative infrastructure, funding arrangements, and legal authority.[356]

Transboundary water governance similarly marks a broad domain where the Colorado River Basin offers reference points for institutional evolution in the Indus Basin. Technical capacity in the form of data generation and dissemination by government agencies is crucial in this area, as is the existence of external entities capable of independent data evaluation and research. Although there is still much room for progress, technical capacity for generating data generally exists in the Colorado River Basin, stemming from a suite of agencies such as the International Boundary and Water Commission and U.S. Bureau of Reclamation, as well as arrayed academic entities and non-governmental organizations. At

354. *See supra* Part III.A.1–2.
355. *See supra* Part III.A.3.
356. *See supra* Part III.A.4–5.

both the international and interprovincial levels in the Indus Basin, an external technical entity may prove useful in performing data generation and dissemination work over an interim period, both for sake of the work itself as well as the capacity- and relationship-building benefits.[357] In a related fashion, reflecting the collaborative turn in Colorado River governance during recent decades, this Article suggests that the Indus Basin might follow suit by empowering the Permanent Indus Commission and commissioners under the IWT and utilizing the CCI for water-related interprovincial collaboration within Pakistan.[358]

At a conceptual as well as practical level, all parties must recognize that this Article proposes solutions with short-term costs but long-term benefits. These benefits will accrue to people in the countries of the basin for generations to come. The short-term costs will be borne by some current users in the form of decreased water allocations, increased operating costs, and more restrictive operational controls. In practical terms, the best way to facilitate such a trade-off is to compensate the "losers" and to amortize the cost of that compensation over successive generations of the "winners." This can be done through loans, long-term government programs, and pay-back schemes that operate similar to a mortgage.

And that bring us to the words of former Pakistani President Ayub Khan for conclusion. They were uttered in regard to the IWT's formation more than a half century ago. "[W]e have been able to get the best that was possible . . . very often the best is the enemy of the good and in this case we have accepted the good after careful and realistic appreciation of our entire overall situation . . . [T]he basis of this agreement is realism and pragmatism."[359] The future evolution of the IWT, interprovincial Water Accord, and associated transboundary water institutions within the Indus Basin should be guided by applying this pragmatic vision of the treaty's framers to the preceding reflections from the Law of the Colorado River.

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357. *See supra* Part III.B.1.

358. *See supra* Part III.B.2.

359. Sardar Muhamad Tariq, *The Indus Waters Treaty and Emerging Water Management*, *in* PROBLEMS AND POLITICS OF WATER SHARING AND MANAGEMENT IN PAKISTAN 87, 88 (Pervaiz Iqbal Cheema et al. eds., 2007).