Four Challenges for International Water Law

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I. INTRODUCTION: SCARCITY, UNILATERAL ACTION, CLIMATE CHANGE, ENVIRONMENTAL DEGRADATION, AND SOCIAL INEQUITY: A RECIPE FOR REGIONAL CONFLICT?

Across the planet, water is an essential but unevenly distributed natural resource. A glance at a recent map of the world's water-stressed areas confirms that many of them lie in politically unstable and/or poor countries.[1] In the past two decades, environmental degradation and resource conflict have been identified as national or regional security issues potentially as serious as armed conflict.[2] Many water and security studies have drawn the normative conclusion that these stresses will result in internal and external conflicts over the use of limited water supplies and that these conflicts can lead to either military action or massive social unrest and political crises.[3] This Article does not evaluate the merits of these conclusions. Rather, it argues that the growing link between water allocation and global security exposes a number of weaknesses in international water law and governance that must be remedied to deal with the full range of global water stresses. It further argues that the United States has a vital stake in the reform of the law and governance institutions that have grown up in its shadow. The interest starts with the United States' two riparian neighbors, Canada and Mexico, with whom she has negotiated treaties and other water agreements that are vulnerable to many of the stresses described in the Article. Beyond our two neighbors, water stresses in a number of strategically important countries may complicate U.S. foreign policy

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1. Joseph Alcamo et al., Global Maps on the World Water Development Situation Prepared for the World Water Assessment Programme, http://www.usf.uni-kassel.de/wwap/results.htm (last visited Jan. 16, 2010).

2. *E.g.*, ROBIN CLARKE, WATER: THE INTERNATIONAL CRISIS (1991); ALEXANDER CARIUS, MELANIE KEMPER, SEBASTIAN OBERTHÜR & DETLEF SPRINZ, THE WOODROW WILSON CTR., NATO/CCMS PILOT STUDY: ENVIRONMENT AND SECURITY IN AN INTERNATIONAL CONTEXT 55-57 (1997); Jutta Brunnée & Stephen J. Toope, *Environmental Security and Freshwater Resources: Ecosystem Regime Building*, 91 AM. J. INT'L L. 26, 27 (1997); Elizabeth Burleson, *Water Is Security*, 31 ENVIRONS: ENVTL. L. & POL'Y J. 197 (2008).

3. *E.g.*, JON MARION TRONDALEN, U.N. WORLD WATER ASSESSMENT PROGRAMME, CLIMATE CHANGES, WATER SECURITY AND POSSIBLE REMEDIES FOR THE MIDDLE EAST (2009); Barbara Schreiner, *Issues of Balancing International Environmental and Equity Needs in a Situation of Water Scarcity*, *in* POLICY AND STRATEGIC BEHAVIOR IN WATER RESOURCE MANAGEMENT 207 (Ariel Dinar & Jose Albiac eds., 2009). For a summary of the literature as of 2007, see A. Dan Tarlock, *Water Security, Fear Mitigation and International Water Law*, 31 HAMLINE L. REV. 704, 707-12 (2008).

interests in promoting greater global security in Africa and Asia and the economic and environmental benefits that follow.[4]

International water law's four weaknesses are: (1) the gap between the law's aspiration to guarantee all riparian states a fair share of available, shared waters and the incentives for more powerful and wealthy states to take unilateral action that prejudices legitimate competing claims and threatens the well-being of those up- and downstream who rely on the water; (2) the gap between global climate change (GCC) adaptation studies, which call for flexible management regimes, and the law's long-standing goal of encouraging nations to negotiate fixed entitlement treaties in order to provide the stability necessary for infrastructure investment; (3) the frequent subordinations of the conservation of aquatic ecosystems to inconsistent, often consumptive, uses despite recent, laudable efforts to "blue" international water law; and (4) the continued promotion of the construction of large-scale dams, though these dams often do not deliver the promised benefits to the poor and disrupt indigenous communities and aquatic ecosystems.

Customary international water law often abets these stresses because it promotes a race to dam and thus provides incentives for nations to invest in large-scale projects without careful consideration of alternative ways to use the water. It stresses firm entitlements over cooperative, adaptive management regimes. It also contributes to the degradation of aquatic ecosystems by allowing this damage to be traded off against consumptive uses, despite efforts to induce a more just sharing of these vital water resources among riparian states to decrease regional tensions and to put environmental values on an equal footing with economic uses.

Two reforms have been proposed to supplement the customary rules to produce management regimes that are fair, flexible and address the four tensions: (1) shared benefits and (2) integrated water resources management (IWRM) combined with adaptive management. This Article details the four weaknesses and evaluates the pros and cons of the proposed solutions and suggests how they can be combined in ways which provide for fairer, open, environmentally sustainable, cooperative, and adaptive management regimes among riparian states.[5] Regimes need

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4. *See* SERGEI VINOGRADOV, PATRICIA WOUTERS & PATRICIA JONES, TRANSFORMING POTENTIAL CONFLICT INTO COOPERATION POTENTIAL: THE ROLE OF INTERNATIONAL WATER LAW 12 (2003).

5. This reflects the growing consensus that GCC adaptation is one of the major challenges facing water managers and that any new regimes that develop must be, inter alia, at the river basin level, environmentally sustainable, and "within the context of IWRM (Integrated Water Resources Management)." U.N. Econ. Comm'n for Eur., *Convention on the Protection and*

to be more receptive to the inclusion of a wider range of interests and open to more innovative management approaches to manage and distribute risk.

International law alone cannot, of course, create sharing regimes that are fair and adaptable and decrease the risks of conflicts. It is too weak due to the ineffectiveness of enforcement. Reform can at best serve two functions. First, it can decrease the uncertainty inherent in the current law and thus increase the incentives to develop more effective and open management regimes.[6] Second, as these regimes develop, international water norms can serve as background standards by which the legitimacy and effectiveness of a regime can be evaluated.[7]

II. INTERNATIONAL WATER LAW: FAIR DISTRIBUTION VERSUS UNILATERAL ACTION TO DAM AND DIVERT

International water lawyers have long recognized that the central problem of too many international rivers has been the unilateral practice of damming and diverting and then defending the new status quo against down- or upstream objections. The long-running conflict among Turkey, Syria, and Iraq over the development and use of the Tigris and Euphrates Rivers, both of which begin in Turkey, is a prime example of upstream unilateral development. For decades, the three riparians have been unable to agree on a permanent apportionment regime. In the 1980s, Turkey started an ambitious development program on the Euphrates, to which she contributes 90% of the annual flow, beginning with the completion of the Ataturk Dam in 1992. Turkey has unilaterally agreed

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Use of Transboundary Watercourses and International Lakes, Guidance on Water and Adaptation to Climate Change 15, U.N. Doc. ECE/MP.WAT/30, U.N. Sales No. 09.II.E.14 (2009). In holding that the U.S. Army Corps of Engineers illegally operated a flood control project for the benefit of urban Atlanta to the detriment of the downstream states of Alabama and Florida, a district court concluded with the observation, "Only by cooperating, planning, and conserving can we avoid the situations that gave rise to this litigation." *In re* Tri-State Water Rights Litig., 639 F. Supp. 2d 1308, 1355 (M.D. Fla. 2009).

6. Or not. In *Hungary v. Slovakia*, discussed *infra* notes 44 and 195, the International Court of Justice found both parties at fault and ordered them to negotiate in good faith. The parties have cooperated but remain deadlocked because "Slovakia's aim is to maintain the *status quo* at the upper section [of the Danube], change at the bottom, while Hungary wishes change at the upper section and wants to keep the *status quo* at the bottom section." Marcel Szabo, *The Implementation of the Judgment of the ICJ in the Gabčikovo-Nagymaros Dispute*, 5 IUSTUM AEQUUM SALUTARE 15, 18 (2009) (Hung.).

7. See Joseph W. Dellapenna, *International Law's Lessons for the Law of the Lakes*, 40 U. MICH. J.L. REFORM 747, 778-96 (2007), for a thorough, if somewhat harsh, application of international water law to the new Great Lakes regulatory regimes discussed *infra* notes 112 to 131.

that she would guarantee a yearly flow of 15.75 km^3 to Syria[8] and has in fact abided by her unilateral guarantee. Further, in 2008 she agreed to the creation of an Iraq-Syria-Turkey water research institute, which will work toward a sharing regime.[9] At the same time that Turkey agreed to this nonbinding sharing regime, she continued to make the legally erroneous claim that the Euphrates only becomes an international river when it joins the Tigris near Basra, Iraq, a claim which has no precedent in international water law.[10] This echoes the 1895 "Harmon Doctrine" articulated by the United States, which claims that what falls on a nation stays there as a matter of privilege.[11]

Customary international water law, following the Lake Lanoux Arbitration,[12] sanctions unilateral dam construction but does not adopt Turkey's narrow definition of an international river. The arbitration arose out of Spain's objection to France's approval of a hydroelectric project, which would reduce the flow of a river that flowed out of Lake Lanoux into Spain.[13] France eventually agreed to restore the pre-project flow of the river, but Spain argued that an 1866 treaty and customary international law guaranteed her the natural flow of the river.[14] This is the counter-Harmon Doctrine because it asserts that upstream states cannot alter the natural flow of international rivers.[15] Both claims are too extreme, and the tribunal found no violation of the treaty or customary international law because the diversion of a river was a reasonable use and Spain had not established a serious injury.[16] However, the tribunal treated the river as an international one, and this position is reflected in subsequent codifications of customary international law.[17] Turkey's

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8. This information is taken from AQUASTAT: Food & Agric. Org. of the U.N., FAO's Information System on Water and Agriculture: Iraq, http://www.fao.org/nr/water/aquastat/countries/iraq/index.stm (last visited Jan. 15, 2010).

9. *Id.*

10. *See infra* notes 11-16.

11. This theory of absolute territorial sovereignty was first articulated by the United States Attorney General, Justin Harmon, to reject Mexico's claim to a share of the Rio Grande River at a time when the United States was starting to use the Upper Rio Grande. For an analysis of the "Harmon Doctrine," see STEPHEN S. MCCAFFREY, THE LAW OF INTERNATIONAL WATERCOURSES: NON-NAVIGATIONAL USES 111-70 (2d ed. 2007).

12. Brunson MacChesney, Lake Lanoux Case (France-Spain), 53 AM. J. INT'L L. 156, 165 (1959).

13. *Id.* at 158.

14. *Id.* at 158-60.

15. McCaffrey, *supra* note 11, at 99.

16. *Id.* at 162.

17. Convention of the Law of the Non-Navigational Uses of International Watercourses, art. 2, G.A. Res. 51/229, Annex, U.N. GAOR, 51st Sess., Supp. No. 49, U.N. Doc. A/51/49 (*opened for signature* May 21, 1997) [hereinafter Watercourses Convention]. Article 2 defines an international watercourse as "a watercourse, parts of which are situated in different States."

extreme version of the Harmon Doctrine may be changing for the better as a by-product of her recent foreign policy decision to reengage the Arab portion of her former Ottoman Empire.[18]

Downstream states can also make life difficult for more slowly developing upstream states by unilateral action. The endless struggle between Egypt, which claims the right to most of the flow of the two Niles to support her high dams, and her upstream neighbors, and conflicts among the central Asian nations over the Amu Darya and Syr Darya rivers[19] are examples of how upstream states can be victimized by powerful downstream ones. The headwater states on the two Niles were unable to put substantial amounts of water to beneficial use before entrenched agricultural and urban economies developed downstream in Egypt.[20] As a result, the basin states have been able to come up with a sharing regime acceptable to all nations.[21] GCC only exacerbates the need to develop fair sharing regimes.[22]

Ideally, there should be no race to dam and divert. Dams should be built through cooperation with all the impacted riparian states, and only after adverse impacts have been addressed, a mitigation program developed, and a shared management regime put in place.[23] This ideal has been the great project of international water law,[24] which starts from the assumption, at least among academic experts, that transboundary

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18. In 2009, Turkey hosted a meeting on the use of international river basins, including the Tigris in Ankara. Hans-Jürgen Schlamp, Daniel Steinvorth & Bernhard Zand, *The Eternal Candidate: Turkey Bets on Regional Influence as EU Hopes Fade*, SPIEGEL ONLINE, June 4, 2009, http://www.spiegel.de/international/europe/0,1518,628575,00.html (Christopher Sultan trans.).

19. *See infra* notes 163-180 and accompanying text.

20. The immediate root of the conflict is the 1929 Nile Waters Agreement, which apportioned most of the river's flow to Egypt and the Sudan. Paul Howell, *Nile Waters*, 33 J. AFR. HIST. 149, 150 (1992) (reviewing ROBERT O. COLLINS, THE WATERS OF THE NILE: HYDROPOLITICS AND THE JONGLEI CANAL, 1900-1988 (1990)); *see* COLLINS, *supra*, at 156-58; Robert O. Collins, *History, Hydropolitics and the Nile: Myth or Reality*, *in* THE NILE: SHARING A SCARCE RESOURCE 109 (P.P. Howell & J.A. Alan eds., 1994); Ashok Swain, *Ethiopia, the Sudan, and Egypt: The Nile River Dispute*, 35 J. MOD. AFR. STUD. 675, 677 (1997).

21. *See infra* notes 183-187 and accompanying text.

22. *See* TRONDALEN, *supra* note 3.

23. *E.g.*, Patricia Wouters, *The Relevance and the Role of Water Law in the Sustainable Development of Freshwater: From "Hydrosovereignty" to "Hydrosolidarity,"* 25 WATER INT'L 202 (2000).

24. One of the leading forces in the development of the doctrine of equitable utilization reports that upstream-downstream conflicts were the impetus for the International Law Association's (ILA) development of rules and that there were sharp differences of opinion among up and downstream states. Charles B. Bourne, *The International Law Association's Contribution to International Water Resources Law*, *in* INTERNATIONAL LAW OF WATER RESOURCES: CONTRIBUTION OF THE INTERNATIONAL LAW ASSOCIATION (1954-2000), at 3-4 (Slavko Bogdanovic, Sergei Vinogradov & Patricia Wouters eds., 2001).

rivers should be shared in such a way that allows each riparian state a realistic opportunity to make an equitable and reasonable utilization of this water.[25] Upstream states do not have an absolute right to control and use all the water that originates in their territories, and downstream states do not have the corresponding right to block upstream development by demanding the unimpeded flow of a river into their territories.[26] At the base of all formulations of the principle of equitable apportionment is the norm of fundamental fairness: no riparian state should be able to unilaterally preclude other states from using their fair share of an international river.[27]

International water law is said to be derived from United States Supreme Court jurisprudence.[28] Article III of the United States Constitution gives the Supreme Court the power to hear water disputes among the states because they cannot make war against each other.[29] When the Supreme Court decided it would use its original jurisdiction to apportion interstate streams, ironically, it relied on the international rule that all states are of equal dignity to support the principle that all riparian states are entitled to an equitable apportionment of an interstate river.[30] Whatever the source of the original principle, international water law used the concept of equitable apportionment to provide the legal basis to constrain unilateral action, positing that all states are entitled to make equitable and reasonable utilization of international rivers. Equitable apportionment rejects the argument frequently asserted by headwaters

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25. Many nations see a difference between sharing a resource and the privilege to make an equitable utilization, although this may be a distinction without a difference. The initial drafts of the Watercourses Convention classified the waters of these rivers as a "shared natural resource." Stephen C. McCaffrey, Special Rapporteur, *Second Report on the Law of Non-Navigational Uses of International Watercourses*, ¶ 14, U.N. Doc. A/CN.4/399 (1986). However, many states objected because of the suggestion that this implied the right of a riparian nation to participate fully in the allocation and decisions of another nation. To mollify these concerns, the privilege was redefined as "the watercourse States . . . shall share in the use of the waters of the [international] watercourse in a reasonable and equitable manner." *Id.*

26. At least four theories of the right to use international waters have been identified. They are (1) absolute territorial sovereignty, (2) absolute territorial integrity, (3) prior appropriation, and (4) restricted sovereignty and community of interests. Edith Brown Weiss, *The Evolution of International Water Law*, 331 RECUEIL DES COURS 163, 184-98 (2009). There is a widespread consensus that the choice is between the last two and that the first two have been rejected as unfair and inefficient. *Id.*; McCaffrey, *supra* note 11, at 112.

27. This principle is consistent with the modern characterization of international law as a system to promote distributive justice to scarce resources among the international community. In his seminal book, FAIRNESS IN INTERNATIONAL LAW AND INSTITUTIONS 74 (1995), Thomas M. Franck describes the Convention as an effort "to provide for distribution of a scarce resource through the application of broadly conceived equity."

28. Kansas v. Colorado, 185 U.S. 125, 143-44 (1902).

29. *Id.*

30. *Id.* at 144-47.

nations that they have the privilege to use all the water which originates within their territory. It equally rejects the argument of downstream states that they are entitled to the natural or unaltered flow of an international river.[31]

All current formulations of equitable apportionment derive from the 1966 Helsinki Rules[32] and the refinement of the Rules in the July 8, 1997, United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (Watercourses Convention).[33] The Watercourses Convention may never come into force but it is regarded as an authoritative statement of customary law.[34] The Helsinki Rules were revised in 2006 by the Berlin Rules,[35] which articulate a progressive vision of shared river management with enhanced environmental protection duties, but the core concept remains relatively unchanged from the Helsinki Rules and the Convention.[36]

Article 5 of the Watercourses Convention enjoins states to use watercourses in an "equitable and reasonable manner."[37] Article VI lists seven nonweighted factors relevant to the determination of what is "equitable" and "reasonable."[38] This international law formulation broadened the United States' equitable apportionment law, which was primarily developed from disputes in the western states that follow the law of prior appropriation, and thus is heavily weighted toward the protection of prior uses.[39] In international water law, the protection of prior uses is an important but not decisive factor because the need to insure all riparian nations an equal opportunity to make future uses is equally important as the protection of existing uses because, unlike in the United States, there is no central authority to mediate and finance alternative distributions of water.[40] The Watercourses Convention still allows unilateral state action, but it is now constrained by the principle of

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31. *See* McCaffrey, *supra* note 11, at 77, 100, 110.

32. ILA, *Helsinki Rules on the Uses of Waters of International Rivers*, 52 Int'l L. Ass'n Rep. Conf. 484 (1966) [hereinafter *Helsinki Rules*]. The ILA report is reprinted in INTERNATIONAL LAW OF WATER RESOURCES: CONTRIBUTION OF THE INTERNATIONAL LAW ASSOCIATION, *supra* note 24, at 99.

33. Watercourses Convention, *supra* note 17.

34. Brown Weiss, *supra* note 26, at 258.

35. ILA, *Berlin Rules on Water Resources and Commentary*, 71 INT'L L. ASS'N REP. CONF. 334 (2004) [hereinafter *Berlin Rules*].

36. *Id.* arts. 12-13 (commentary).

37. Watercourses Convention, *supra* note 17.

38. *Id.*

39. Wyoming v. Colorado, 259 U.S. 419, 458-59 (1922).

40. The U.S. federal government has the power to apportion interstate rivers, Arizona v. California, 373 U.S. 546, 292-94 (1962), and during the first six decades of the twentieth century financed multipurpose projects to develop interstate rivers for the benefit of all riparian states.

equitable and reasonable utilization, which allows other states to object to a dam, diversion, or discharge if they can prove significant harm.[41] Harm can range from the displacement of existing uses to preempted development opportunities.[42] Thus, a late-developing riparian state is not barred from asserting her right to an equitable apportionment.[43]

Equal sharing is reinforced by various procedural duties, such as prior notice of a major water project and adequate environmental impact assessment, which promote riparian nation cooperation. It is also reinforced by the International Court of Justice's (ICJ) recognition of equitable apportionment, as articulated in the Watercourses Convention, as a customary norm. In *Hungary v. Slovakia*, the ICJ held that the former Czechoslovakia's unilateral decision to proceed with a dam-and-lock project on the Danube, which diverted 80% to 90% of the river's flow, over Hungary's environmental objections, deprived "Hungary of its right to an equitable and reasonable share of the natural resources of the Danube."[44]

Unfortunately, on the ground the project of constraining unilateral action can at best be described as a very limited success. States such as China, India, and Turkey continue to engage in large multipurpose water projects unilaterally. Asia is now rife with conflicts between proposed dams in headwaters states and downstream states. For example, India is concerned about China's plans to divert water from the Yarlung Tsangpo River in the Tibetan Plateau to bail out the stressed Yellow River Basin in northern China.[45] At the same time, India has been engaged in a long-running dispute with Bangladesh over the Tipaimukh project on the Barak River in northeast India. Bangladesh argues that the project has devastating impacts on all downstream uses and indigenous groups who depend on the river.[46]

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41. Watercourses Convention, *supra* note 17, art. 7. See ATTILA TANZI & MAURIZIO ARCARI, THE UNITED NATIONS CONVENTION ON THE LAW OF INTERNATIONAL WATERCOURSES: A FRAMEWORK FOR SHARING 142-60, 175-79 (2001), for a history of the article and its relationship to the privilege of equitable and reasonable use.

42. It has even been suggested that a state which foregoes a project which would cause significant harm to co-riparians is entitled to compensation. TANZI & ARCARI, *supra* note 41, at 166.

43. Afghanistan is a classic example of a very slowly developing headwaters state. *See* James C. McMurray & A. Dan Tarlock, *The Law of Later-Developing Riparian States: The Case of Afghanistan*, 12 N.Y.U. ENVTL. L.J. 711 (2005).

44. Gabčikovo-Nagymaros Project (Hung. v. Slovk.), 1997 I.C.J. 7, 56, 193 (Sept. 25).

45. Kimberly Layton, Inst. of Peace & Conflict Studies, Tibetan Waters: Coming Conflict? (July 29, 2009), http://www.ipcs.org/article/india/Tibetan-waters-coming-conflict-2923.html.

46. Jiten Yumnam, Transboundary Water Conflicts and Tipaimukh Dam (July 28, 2008), http://icrindia.org/?p=412.

These conflicts reflect the fact that geopolitics, not law, drives unilateral action, but international water law shares some of the blame because the equitable apportionment factors are vague. All uses of international rivers are correlative and thus can only be determined in relationship to the uses of other riparians. The geography, hydrology and climate of the basin, past utilization, the population and economic and social needs of the basin, and the availability of alternative sources of supply are among the relevant factors to be considered in determining what is a reasonable and equitable use of the water.[47] The vagueness of the factors combined with inadequate enforcement institutions create incentives for nations to continue to dam and divert first and respond to objections second. However, this is a not a legal justification for unilateral action. The factors are not incoherent or incapable of unilateral application; sufficient guidelines have been developed which allow nations to make a reasonably accurate assessment of their entitlement in relation to other riparian nations.[48] But the law is better, if slow, at corrective than distributive justice. It is easier to remedy a past violation of a firm obligation than to encourage states to take actions that would prevent future conflicts.[49]

III. LARGE DAMS, LARGE PROBLEMS

International water law's tolerance for unilateral action has encouraged the construction of large dams and multipurpose water projects throughout the world. During the first three decades of the twentieth century, the Soviet Union and the United States developed

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47. *Helsinki Rules*, *supra* note 32, art. V.

48. PATRICIA WOUTERS ET AL., SHARING TRANSBOUNDARY WATERS: AN INTEGRATED ASSESSMENT OF EQUITABLE ENTITLEMENT: THE LEGAL ASSESSMENT MODEL (UNESCO Technical Documents in Hydrology No. 74, 2005), *available at* http://unesdoc.unesco.org/images/0013/001397/439794e.pdf, is the most ambitious effort to provide a framework to apply the equitable apportionment factors.

49. For example, starting in 1992, Mexico failed to honor its delivery obligations under the Mexico-United States Treaty for the Rio Grande River. After years of unsuccessful efforts by the U.S. State Department to resolve the issue, Texas irrigators tried to use Chapter 11 of NAFTA. Chapter 11 allows a foreign investor to challenge host nation actions which are "tantamount to nationalization or expropriation," but Mexico and the State Department obtained a dismissal because NAFTA applies only to host nation investments and all the lost investment was in Texas not Mexico. North American Free Trade Agreement, U.S.-Can.-Mex., ch. 11, § A, art. 1110, Dec. 17, 1992, 32 I.L.M. 289 (1993). However, in 2005 Mexico agreed to a repayment schedule. *See* Gregory F. Szydlowski, *The Commoditization of Water: A Look at Canadian Bulk Water Exports, the Texas Water Dispute, and the Ongoing Battle Under NAFTA for Control of Water Resources*, 18 COLO. J. INT'L ENVTL. L & POL'Y 665, 679-80 (2007); Jorge E. Vinuales, Workshop Paper, *Access to Water in Foreign Investment Disputes*, 21 GEO. INT'L ENVTL. L. REV. 733, 743-47 (2009).

large multipurpose dams and reservoirs to stimulate national and regional economic development.[50] After World War II, both countries competed aggressively to export this idea to Africa and Asia.[51] Dam construction continues to thrive in China, India, Brazil, and many other developing countries, but in the late twentieth century, the social, equitable, environmental, and economic costs of these projects became clearer. Many large dams and irrigation projects foreclose future downstream (and upstream) uses and produce high, unaccounted-for social and environmental costs, and the international community has now begun the process of calculating these costs and trying to mitigate them. In 2000, a privately funded commission published a major critique of large dams, especially those built after World War II in developing countries.[52] The World Commission on Dams estimated that most of the forty to eighty million people resettled by dams "have rarely had their livelihoods restored."[53]

A subsequent social displacement study by a Commission member reported that minorities are disproportionately victims of dams and reservoirs in Canada, India, Mexico, and the United States, but in China, Japan, and Korea, the victims are the majority poor.[54] The study also found that many irrigation dams "have typically fallen short of physical targets, did not recover their costs and have been less profitable in economic terms."[55] Even the flood control benefits of these dams are at best mixed. The role of dams in preventing flood damage has long been controversial because dams encourage irresponsible flood plain behavior. The World's Commission on Dams also found considerable evidence that

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50. For a history of the "Big Dam Era" in the United States, see JOHN R. FERRELL, BIG DAM ERA: A LEGISLATIVE AND INSTITUTIONAL HISTORY OF THE PICK-SLOAN MISSOURI BASIN PROGRAM (1993), and MARC REISNER, CADILLAC DESERT: THE AMERICAN WEST AND ITS DISAPPEARING WATER (1986).

51. The most spectacular example is the withdrawal of United States aid to finance the Aswan High Dam after Egypt entered into a cotton-for-arms barter with Czechoslovakia. The Soviet Union seized the opportunity to finance the dam and to send military advisors to Egypt. HUSSEIN FAHIM, DAMS, PEOPLE AND DEVELOPMENT: THE ASWAN HIGH DAM CASE (1981).

52. WORLD COMM'N ON DAMS, DAMS AND DEVELOPMENT: A NEW FRAMEWORK FOR DECISIONMAKING (2000).

53. *Id.* at 129. For a case of the impact of dams on the First Nations of western Canada, see KENICHI MATSUI, NATIVE PEOPLES AND WATER RIGHTS: IRRIGATION, DAMS, AND THE LAW IN WESTERN CANADA (2009).

54. THAYER SCUDDER, THE FUTURE OF LARGE DAMS: DEALING WITH SOCIAL, ENVIRONMENTAL, INSTITUTIONAL AND POLITICAL COSTS 61 (2005); *see* INT'L INST. FOR ENV'T & DEV., SHARING THE BENEFITS OF LARGE DAMS IN WEST AFRICA (Jamie Skinner, Madiodio Niasse & Lawrence Haas eds., 2009) (discussing the impact of dam projects on poor communities).

55. WORLD COMM'N ON DAMS, *supra* note 52, at 68; *see also* John Briscoe, *Water Security: Why It Matters and What To Do About It*, 4 INNOVATIONS 3, 8 (2009) (describing the positive role that water infrastructure development in Petrolina, Brazil, has had on creating jobs for the poor in the region).

dams are moral hazards because they exacerbate rather than alleviate the risks of flood damage.[56] And, reservoirs may account for between 1% and 28% of all greenhouse gas emissions. Altered downstream flows can disrupt flood-dependent ecosystems and societies who depend on them.[57]

IV. GLOBAL CLIMATE CHANGE

Global Climate Change is the third reason that international water law is stressed. There is a relatively firm consensus that the world's arid and semiarid regions, including the southwestern United States,[58] will face a net loss of stream runoff as glaciers melt and annual winter snowpacks diminish at the same time that summer evaporation increases.[59] The California Department of Water Resources estimates that the state's vital Sierra Nevada Mountain snowpack, on which both its agriculture and cities depend, "will experience a 25 to 40 percent reduction from its historic average by 2050."[60] Arid and semiarid regions in the tropics and subtropics and Mediterranean regions in southern Europe, South America, and Australia are equally vulnerable to GCC.[61] Arid areas may also face intense outbursts of floods.[62]

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56. WORLD COMM'N ON DAMS, *supra* note 52, at 58-62. This argument is partially adopted by a United States government study on ways to lessen the damage caused by large floods. *See* INTERAGENCY FLOODPLAIN MGMT. REVIEW COMM., SHARING THE CHALLENGE: FLOODPLAIN MANAGEMENT INTO THE 21ST CENTURY 180 (1994).

57. SCUDDER, *supra* note 54, at 75, 213-18.

58. This water loss will stress irrigated agriculture. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), CLIMATE CHANGE AND WATER (IPCC Technical Paper VI, 2008), *available at* http://www.ipcc.ch/pdf/technical-papers/climate-change-water-en.pdf. The IPCC summarizes the studies that predict a decline in irrigated acreage and withdrawals in the United States due to higher temperatures and greater yields by rain-fed crops as precipitation increases in nonarid areas. In addition to reduced demand for irrigation, some experts recommend that imports of food be increased (an issue that sunk the Doha Round of trade negotiations in 2008) to create virtual water. However, the IPCC also counsels, "These studies [do] not take into account the increasing variability of daily precipitation and, as such, rain-fed yields are probably overestimated." *Id.* at 62.

59. *E.g.*, NAT'L RESEARCH COUNCIL, COLORADO RIVER BASIN WATER MANAGEMENT: EVALUATING AND ADJUSTING TO HYDROCLIMATIC VARIABILITY (2007) (evaluating the potential impacts of reduced flows on the existing uses of the Colorado River).

60. CAL. RES. AGENCY, DEP'T OF WATER RES., MANAGING AN UNCERTAIN FUTURE: CLIMATE CHANGE ADAPTATION STRATEGIES FOR CALIFORNIA'S WATER 4 (2008), *available at* http://www.water.ca.gov/climatechange/docs/ClimateChangeWhitePaper.pdf.

61. IPCC, *supra* note 58, at 59.

62. Declan Conway et al., *Rainfall and Water Resource Availability on Sub-Saharan Africa During the 20th Century* (Tyndall Ctr. for Climate Research, Working Paper No. 119, 2008) (predicting that Ethiopia will experience increased flooding); Anjali Nayar, *When the Ice Melts*, NATURE, Oct. 22, 2009, at 1042, 1042-46 (detailing the flood risks that Bhutan faces from melting glaciers which may cause glacial lakes to burst).

Predictions are cloudier and mixed for more humid areas, but the impacts could be no less serious under a wetter, warmer future. Many of these areas throughout the world, especially Europe, East Africa, Central Asia, and the equatorial Pacific Ocean, may experience intense bursts of increased runoff, which may cause severe flood events at the same time that these areas experience lower summer water flows in major, heavily used rivers. For example, summer flows in the heavily used Rhine River may decrease from 5 to 15%.[63] In the southeastern United States, Florida, South Carolina, Texas, and western Georgia are more vulnerable to droughts,[64] especially as population has increased in parts of the region.[65] A synthesis of the climate change literature for the Great Lakes concludes:

> Mean annual lake surface evaporation could increase by as much as 39 percent due to an increase in lake surface temperatures. This will present particular concern during summer and autumn, which are already characterized by low stream flow. Moreover, with increased evapotranspiration and decreased snowpack, less moisture will enter the soil and groundwater zones, and runoff will be even further decreased. Consequently, under future warmer and drier conditions, Great Lakes residents could become more vulnerable to water supply and demand mismatches.[66]

Responding to GCC raises a complex mix of technical, economic, and moral issues. Technical questions such as the timing, location, and magnitude of the change are daunting because of the high degree of uncertainty that exists in all efforts to apply GCC scenarios to smaller geographic scales.[67] If historic flows decline in many river basins and severe floods become more frequent in others, all the fundamental hydrologic assumptions upon which water allocation, water pollution control, and aquatic ecosystem conservation are premised must be

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63. Alan Nicol & Nanki Kaur, *Adapting to Climate Change in the Water Sector*, OVERSEAS DEV. INST. BACKGROUND NOTE (2009), http://www.odi.org.uk/resources/download/3149.pdf.

64. OXFAM AM., EXPOSED: SOCIAL VULNERABILITY AND CLIMATE CHANGE IN THE US SOUTHEAST 6-7 (2009), *available at* http://adapt.oxfamamerica.org/resources/Exposed_Report.pdf.

65. The Southeast experienced a severe drought in 2005-2007 which stressed Atlanta's water supply and destroyed billions of dollars of crops. However, three Columbia University scientists have concluded that the stresses were the product of regional population growth and bad planning not GCC. Richard Seager, Alexandrina Tzanova & Jennifer Nakamura, *Drought in the Southeastern United States: Causes, Variability over the Last Millennium and the Potential Future Hydroclimatic Change*, 22 J. OF CLIMATE 5021, 5022 (2009).

66. Noah D. Hall & Bret B. Stuntz, *Climate Change and Great Lakes Water Resources: Avoiding Future Conflicts with Conservation*, 31 HAMLINE L. REV. 641, 645 (2008).

67. *See* U.N. ECON. COMM'N FOR EUR., *supra* note 5.

reevaluated starting with the hydroelectric generating capacity of the large multipurpose systems around the world.[68]

Since the Climate Change Kyoto Protocol, the global community has been focused on mitigating the adverse impacts of altered climates by rolling back greenhouse gas emissions. Unfortunately for water-stressed nations and regions, mitigation does no good for two reasons. First, real mitigation is unlikely to happen as greenhouse gas emissions continue to rise as the nations tinker with modest reduction allowances and offsets.[69] Second, even if real mitigation were to take place, it will be at least a century before any benefits are realized.[70] Thus, the only option for nations and water managers is to adapt to the inevitable changes that are already manifesting themselves.[71] Adaptation takes the various adverse impact scenarios as a given and asks how the adverse impacts can be reduced through changes in resource use.[72] Techniques range from physical projects, such as barriers to protect flood-prone areas, to management changes. With respect to water, the tool kit includes scenario development, adaptive management,[73] supply enhancement, demand management, water transfers, and integrated water resources

68. *E.g.*, WORLD ECON. FORUM, THIRSTY ENERGY: WATER AND ENERGY IN THE 21ST CENTURY 13 (2009).

69. The December 2009 Copenhagen Summit failed to produce a treaty or other agreement committing the nations of the world to greenhouse gas emissions reductions sufficient to meet the scientific consensus goal of a maximum two-degree Celsius temperature rise. Instead, it produced the last minute Copenhagen Accord among the United States, Brazil, China, India, and South Africa. The Accord commits the major nations to nonbinding percentage greenhouse gas emission reductions below 2005 levels and other measures, all of which fall short of limiting projected temperature increases to two degrees Celsius. Fifteenth Conference of the Parties to the Copenhagen Accord, Copenhagen, Den., Dec. 7-18, 2009, *Draft Decision*, ¶ 10, U.N. Doc. FCCC/CP/2009/L.7 (Dec. 18, 2009).

70. Dr. Susan Solomon, winner of the 2009 Volvo Environmental Prize, estimates that changes produced by anthropocentric CO_2 emissions will last until 3000. Thomas H. Maugh, *Climate Change Has a Firm Grip*, L.A. TIMES, Jan. 27, 2009, http://articles.latimes.com/2009/jan/27/science/sci-warming27.

71. The retreat of glaciers around the world provides one the clearest examples of established change. *E.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE COMPENDIUM 113-23 (2009).

72. Adaptation has been criticized because it deflects attention away from mitigation. Holly Doremus & Michael Hanemann, *The Challenges of Dynamic Water Management in the American West*, 26 UCLA J. ENVTL. L & POL'Y 55, 56-57 (2008), discuss and answer the objections. *See generally* Matthew D. Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 ECOLOGY L.Q. 61 (2007) (discussing potential for problems in adaptation approach).

73. *See infra* notes 223-228 and accompanying text.

planning.[74] More flexible institutions, which are capable of responding to real-time events, will be required.

The technical issues merge into the economic ones. To take one example, GCC will increase the demand for water for food production at the same time that it stresses the hydroelectric energy sector as many basins through the world experience lower flows. GCC is a moral issue as well as a technical and economic one. Mitigation has been cast as a social justice issue,[75] an obligation *erga omnes*, but adaptation raises equally compelling social justice issues. Many water users dependent on stressed rivers and aquifers have little capacity to adapt.[76] And, many water-stressed nations are poor and can only take the necessary adaptation steps if the Least Developed Countries Fund, created by the 2001 meeting of the U.N. Framework Convention on Climate Change, provides them the necessary funds. The initial success of this effort is not promising as the Fund is underfunded and has been slow to disburse money.[77] Thus, the interests of indigenous peoples, the poor and the environment may suffer disproportionately as states make the water management choices necessary to adapt to GCC.[78]

Adaptation will be legally challenging because both domestic and international water law has long stressed stability, which has been associated with destabilizing uncertainty, over flexibility. To promote the efficient use of rivers and aquifers, water law has sought to create secure rights to encourage infrastructure investment. On many river basins the vagueness of equitable apportionment formulations were corrected by

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74. ALAN NICOL & NANKI KAUR, OVERSEAS DEV. INST., ADAPTING TO CLIMATE CHANGE IN THE WATER SECTOR 5 (2009), *available at* http://www.reliefweb.int/rw/RWfiles2009.nsf/FilesByRWDocUnidFilename/SNAA-7QA9L2-full_report.pdf/$file/full_report.pdf.

75. Climate change students have adopted Professor Edith Brown Weiss's seminal principle of intergenerational justice. EDITH BROWN WEISS, IN FAIRNESS TO FUTURE GENERATIONS (1989); *see also* BURNS H. WESTON & TRACY BACH, CLIMATE LEGACY INST., RECALIBRATING THE LAW OF HUMANS WITH THE LAWS OF NATURE: CLIMATE CHANGE, HUMAN RIGHTS, AND INTERGENERATIONAL JUSTICE (2009); John Holland, *The United States and Its Climate Change Policy: Advocating an Alignment of National Interest and Ethical Obligations*, 23 NOTRE DAME J.L. ETHICS & PUB. POL'Y 623 (2009).

76. Erik Ansink & Arjan Ruijus, *Climate Change and the Stability of Water Allocation Agreements* (FEEM Workshop, Working Paper No. 16, 2007), *available at* http://papers.ssrn.com/sol13/papers/cfm?abstract_id=962389, conclude that dramatic declines as well as increases in mean river flows decrease the stability of fixed allocation agreements.

77. Ten times the available funds are necessary to fund all the adaptation projects currently submitted to the Fund. Nayar, *supra* note 62, at 1045.

78. An early study, WILLIAM D. NORDHAUS & JOSEPH BOYER, WARMING THE WORLD: ECONOMIC MODELS OF GLOBAL WARMING 81 (2000), estimated that climate change will cost people in Sub-Saharan Africa 226 million life years. A more recent one, GLOBAL HUMANITARIAN FORUM, THE HUMAN IMPACT REPORT: CLIMATE CHANGE—THE ANATOMY OF A SILENT CRISIS 1, 3 (2009), estimated that 500 million people are at "extreme risk."

treaties and other agreements among riparian states. Therefore, treaty regimes are usually rigid one-off allocations because nations are reluctant to surrender any additional sovereignty to create the necessary adaptive management institutions, especially with the flexibility to adjust to changed conditions such as GCC.[79]

Nations have good reason to resist change. The recognition that each riparian nation has a right to a fixed, firm, and fair share of an international river through adjudication, arbitration, or a treaty is a major legal achievement. A fixed apportionment of "wet" water among the riparian states promotes development and interstate fairness. However, the general assumption that treaties create perpetual rights unless the countries agree to revise the instrument[80] may create problems as nations develop GCC adaptation strategies, and the establishment and protection of fixed entitlements runs counter to the thinking among students of adaptation. Experts have begun to identify the desired characteristics of an effective adaptive allocation regime. Adaptive regimes are characterized by the flexibility to make real-time allocations to adjust to changed conditions. In turn, this requires a high degree of cooperative management among riparian nations.

For example, the Economic Commission for Europe concludes:

> In the transboundary context, riparian countries should focus on generating basin-wide benefits and on sharing those benefits in a manner that is agreed as equitable and reasonable. A focus on sharing the benefits derived from the use of water, rather than the allocation of water itself, provides far greater scope for identifying mutually beneficial cooperative actions.[81]

U.S. domestic interstate compacts have the same rigidity problems.[82] Thus, in some cases, existing perpetual, stable allocations must be

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79. For a more optimistic view of the ability of treaties and other regimes to adapt, see Brown Weiss, *supra* note 26, at 231-67.

80. The Columbia River Treaty is permanent, but either country can withdraw after 2024 by giving ten years' notice. Treaty Relating to Cooperative Development of the Water Resources of the Columbia River Basin, U.S.-Can., art. XIX, Jan. 22, 1964, 15 U.S.T. 1555 [hereinafter Columbia River Treaty].

81. ECON. COMM'N FOR EUR., *supra* note 5, at 102.

82. Stephen Draper, *The Impact of Climate Change on Interstate/International Water Sharing*, ABA WATER RESOURCES COMMITTEE NEWSLETTER (Section of Env't, Energy & Res., Am. Bar Ass'n, Chi., Ill.), Feb. 2009, at 11, notes that interstate and international agreements which require fixed water delivery schedules "no longer appear[] to be viable for the future" and that future agreements may include adjustable flow percentage entitlements with a "real time feedback loop that provides river stages . . . at various locations on the river on a regular basis." *See generally* Raymond Dake, *The Great Compromise: Overcoming Impasse in Interstate Water Compacts Through the Use of Alternative Dispute Resolution*, 77 UMKC L. REV. 789 (2009) (discussing benefits of interstate compacts and methods of dispute resolution between parties).

overlaid with management regimes that permit carefully tailored modifications as a basin's water balance changes.

An example of the adverse consequences of a one-off allocation with no management regime attached occurred recently between the United States and Mexico. Under the 1944 Mexico Water Treaty, which divides the Colorado River between the two countries, Mexico was awarded 1,500,000 acre feet compared to the 15 million unilaterally allocated by the United States to the seven basin states.[83] For years, farmers on the Mexican side of the California border depended on seepage flows from the unlined All American Canal. However, California irrigators wanted to line the canal to capture this seepage, and after they could not secure federal financing, California financed the lining. Mexican irrigators and environmental NGOs sued the United States under the United States National Environmental Policy Act of 1969 alleging that the environmental impact statement did not adequately address the impacts of lining on less wealthy Mexican farmers and cut off flows to the stressed Colorado Delta,[84] an ecological treasure. Before the merits of the suit could be heard, the United States Congress terminated the litigation by special legislation which, de facto, validated California's claim that it could use its share of the river without regard to its cross border impacts.[85]

V. THE SUBORDINATION OF AQUATIC ECOSYSTEM PROTECTION

A. Stronger but Often Ignored Protection Rules

As previously discussed, the initial and still dominant purpose of international water law is to establish the ground rules for the construction of large dams. These dams cause substantial adverse

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83. Treaty Between the United States and Mexico on the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, U.S.-Mex., art. 10(a)-(b), Feb. 3, 1944, 59 Stat. 1219 [hereinafter Mexican Water Treaty].

84. *See* discussion *infra* Part V.B.1.

85. Tax Relief and Health Care Act, Pub. L. No. 109-432, 120 Stat. 2922, § 397 (2006). *Consejo de Desarrollo Economico de Mexicali v. United States*, 482 F.3d 1157, 1168, 1174 (9th Cir. 2007), dismissed all claims. The court found the language of the statute clear and followed *Robertson v. Seattle Audubon Society*, 503 U.S. 429 (1992). *Consejo*, 482 F.3d at 1170. Congress may change the substantive law of a pending case consistent with separation of powers principles as long as it does not make specific findings of fact without changing the underlying law. *Id.* The plaintiffs' Tenth Amendment challenge was rejected because it found no compelling state participation by the United States since California had agreed to fund the project after the federal government had not. *Id.* The plaintiff's equal protection argument, based on the selective denial of the right to healthy environment only to Latinos, was dismissed because the organization failed to identify any member who would have individual standing or that the interests of Latinos were germane to the organization. *Id.* at 1170-71.

ecosystem impacts. They inundate large areas and kill terrestrial plants and displace fauna. More generally, large dams and diversions "compromise the dynamic aspects of rivers that is fundamental to maintaining the character of aquatic ecosystems."[86] GCC adds another level of stress to aquatic ecosystems and may trigger a new round of species extinction. For example, the Intergovernmental Panel on Climate Change predicts that "[e]ndorheic (terminal or closed) lakes are most vulnerable to a change in climate because of their sensitivity to changes in the balance of inflows and evaporation" and could disappear.[87] Rivers may become more saline and contain less oxygen that is vital to ecosystem productivity, and "climatic warming is expected to start a drying trend in wetland ecosystems."[88]

The loss of biodiversity can also adversely impact a country's hydrology well beyond the degraded area. Much of Brazil's rainfall in the southern plains, the source of much of her agricultural production, is reevaporation from rains that fall on the Amazon. Although the rate of rainforest destruction has slowed recently, the loss of forest cover will redirect water directly back into the Atlantic and thus reduce "the moisture that makes its way to the plains."[89] Even after four decades of environmental sensitivity and the "bluing" of international water law, the operating regimes for these projects and the weak management regimes put in place on some rivers make it easy for riparian states to give some consideration to environmental issues, but then to trade them off against other values. The rights of other riparian states are primarily procedural.[90] Nations have no duty to forgo development once they have met their notice, negotiation, and perhaps environmental assessment duties with other states.

International water law offers three possible legal routes to the protection of aquatic ecosystems. In addition, other general international conventions such as the UNESCO World Heritage Conservation Programme and the Ramsar Wetlands Convention offer opportunities for

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86. WORLD COMM'N ON DAMS, *supra* note [52], at 77. *See generally* Symposium, *Transboundary Freshwater Ecosystem Restoration: The Roles of Law, Process and Lawyers*, 19 PAC. MCGEORGE GLOBAL BUS. & DEV. L.J. 1 (2006) (discussing ecological decision making).

87. IPCC, *supra* note 58, at 55-56.

88. *Id.* at 56.

89. Briscoe, *supra* note 55, at 17.

90. *E.g.*, Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, June 25, 1998, 2161 U.N.T.S. 447 [hereinafter Aarhus Convention]; Framework Convention on Climate Change, art. 6, May 9, 1992, 31 I.L.M. 849 (1992) [hereinafter FCCC].

NGOs and international organizations to intervene in specific disputes.[91] The first route is the general law of equitable apportionment. The Watercourse Convention's article 6 factors can support nonconsumptive uses, such as flow maintenance, as well as consumptive uses.[92] However, there is still no right to the natural flow rule in international water law.[93]

The second route is the Watercourse Convention's article 21 duty to "prevent, reduce and control" pollution "that may cause significant harm to other watercourse States or to their environment."[94] Flow maintenance is a pollution prevention strategy, and pollution can degrade biodiversity. The problem is that at best international water law protects rivers from only serious episodes of pollution and a "reasonable" level of pollution can be traded off against other benefits. The material injury rule, which is at the heart of equitable apportionment, allows upstream states to use water progressively and therefore to create the risk of environmental damage that does not rise to the level of legally cognizable damage. For example, upstream diversions may generally increase the salinity of rivers by allowing salt water to migrate slowly upstream. In addition, pollution is often limited to serious, identifiable pollution rather than less visible, cumulative impacts from environmentally destructive watershed land use practices. And, the presumed remedy is *post hoc* mitigation rather than prevention.[95]

The third route, which builds on the first two, is the slowly evolving substantive aquatic ecosystem rules which have been incorporated into international water law formulations. The Waterways Convention contains several innovative environmental protection rules which could provide a foundation for increased flow protection. Article 20 requires that, "where appropriate," states protect the ecosystems of international watercourses, and article 22 requires a state to "take all measures

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91. See A. Dan Tarlock, *Possible Lessons from the Restoration of the Danube and Colorado Deltas*, 19 PAC. MCGEORGE GLOBAL BUS. & DEV. L.J. 61 (2006), for a discussion of the unsuccessful attempts to use a Ramsar Convention fact-finding mission to persuade the Ukraine to stop the construction of a shipping canal through a biodiversity-rich stretch of her portion of the Delta.

92. Watercourses Convention, *supra* note 17, art. 6. The leading study is OWEN MCINTYRE, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW (2007).

93. The Lake Lanoux Arbitration (France v. Spain), [1957] 24 I.L.R. 101, 124 (Arbitral Trib. 1957), has been widely read to reject any right to the undiminished flow of an international stream. For a full exposition of the rise and fall of the theory, see C.B. Bourne, *The Right To Utilize the Waters of International Rivers*, *in* 3 CAN. Y.B. OF INT'L L. 187, 189-203 (1965).

94. Watercourses Convention, *supra* note 17, art. 21.

95. *See* Toru Iwama, *Emerging Principles and Rules for the Prevention and Mitigation of Environmental Harm*, *in* ENVIRONMENTAL CHANGE AND INTERNATIONAL ENVIRONMENTAL LAW 107 (Edith Brown Weiss ed., 1992).

necessary to prevent the introduction of [alien] species" into a river system if the species "may have effects detrimental to the ecosystem of the watercourse."[96]

The Berlin Rules impose considerably stronger aquatic ecosystem duties. For example, article 22 of the Berlin Rules provides: "States shall take all appropriate measures to protect the ecological integrity necessary to sustain ecosystems dependent on particular waters."[97] However, as the next three Parts of this Article indicate, international water law still plays little formal role in efforts to restore degraded ecosystems.[98] There is some hope for the future—river management efforts in southern Africa may provide an international model of the successful integration of domestic, treaty, and customary international water law to conserve aquatic ecosystems.

B. Three Examples of Aquatic Ecosystem Conservation Efforts

1. The Colorado River Delta: An End Run Around International Law

The impaired Colorado River Delta in Baja California, Mexico, is a classic example of the adverse impacts from damming a river on an aquatic ecosystem. It is equally an example of the barriers that customary equitable apportionment and treaty regimes impose on restoration efforts. The delta is all that remains of a wetland once occupied by the Cocopah Indians (and later designated by the Spanish as the *Delta del Rio Colorado*) that stretched from southern California to the Gulf.[99] The construction of upstream dams and intense farming along the river nearly desiccated the delta, as the river's resulting diminished flow often evaporated before any water could reach it.[100] Between 1983 and 2000, the river reached the delta on five occasions, reviving the remnant wetlands (*ciénegas*), which expanded to nearly 10% of their original acreage.[101] As an example, the *Ciénega de Santa Clara*, a manmade wetland in the delta, covered only about 500 acres in the 1970s, but now covers about 1500 acres thanks to the Welton Mohawk Irrigation and Drainage District in Arizona.[102] Endangered fish, such as the totoba, and birds, such as the southwestern willow flycatcher and the

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96. Watercourses Convention, *supra* note 17, arts. 20, 22.
97. Berlin Rules, *supra* note 35, art. 22.
98. *See* Symposium, *supra* note 86.
99. Tarlock, *supra* note 91, at 64.
100. *Id.*
101. *See* DANIEL F. LUECKE & JENNIFER PITT, ENVTL. DEF. FUND, A DELTA ONCE MORE: RESTORING RIPARIAN AND WETLAND HABITAT IN THE COLORADO RIVER DELTA (1999).
102. *Id.*

Yuma clapper tail, still survive in the *ciénega*, as do a few remaining members of the Cocopah though they do not maintain the traditional lifestyles of their ancestors.[103]

The delta needs a guaranteed flow in dry years, but the United States has consistently maintained that as long as it supplies Mexico with 1,500,000 acre feet of water a year, as required under the 1944 treaty, it has no further obligations to Mexico or to the river.[104] Mexico uses its allocation on farms immediately south of the border. Aside from its treaty obligation, the seven basin states are entitled to the majority of the flow of the River as allocated by the Colorado River Compact.[105] The Compact and the Mexico Water Treaty have generated strong expectations that the allocations and uses that they support are perpetual and represent the best use of the river.[106] Thus, it has proved politically impossible to amend them to include protection of the delta. And, because a treaty supersedes customary international water law, the recently articulated ecosystem protection duties do not apply to the Colorado.[107]

Mexican and U.S. NGOs have nonetheless made some progress toward ecosystem protection by a two-pronged strategy. First, NGOs have succeeded in putting the delta on the U.S. federal government's radar screen. The U.S. Department of Interior now includes delta impacts in its evaluation of the environmental impacts of any change in Lower Colorado River operations:

> Both the U.S. and Mexico utilize nearly their entire apportionment of Colorado River water for agriculture, municipal, and industrial purposes. The IS Criteria further restrict the possibility that flood flows might reach the delta and Sea of Cortez, and the more exact quantifying of flows for the IA and IOP will further reduce inadvertent overruns that nourished the delta. The reporting agencies, USBR, and their counterparts in Mexico have begun documenting the status of fish and wildlife resources of this area in a first step towards fulfilling Minute 306, a 2000 amendment to the

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103. *Id.*

104. Mexican Water Treaty, *supra* note 83, art. 10(a). *See generally* Charles J. Meyers & Richard L. Noble, *The Colorado River: The Treaty with Mexico*, 19 STAN. L. REV. 367 (1967) (discussing the history of and controversies surrounding the Mexican Water Treaty).

105. Colorado River Compact, Pub. L. No. 56, 42 Stat. 171 (1922); *see* Meyers & Noble, *supra* note 104, at 379.

106. "There is hereby apportioned from the Colorado River Basin in perpetuity. . . . Colorado River Compact, Pub. L. No. 56, 42 Stat. 171, at Article III(a) (1922); *see also* Helen Ingram, A. Dan Tarlock & Cy R. Oggens, *The Law & Politics of the Operation of Glen Canyon Dam*, *in* COLORADO RIVER ECOLOGY & DAM MGMT., PROCEEDINGS OF A SYMPOSIUM, SANTA FE, NEW MEXICO, MAY 24-25, 1990 (1991).

107. Watercourses Convention, *supra* note 17, art. 3.

> 1944 Water Treaty. The amendment calls for joint studies and for examining ways to ensure water for ecological purposes. Negotiations with Mexico would ensure that water used to sustain the ecological resources of the Limitrophe that flows past the Southern International Boundary would sustain ecological resources in the delta and the Sea of Cortez. To assist in identifying the potential water needs of fish and wildlife resources in the Limitrophe, data collection for the monitoring plan will also include the remainder of the river to the Southern International Boundary. This will include the wildlife economic data necessary for any sustainable economics review and would be an important consideration in the process of reuniting the ecosystem connection between the delta and Sea with the LCR.[108]

The Department of the Interior may also taketh away. As water supplies decrease in the stressed Colorado, the Bureau of Reclamation is considering reopening the Yuma desalinization plant and using the purified water in the United States. This could put the *Ciénega de Santa Clara* at risk or be the basis for a plan to find substitute water for it.[109]

The second prong of restoration efforts is to use water markets to reallocate water in both countries and thus adapt to the use of the river to new values within the Mexican Water Treaty and Colorado River Compact regimes. Water marketing could work because the water needs of the delta are modest—a minimum flow of 50,000 acre feet a year—and this amount is not needed during wet years.[110] Thus, water markets could allow more water to remain in the river with minimal disruption to existing allocations.[111] Still, the efforts to conserve the Colorado Delta can best be described as a creative second best compared to a binational cooperative, adaptive management regime.

2. The Great Lakes: Ecosystem Conservation as a By-Product of Regional Politics

The Canadian-United States Great Lakes offer an example of a hybrid domestic-transnational water management regime that reverses the traditional subordination of aquatic ecosystem conservation to

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108. U.S. DEP'T OF INTERIOR, FISH & WILDLIFE SERV., DRAFT FISH AND WILDLIFE COORDINATION ACT 2(B) REPORT ON EXECUTION OF IMPLEMENTATION AGREEMENT, ADOPTION OF INADVERTENT OVERRUN AND PAYBACK POLICY, AND OTHER ACTIONS ON THE LOWER COLORADO RIVER 16 (Jan. 23, 2003).

109. Randal C. Archibold, *Eyes Turn to Mexico as Drought Drags On*, N.Y. TIMES, Sept. 14, 2009, at A9.

110. MARK LELLOUCH, KAREN HYUN & SYLVIA TOGNETTI, SONORAN INST., ECOSYSTEM CHANGES AND WATER POLICY CHOICES: FOUR SCENARIOS FOR THE LOWER COLORADO RIVER BASIN TO 2050, at 28, 78, 81 (2007).

111. *Id.*

consumptive uses and hydropower generation, tries to insure that the aquatic ecosystem remains resilient enough to adapt to GCC, and contains a management regime that implements many of the principles of Integrated Water Resources Management, discussed *infra*, without formally adopting the concept. In the past four decades, the two countries, including two Canadian provinces and eight basin states, have come to view the lakes as a single ecosystem that should be conserved by prohibiting most trans-watershed diversions because they threaten to disturb the dynamic, long-term stability of the system. There are many legal landmarks in this process. Perhaps the most important conceptual development is the 1978 Great Lakes Water Quality Agreement which adopted an ecosystem approach and subsequently shaped thinking about all aspects of the use of the lakes.[112] In 2008, this thinking culminated in the Great Lakes-St. Lawrence River Basin Compact (Great Lakes Compact).[113]

The Compact was a response to several extremely remote or trivially possible U.S. and international transbasin diversion threats from the 1980s through the 1990s.[114] In 1985, the eight Great Lakes states and the Canadian provinces of Ontario and Quebec adopted a soft law regime to limit large-scale diversions.[115] Fears that this agreement was too weak led to the innovative 2008 Great Lakes Compact.[116] In sum, the Great Lakes Compact prohibits nearly all diversions outside the basin, setting a high standard for large water withdrawals within it.[117] Even small

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112. *See* NAT'L RESEARCH COUNCIL OF THE U.S. & THE ROYAL SOC'Y OF CAN., THE GREAT LAKES WATER QUALITY AGREEMENT: AN EVOLVING INSTRUMENT FOR ECOSYSTEM MANAGEMENT 17 (1985).

113. Great Lakes-St. Lawrence River Basin Sustainable Water Resources Compact (Dec. 13, 2005), Pub. L. No. 110-342, 122 Stat. 3739 (2008) [hereinafter Great Lakes Compact], *available at* http://www.cglg.org/projects/water/docs/12-13-05/Great_Lakes-St_Lawrence_River_Basin_Water_Resources_Compact.pdf.

114. PETER ANNIN, THE GREAT LAKES WATER WARS 57-81 (2006).

115. Great Lakes Charter (Feb. 11, 1985), *reprinted in* GREAT LAKES GOVERNORS TASK FORCE, COUNCIL OF GREAT LAKES GOVERNORS, FINAL REPORT AND RECOMMENDATIONS ON WATER DIVERSION AND GREAT LAKES INSTITUTIONS 40 app. III (1985), *available at* http://www.cglg.org/pub/charter/index.html; Peter V. MacAvoy, *The Great Lakes Charter: Toward a Basinwide Strategy for Managing the Great Lakes*, 18 CASE W. RES. J. INT'L L. 49 (1986).

116. Noah Hall's article, *Toward A New Horizontal Federalism: Interstate Water Management in the Great Lakes Region*, 77 U. COLO. L. REV. 405 (2006), is a thorough analysis of the innovative aspects of the Great Lakes Compact. *See* A. Dan Tarlock, *The Great Lakes as an Environmental Heritage of Humankind: An International law Perspective*, 40 U. MICH. J.L. REFORM 995 (2007) (discussing the benefits of greater recognition of the Great Lakes' international character in the Great Lakes Compact); Christine Klein, *The Law of the Lakes from Protectionism to Sustainability*, 2006 MICH. ST. L. REV. 1259 (2006) (illustrating the influence of protectionism on the development of the Great Lakes Compact).

117. Great Lakes Compact, *supra* note 113, § 4.8-.13.

communities located just a few miles from the Great Lakes must satisfy strict standards to access water.[118] Canada has adopted similar antidiversion legislation.[119]

From a broader international water law perspective, the most interesting aspect of the Great Lakes Compact is that it illustrates the use of domestic law to de facto incorporate progressive international environmental and international water law norms. In effect, the Great Lakes Compact classifies the lakes as a heritage resource that should be conserved for the benefit of present and future generations.[120] It is another example of the bypass of traditional international instruments which do not address the stresses discussed in this Article. In 1909, the two nations entered into the Boundary Waters Treaty.[121] The treaty only prohibits diversions that lower the lakes *and* cause material injury to either nation[122] and creates a binational body, the International Joint Commission (IJC), with the power to adjudicate disputes or issue factual reference reports if both countries request it.[123]

Instead of amending the Boundary Waters Treaty, the U.S. federal government allowed the states to negotiate a compact that provided more stringent antidiversion standards than the treaty. The IJC was used instead to support state and provincial efforts by providing a rationale for the Great Lakes Compact.[124] The two countries agreed to a fact-finding

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118. A Dan Tarlock, *The International Joint Commission and Great Lakes Diversion: Indirectly Extending the Reach of the Boundary Waters Treaty*, 54 WAYNE L. REV. 1671, 1673 (2008).

119. *E.g.*, International Boundary Waters Treaty Act, R.S.C., chs. 1-17 (2002) (Can.).

120. *See* Tarlock, *supra* note 116, at 995, 1003-07.

> This remarkable dedication to ecosystem conservation of the Lakes is a happy accident of two domestic political factors in Canada and the United States. First, there are no foreseeable competing consumptive uses. . . . Thus, the usual political opposition to environmental protection does not exist in the region. Second, the protection of the Lakes from phantom diversions makes for good domestic politics on both sides of the border. Canadian nationalist greens have supported a strong anti-diversion regime by stoking the traditional fear that the United States is always poised to grab and export all of Canada's natural resources, including its abundant clean water, [to support] strong national and provincial anti-diversion legislation. In the United States, the continued erosion of political power in the Great Lakes region, as the nation's population drifts south and west . . . provided the necessary urgency [for the Compact].

Id. at 996-97.

121. Treaty Between the United States and Great Britain Relating to Boundary Waters Between the United States and Canada, U.S.-U.K., Jan. 11, 1909, 36 Stat. 2448 (1909) [hereinafter Boundary Waters Treaty].

122. *Id.* arts. 2-3.

123. *Id.* art. 3.

124. *See* Tarlock, *supra* note 118, at 1684-90.

IJC reference,[125] and the resulting reference report both endorsed the heritage concept and provided a rationale for walling off 20% of the world's fresh water supply from out-of-basin use.[126] It described the Great Lakes as "a critical part of the natural and cultural heritage of the [Great Lakes] region."[127] The report also characterized the lakes as a "nonrenewable resource" because less than 1% of the lakes' waters are renewed annually by precipitation,[128] and it concluded that "[i]f all interests in the Basin are considered, there is never a 'surplus' of water in the Great Lakes system."[129]

The antidiversion regime has an important supplemental benefit: it promotes climate change adaptation in the basin. Lake levels have historically fluctuated widely depending on the basin's precipitation, and many GCC scenarios forecast more lower-level cycles as droughts become frequent. Studies have found that there may be a net increase in rainfall, but the benefits of this increased precipitation may be offset by increased evaporation.[130] The compact's antidiversion and governance structure promotes adaptation, "brings much needed requirements for water conservation and resource protection [and] creates a regional governance mechanism empowered to adaptively manage Great Lakes water resources as new scientific information becomes available."[131]

3. Southern Africa: The Integration of Domestic and International Water Law

Southern Africa offers several potential examples of the direct incorporation of international water norms into domestic law and binational management regimes.[132] Postapartheid South Africa enthusiastically embraced international law, which had been extensively used to oppose apartheid, when it adopted a very progressive water code, based on both international law and an extensive study of comparative systems, which provides for both environmental protection and social

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125. INT'L JOINT COMM'N, PROTECTION OF THE WATERS OF THE GREAT LAKES: FINAL REPORT TO THE GOVERNMENTS OF CANADA AND THE UNITED STATES (2000), *available at* http://www.ijc.org/php/publications/html/finalreport.html.

126. *Id.* §§ 2, 10.1.

127. *Id.* § 2.

128. *Id.*

129. *Id.* § 10.6.

130. The studies are summarized in Hall & Stuntz, *supra* note 66, at 644-50.

131. *Id.* at 676.

132. *See* Stefan Lindemann, *Explaining Success and Failure in International River Basin Management-Lessons from Southern Africa*, *in* FACING GLOBAL ENVIRONMENTAL CHANGE (Hans Guenter Brauch et al. eds., 2009).

equity.[133] The 1998 Water Act adapted the U.S. doctrine that the use of water is subject to the public trust to create two water reserves that function as floors on water use.[134] The reserves both guarantee water "to satisfy basic human needs" and "to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource" and redressed the previous bias toward large diversions for white irrigated agriculture, which resulted in the denial of adequate water access to much of the country's majority black population.[135] A quantified reserve will be established for each covered water resource. In 2002, the South African government released the Proposed First Edition of the National Water Resource Strategy, which surveyed nineteen water management areas and concluded that between twelve and thirty percent of the river's base flow would be required to maintain the ecological reserves.[136]

The reserve concept was applied in the 2002 Incomaputo Agreement with Mozambique and Swaziland, which governs the use and management of Incomati River Catchment.[137] The river arises in South

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133. National Water Act 36 of 1998 (S. Afr.), *available at* http://www.dwaf.gov.za/Documents/Legislature/nw_act/NWA.pdf.

134. The leading international precedent case is the California Supreme Court opinion in *National Audubon Society v. Superior Court*, 658 P.2d 709 (Cal.), *cert. denied*, 464 U.S. 977 (1983).

135. National Water Act 36, supra note 133, ch. 1. The scope of South Africa's human right was limited by the Constitutional Court. *Mazibuko v. City of Johannesburg*, 2008 (4) All SA 471 (W) (S. Afr.), recognized that all residents of Johannesburg had a right to forty-two liters of water per day, which must be provided free "to the extent that it is . . . reasonable to do so, having regard to its available resources." *Id.* at 16. Article 27 of the South African Constitution, which recognizes a right of access to "sufficient food and water," creates an enforceable right to a minimum amount of free municipally supplied water. S. AFR. CONST. 1996. The Constitutional Court invalidated the Supreme Court of Appeal's decision. *Mazibuko v City of Johannesburg* 2009 (4) All SA 39 (CC) (S. Afr.). The Court drew on the familiar distinction between negative state duties to respect human rights, which are relatively absolute, and affirmative state duties to promote social and economic equity which must balance individual dignity against the need to allow the state to marshal the resources to provide the demanded service. The Court had previously held that the state had a duty to refrain from interfering with both economic and civil rights, Jaftha v Schoeman 2005 (2) SA 140 (CC) (S. Afr.), but it refused to recognize an individual entitlement to a minimum core of economic and social rights. *South Africa v Grootboom* 2001 (1) SA 46 (CC) (S. Afr.). The state's duty is limited, as the Constitution states in sections 26 and 27, only to the "progressive realization" of the economic rights, although the court in *Jaftha* did suggest that it would intervene in the case of delay in setting realization targets or the adoption of unreasonable measures.

136. DEP'T OF WATER AFFAIRS & FORESTRY, NATIONAL WATER RESOURCE STRATEGY chs. 2, 22 (2004), *available at* http://www.dwaf.gov.za/Documents/Policies/NWRS/Sep2004/pdf/Chapter2.pdf; Michael Kidd, *South Africa's National Water Act: A Five-Year Report Card*, *in* 1 LAW, WATER, AND THE WEB OF LIFE 177, 187 (Antonio Herman Benjamin ed., 2003).

137. Tripartite Interim Agreement Between the Republic of Mozambique and the Republic of South Africa and the Kingdom of Swaziland for Co-operation on the Protection and Sustainable Utilization of Water Resources of the Incomati and Maputo Watercourses, Mozam.-S.

Africa and flows through Swaziland and Mozambique, and is (or will be) intensely used in all three countries and experiences both low flow episodes and floods.[138] The Incomaputo Agreement allocated each country fixed amounts of water and set downstream flow releases for the sub-catchments.[139] To date, it has allowed South Africa and Swaziland to construct dams to the benefit of bank farmers,[140] but experts predict that the supply will not support the projected increased irrigation and may stress the environmental flow regime.[141]

International water law has also influenced other southern African countries to manage shared water resources to conserve their aquatic ecosystems, which provide a high level of services. The management of the still pristine Okavango River illustrates a promising cooperative regime. The magnificent river is shared among three countries, each with different views of its use.[142] Angola, the headwaters state, is emerging from decades of civil war and is just now considering her use options, which include hydroelectric projects. Downstream Namibia and Botswana are among the driest countries in the world.[143] Namibia views the River as the only dependable source of water for the arid central part of the country where her population is concentrated and has proposed a diversion to the head of the Eastern National Water Carrier.[144] Arid Botswana depends on the flow for both existing and planned agriculture, but the river's primary function is to sustain a vibrant ecosystem and attendant tourism industry in the spectacular, wildlife rich Okavango Delta, the largest Ramsar Convention wetlands in the world.

Afr.-Swaz., Aug. 29, 2002 [hereinafter Incomaputo Agreement], *available at* http://www.dwaf.gov.za/Docs/other/Incomaputo/Incomaputo_AGREEMENT29082002.pdf.

138. *See generally* KADER ASMAL, WATER IN CIVIL SOCIETY: ARID AFRICAN UPSTREAM SAFARI: A TRANSBOUNDARY EXPEDITION TO SEEK AND SHARE IN NEW SOURCES OF WATER 7 (UNESCO Water & Ethics Series, Essay No. 3, 2004), *available at* http://www.internationalwaterlaw.org/biblioglaphy/article/Ethics/Water_in_Civil_Society.pdf (written by South Africa's first postapartheid minister of water).

139. Incomaputo Agreement, *supra* note 137, annex 1.

140. Sakhiwe Nkomo & Pieter van der Zaag, *Equitable Water Allocation in a Heavily Committed International Catchment Area: The Case of the Komati Catchment*, 29 PHYSICS & CHEMISTRY OF THE EARTH 1309, 1310 (2004).

141. *Id.*

142. *See* Volker Böge, *A Glass Half Full or Half Empty? Water, Conflict or Cooperation in Southern Africa*, *in* RESOURCE POLITICS IN SUB-SAHARAN AFRICA 273, 291-99 (Matthias Basedau & Andreas Mehler eds., 2005).

143. A river basin map is almost blank for the two countries except for the Okavango, which forms Namibia's northern border with Angola and the Delta in far northern Botswana. Peter Ashton, *Southern African Water Conflicts: Are They Inevitable or Preventable?*, 11 (African Dialogue Series Paper, Pretoria Univ., S. Afr., Feb. 24, 2000).

144. *Id.* at 8-12.

In 1994, the three countries signed the OKACOM Agreement, creating a commission to develop criteria for the equitable utilization and sustainable development of the river,[145] which has evolved in a more ambitious, broad-based, long-term cooperative effort to collect and share the data necessary to develop a coherent management regime for this aquatic treasure.[146] The management effort began in earnest in 2004, and the nascent regime, very much a creature of foreign support, is still in the capacity building and modeling stage, although the initial reports are positive.[147]

VI. THE WAYS FORWARD: SHARED BENEFITS AND COOPERATIVE MANAGEMENT

Two models, shared benefits and cooperative management, have been offered to supplement customary law's restraints on unilateral action, to address GCC, to encourage more sustainable dam projects, and to promote aquatic ecosystem conservation and restoration. The two models can overlap and be complementary in any given situation. However, there are important distinctions among them that can affect stresses such as large dam construction and ecosystem conservation differently. Both models rely on integrated water resources management planning to promote sufficient cooperation, and to address environmental protection and climate change adaptation.

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145. Agreement of the Governments of the Republic of Angola, the Republic of Botswana and the Republic of Namibia on the Establishment of a Permanent Okavango River Basin Water Commission, Angl.-Bots.-Namib., art. 4.3, Sept. 16, 1994.

146. *See* ELIZABETH SODERSTROM ET AL., INT'L WATER MGMT. INST., TRANSBOUNDARY COLLABORATIVE LEARNING: CASE STUDY IN THE OKAVANGO RIVER BASIN 17, *available at* http://www.iwmi.cgiar.org/assessment/FILES/word/ProjectDocuments/Okavango/Okavango_Draft%20Report.pdf (last visited Feb. 5, 2010).

147. MARK ANDREINI, KUMBULANI MURENGA & TOM WILBANKS, REPORT TO USAID/SOUTHERN AFRICA, MID-TERM PROGRAMMATIC EVALUATION OF USAID/SOUTHERN AFRICA'S PROGRAM TO "IMPROVE MANAGEMENT OF SHARED RIVER BASINS" (2007), *available at* http://pdf.usaid.gov/pdf_docs/PDACK369.pdf. In this work the authors identify the following successful steps as well as some challenges facing the project:

> [E]stablishing a Secretariat for OKACOM and transferring responsibility for the Secretariat's ongoing support to regional partners; a pioneering river basin organization (RBO) workshop; cross-boundary river basin management networks; and significantly strengthened relationships with partners. Challenges for the project include institutional, technical, and financial sustainability; certain differences between the priorities of USAID and those of regional partners; uncertainties about future roles and activities of GEF; enhancing the relationship with SADC; and improving IRBM-related communications with Angolan partners through increased bilingualism.

A. Shared Benefits

In recent years, there have been increasing calls to address the inefficiencies and injustices of the race to dam by shifting the focus of international disputes from the allocation of rivers to benefit sharing throughout the basin.[148] The shared benefits model accepts the need for large dams but substitutes money for the use and control of wet water. Nations can forgo the construction of a dam or even the actual use of wet water in return for monetary or in kind compensation that satisfies other domestic needs, thus making it possible for other states to put the water to its most efficient use.

The concept is derived from welfare economics which posits that water is simply a valuable, scarce commodity with multiple possible alternative uses. The transcendental objective of efficiency requires that the resource be allocated to the most valuable uses without regard to territorial boundaries. Thus, it may be economically rational for nations to forgo the actual use of wet water in return for the lost opportunity cost development, because benefits can only be shared if there is some degree of cooperation among riparian nations. Three possible efficiency gains have been identified that can flow from benefit sharing: "(1) better ecosystem management, (2) [more efficient] rivers services such as hydroelectric power, and (3) the achievement of regional water security through cost-sharing rather than inefficient duplicate development."[149]

On one level, the distinction between equitable utilization and benefit sharing is artificial, as the object of any international river process is to ensure that all riparian states receive a measure of water justice. But shared benefits need not be just as between riparian states or to users and interests within them. For example, the idea can be found in voluntary decisions of arid countries to forgo water-based development in favor of virtual water, such as imported food. Saudi Arabia has recently made this decision. It will phase out the use of its limited groundwater resources used to grow wheat by 2016.[150] Instead of trying to be self-sufficient in food, it will apply the worldwide energy supply model that it helped create—reliance on exports—to food.

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148. The history of the shift from rights to needs is traced in Aaron T. Wolf, *Criteria for Equitable Allocations: The Heart of International Water Conflict*, 23 NAT. RESOURCES FORUM 3 (1999).

149. A. Dan Tarlock & Patricia Wouters, *Are Shared Benefits of International Waters an Equitable Apportionment?*, 18 COLO. J. INT'L ENVTL. L. & POL'Y 523, 533 (2007) (citing Claudia W. Sadoff & David Grey, *Beyond the River: The Benefits of Cooperation on International Rivers*, 4 WATER POL'Y 389 (2002)).

150. Jennifer R. Dunne, Agriculture: The End of Cheap Food 3 (June 2008), http://www.cambiar.com/cms_images/file_173.pdf.

The idea of shared benefits arose from the 1961 Columbia River Treaty between Canada and the United States, and has developed into a basic principle of international water and environmental law.[151] The signatories entered the treaty in hopes of damming the Columbia for power plants and flood control.[152] Prior to signing, the United States' planned dams would have been constructed too far downstream for Canada to harvest the river for power, while Canada's planned dams would have provided the "free" benefit of flood control to the United States.[153] Canada's basic problem was that it wanted to develop its hydro potential but had little internal demand for electricity or flood control storage. In protesting a planned U.S. dam, Canada asked for the sharing of benefits from Canadian storage throughout the river downstream. The United States initially rejected Canada's expansive view of shared benefits, but eventually came around to the idea as Canada threatened out-of-basin diversion, which would decrease the river's flow into the Libby Dam.[154] After long and hard negotiations,[155] the two countries agreed to allow dams in the United States but Canada was compensated for her lost development opportunities.

Pursuant to the treaty, Canada has developed 15.5 million acre feet of storage among three different projects.[156] Most of the storage provides flood-control benefits, 50% of which the United States shares.[157] The United States has paid Canada US$64.4 million for flood control benefits through 2024, and a consortium of U.S. power companies paid her US$254 million for a hydropower entitlement that ended in 2003.[158]

The idea has since been applied in other basins where upstream states can store and divert water while downstream states claim almost the entire flow of an international river, but the success of the Columbia River Treaty has not yet been duplicated in other regions.[159] As with Swiss wine, the concept of shared benefits does not travel too well.

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151. *See* Columbia River Treaty, *supra* note 80.

152. Tarlock & Wouters, *supra* note 149, at 527.

153. *Id.*

154. KEITH W. MUCKLESTON, INTERNATIONAL MANAGEMENT IN THE COLUMBIA RIVER SYSTEM 10 (UNESCO Technical Documents in Hydrology No. 12, 2003), *available at* http://www.unesdoc.unesco.org/images/0013/001332/133292e.pdf.

155. The most exhaustive study of the treaty is JOHN V. KRUTILLA, THE COLUMBIA RIVER TREATY—THE ECONOMICS OF AN INTERNATIONAL BASIN DEVELOPMENT (1967).

156. *See* Columbia River Treaty, *supra* note 70, art. II.

157. *Id.* art. VIII.

158. U.S. ARMY CORPS OF ENG'RS, COLUMBIA RIVER TREATY HISTORY AND 2014/2024 REVIEW 6 (2009).

159. Richard Paisley, *Adversaries into Partners: International Water Law and the Equitable Sharing of Downstream Benefits*, 3 MELBOURNE J. INT'L L. 280, 288-300 (2002).

There are a number of actual and potential problems with shared benefits. These include buyer's remorse as nations become dissatisfied with the original deal, the inability of the regime to adapt to GCC, and the attendant problems that the construction of large dams brings.[160] For example, Canadian First Nations and U.S. Indian tribes have expressed unhappiness with the near extinction of salmon runs on the Columbia and other forms of environmental degradation of the river,[161] despite the millions of dollars the United States has spent on salmon restoration.[162]

1. Central Asia: A Case Study in the Difficulty of Applying Shared Benefits

The endless conflicts over Amu and Syr Darya Rivers in central Asia illustrate the difficulty of applying the idea of shared benefits. These rivers, which originate in Tajikistan and Kyrgyzstan, respectively, once emptied into the Aral Sea. Now, the use of water for agricultural irrigation along the Amu Darya and the Syr Darya has significantly diminished the flow that reaches the Aral.[163] Furthermore, diversions downstream in Kazakhstan, Uzbekistan, and Turkmenistan have resulted in one of the globe's most infamous disasters, affecting the economy, the environment, and public health.[164] The Amu Darya's flow is zero, and as a result, the sea is dead and has divided into three smaller seas.[165] Of these highly saline water bodies, the Big Sea does not support any aquatic life, while the Little Sea only tolerates the hearty flounder.[166] In Uzbekistan and Turkmenistan, reduced flows caused by agriculture have also created highly concentrated salt levels in the Aral.[167] Though riparian nations have not followed through with plans laid out by the Soviet Union to restore the sea by diverting Siberian rivers, a modest restoration effort is underway today to restore a remnant of the former sea.[168]

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160. *See* Tarlock & Wouters, *supra* note 149, at 533-36.

161. *Id.* at 534.

162. *E.g.*, Michael C. Blumm, Erica J. Thorson & Joshua D. Smith, *Practiced at the Art of Deception: The Failure of the Columbia Basin Salmon Recovery Under the Endangered Species Act*, 36 ENVTL. L. 709 (2006).

163. SOUTH PREARALIE: NEW PERSPECTIVES (Joop de Schutter & Victor A. Dukhovny eds., 2003), *available at* http://www.cawater-info.net/library/eng/nato_eng.pdf.

164. Tarlock & Wouters, *supra* note 149, at 531.

165. Michael J. Glantz, *Aral Sea Basin: A Sea Dies, A Sea Also Rises*, 36 AMBIO 323, 323 (2007).

166. Tarlock & Wouters, *supra* note 149, at 531.

167. *Id.*

168. *Id.* at 536. In an effort to restore the Large Sea, the World Bank financed an $85 million dyke to keep the Syr Darya's flow in check. Rerouting the river's flow into the Small Sea, water will not be permitted to flow into the Large Sea until the salt levels in the Small Sea drop.

Benefits were shared in the former Soviet Union but at the expense of the two upstream states, Tajikistan and Kyrgyzstan. Payments for forgone hydropower generation served as the source of irrigation diversions and provided upstream storage and less than full energy production. Today, the two states are choosing to release less water for irrigation in order to maximize hydroelectric generation.[169] Their current problems have grown out of Stalinist policies that abrogated existing water use norms dictated by tribal customs.[170] Under those customs, tribes regarded water as a common resource and recognized individual entitlements to it.[171] Thus, tribes distributed water according to historical records, and their chiefs settled any disputes.[172] The Soviets replaced this scheme with central planning and control.[173]

Stalin nationalized water by decree in 1924.[174] Soviet strength was further consolidated from 1925 to 1936, when the former Tsarist administrative units were divided into five republics lacking any meaningful hydrologic logic.[175] The Syr Darya and Amu Darya thus became both de jure and de facto transnational rivers, and irrigation canals now crossed borders from one republic into another. This division created a pressing need for central control.

The Soviet allocation regime favored downstream cotton production in Uzbekistan and Turkmenistan, so Kyrgyzstan and Tajikistan, the two upstream states, needed to trade what they lost in power revenues for money. In an attempt to recoup lost revenue, Kyrgyzstan passed a law in 2001 requiring downstream states to pay for water issuing from within Kyrgyzstan's boundaries. The law, however, has been largely ineffectual, and Kyrgyzstan has had to settle for payment of operational and maintenance costs involved in delivering the water to the downstream states. Further, Kyrgyzstan has rejected plans to manage jointly its dams and reservoirs. While Uzbekistan has made annual payments to both Kyrgyzstan and Tajikistan for their lost power revenues, Tajikistan, the source of nearly half of Central Asia's water, set out on a water self-sufficiency plan in 2004.

Christopher Pala, *$85 Million Project Begins for Revival of the Aral Sea*, N.Y. TIMES, Aug. 5, 2003, at F3.

169. Tarlock & Wouters, *supra* note 127, at 532.

170. OLAF CAROE, SOVIET EMPIRE: TURKS OF CENTRAL ASIA AND STALINISM 156 (1954).

171. *Id.*

172. *Id.* at 152.

173. *Id.* at 153.

174. *Id.*

175. This Part is drawn from Bakhiyor Mukhamadiev, Application of the "Benefits Sharing" Concept to the Case of Transboundary Water Resources Politics in the Aral Sea Basin (unpublished manuscript, on file with author).

A new Russian-financed power plant was constructed at the Rogun Dam, and China is constructing a second station.[176] Tajikistan has two high dams, and additional reservoirs would give her complete control over downstream flows. GCC will add new stresses to the system. Melting glaciers in the Pamir Mountains, the headwaters of the Amu Darya River, will increase winter runoff but decrease summer runoff, further threatening irrigation in the region.[177]

As the environmental conditions in the basin continue to worsen, water shortages continue, and the states have not reached basic agreement on how the waters will be shared. The victims are the environment and poor farmers trapped in a monocrop culture. A United Nations Development Programme Report describes the Aral Sea Basin as "an environmental disaster" stressed by chemical pollution, drought, and inefficient use of water in the downstream states.[178] In 2003, the World Bank issued a report recommending that Kyrgyzstan manage its water upstream for the benefit of downstream irrigation, rather than to generate hydroelectric power, because the benefits of doing so would far outweigh the costs of storage maintenance.[179] However, as previously discussed, Tajikistan disagrees with this recommendation. As the republic most shut off from water resources, Turkmenistan has also pursued aggressive strategies of increasing both agricultural flow diversions and irrigated acreage.[180]

2. The Nile: Shared Benefits in Theory but Not Yet in Practice

The Nile Basin illustrates both the promise and the peril of shared benefits from both a social justice and environmental perspective. In the 1950s, Egypt dammed the Nile to generate energy and to replace seasonable with perennial irrigation for cotton production in the delta. Hydropower is a crucial energy source for all basin states as more than half of them get more than 90% of their electricity from hydropower, while another three are 70% dependent on hydro.[181] The Nile is among

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176. David V. Stern, *Tajikistan Hopes Water Will Power Its Ambitions*, N.Y. TIMES, Aug. 31, 2008, at A5.

177. JAKUB LANDOVSKY, INSTITUTIONAL ASSESSMENT OF TRANSBOUNDARY WATER RESOURCES MANAGEMENT 10 (Human Development Report 2006).

178. *Id.*

179. WORLD BANK, IRRIGATION IN CENTRAL ASIA: SOCIAL, ECONOMIC AND ENVIRONMENTAL CONSIDERATIONS (2003), *available at* http://siteresources.worldbank.org/ECAEXT/Resources/publications/Irrigation-in-central-Asia/Irrigation_in_Central_Asia-Full_Document-English.pdf.

180. Mukhamadiev, *supra* note 142, at 14-15.

181. INTER-GOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2001: IMPACTS, ADAPTATION, AND VULNERABILITY 496-97 (2001).

the most stressed rivers in the world. Climate change experts believe that the dry parts of Africa will see further reductions in precipitation. The Intergovernmental Panel on Climate Change found that there has already been "a reduction in runoff of 20% between 1972 and 1987" and "significant interruptions in hydropower generation as a result of severe droughts" in the Basin.[182]

The much heralded Nile Basin Initiative is designed to try and break the legal and political lock that Egypt has been able to assert over all upstream development.[183] It is based on the sustainable development of the entire basin and "the equitable utilization of, and benefits from, the common Nile Basin water resources."[184] The agreement envisions fourteen upstream dams along with other smaller watershed improvement projects.[185] However, the dam projects now underway on the Nile—Merowe and Kajbar in Sudan, Tekeze and Gilgel–Gibe in Ethiopia, and Bujagali in Uganda—have been criticized for the serious social and environmental problems, corruption, secrecy, and human–rights violations that they cause.[186] The problem has been exacerbated by China's decision to invest massively in African infrastructure projects.[187]

B. Shared Management

To correct the defects of a static equitable apportionment doctrine, commentators have proposed an expansion of the core principle of equitable apportionment—that each riparian state is entitled to a fair "wet" share of an international river—to include continuing shared

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182. *Id.*

183. Fasil Amdetsion, *Scrutinizing the "Scorpion Problematique": Arguments in Favor of the Continued Relevance of International Law and a Multidisciplinary Approach To Resolving the Nile Dispute*, 44 TEX. INT'L L.J. 1 (2008), details the history of the conflict, the legal and political posturing of all states, and casts a cold eye on the Nile Initiative. *See* Takele Soboka Bulto, *Between Ambivalence and Necessity: Occlusions on the Path Toward a Basin-Wide Treaty in the Nile Basin*, 20 COLO. J. INT'L ENVTL. L. & POL'Y 291 (2009) (identifying obstacles to cooperative efforts in the Nile Basin).

184. Nile Basin Initiative Mission Statement, http://www.nilebasin.org/index.php (last visited Jan. 18, 2010).

185. LORI POTTINGER, INT'L RIVERS NETWORK, CAN THE NILE STATES DAM THEIR WAY TO COOPERATION?: IRN BACKGROUNDER ON THE NILE BASIN INITIATIVE (2004), http://www.internationalrivers.org/files/Nile_Briefing.pdf.

186. *E.g.*, INT'L RIVERS NETWORK, REVIEW OF WORLD BANK INSPECTION PANEL REPORT ON BUJAGALI DAM (2002), *available at* http://www.internationalrivers.org/files/IRN_comment.pdf.

187. *See* INT'L RIVERS NETWORK, MEMORANDUM ON THE MEROWE DAM PROJECT (2007), *available at* http://internationalrivers.org/en/Chinasgloval-role/africa/merowe-dam-sudan/memorandum-merowe-dam-project. For a careful assessment of China's role in the project, see Linden J. Ellis, China Exim Bank in Africa: Opportunities for Strengthening Environmental Standards for Hydropower in Sudan (Mar. 22, 2007), http://www.wilsoncenter.org/index.cfm?fuxaction=events.event_summary&event_id=224956.

management of international rivers. The principle has been variously styled as "restricted sovereignty" and a "community of interests,"[188] or "hydrosolidarity."[189] The foundation is the extension of the idea of limited sovereignty as a constraint on unilateral action, the foundation of the customary rule of equitable apportionment, to the affirmative duty to share use and management of the international water resources. The normative premise is that there is an inherent community of interests among riparian states.[190] The model draws on the post World War II partial erosion of absolute national sovereignty as a result of universal human rights[191] and the imposition of duties on states not to cause environmental damage to other states.[192] The immediate legal foundation is article 8 of the Watercourses Convention, which imposes a duty on states to "cooperate on the basis of sovereign equality, territorial integrity, mutual benefit and good faith in order to attain optimal utilization and adequate protection of an international watercourse."[193] The Berlin Rules posit a much stronger cooperative management duty, derived from *Hungary v. Slovakia*, compared to the Watercourses Convention. Article 11 posits that "Basin States shall cooperate in good faith in the management of waters of an international drainage basin for the mutual benefit of the participating States."[194] In *Hungary v. Slovakia*, the ICJ refused to order Hungary to complete the project or Slovakia to demolish the dam that it had constructed, but instead urged the parties to agree on a joint operating plan for "what remains of the Project"[195] and both the majority and concurring opinions endorsed the protection of environment values.[196]

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188. BROWN WEISS, *supra* note 26, at 194-98.

189. The term was first introduced in MALIN FALKENMARK ET AL., STOCKHOLM INT'L WATER INST., HYDROSOLIDARITY THROUGH CATCHMENT BASED BALANCING OF HUMAN SECURITY AND ECOLOGICAL SECURITY (2003). It is now understood to refer to the joint, cooperative, basin-wide management of shared international water resources. *See* Andrea Gerlak, Robret Varady & Arin Haverland, *Hydrosolidarity and International Water Governance*, 14 INT'L NEGOTIATION 311, 312-14 (2009).

190. McCaffrey, *supra* note 11, at 148-51.

191. *E.g.*, HELEN STACY, HUMAN RIGHTS FOR THE 21ST CENTURY: SOVEREIGNTY, CIVIL SOCIETY, CULTURE (2009).

192. Brown Weiss, *supra* note 26, at 199-207. For an early expression of the idea, see Dante A. Caponera, *Patterns of Cooperation in International Water Law: Principles and Institutions*, 25 NAT. RESOURCES J. 563 (1985).

193. Watercourses Convention, *supra* note 17, art. 8.

194. Berlin Rules, *supra* note 35, art. 11.

195. Gabčikovo-Nagymaros Project (Hong. v. Slovk.), 1997 I.C.J. 7, 79 (Sept. 25). The two parties, however, have not been able to agree to do this. Szabo, *supra* note 6, at 18, 23, 25.

196. Gabčikovo-Nagymaros Project, 1997 I.C.J. 7, at 78-88.

Shared management is an aspirational principle, but if it is implemented, it can better help nations address all four stresses provided that any regime satisfies four conditions. First, the regime must impose procedural duties that go beyond the customary duty of prior notice and consultation[197] to include a wide range of voices and perspectives in major development and use decisions. Second, it must have stringent *and continuing* environmental assessment and monitoring duties that meet the standards set out by the World Commission on Dams in *Dams and Development* and the evolving international standard.[198] Third, it must have substantive rules that constrain unilateral state behavior. Fourth, the management regimes must have the flexibility to adjust quickly to changing hydrologic conditions.[199] No single existing or proposed allocation regime currently exhibits all four characteristics. Therefore, the model must be assembled from a variety of sources.

The procedural components for the long-term cooperative management of international rivers are the easiest to assemble. The Watercourses Convention imposes the basic prior notice duty among riparian states. Before undertaking a major development, the moving state must give "timely notification" to other affected states[200] and must consult and exchange information with those states.[201] The Berlin Rules contain more stringent access to information, public participation and cooperation duties.[202] The other three conditions can be implemented under the umbrella of Integrated Water Resource Management.

C. Integrated Water Resource Management and Adaptive Management

Integrated Water Resource Management (IWRM) has been progressively adopted as the international water management standard. No single principle alone can overcome the geopolitical self-interest that has produced a pattern of "sporadic, fragmentary, and sometimes ambiguous cooperation on international rivers,"[203] but IWRM is a first

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197. DANTE A. CAPONERA, NATIONAL AND INTERNATIONAL WATER LAW AND ADMINISTRATION 211-19 (2003).

198. WORLD COMM'N ON DAMS, *supra* note 52. Article 29 of the Berlin Rules restates the evolving international standard.

199. *Id.*

200. Watercourses Convention, *supra* note 17, art. 12; *see* TANZI & ARCARI, *supra* note 41, at 203-14.

201. Watercourses Convention, *supra* note 17, arts. 9, 11.

202. Berlin Rules, *supra* note 35, arts. 4, 11, 18.

203. KEN CONCA, GOVERNING WATER: CONTENTIOUS TRANSNATIONAL POLITICS AND GLOBAL INSTITUTION BUILDING 106 (2006).

step. To induce shared management, IWRM seeks to combine the power of "neutral" technical information with modern public participation norms especially for previously excluded interests.[204] IWRM is a river basin or catchment area-focused process and thus can be confined to the national level or expanded across national boundaries.

IWRM is neither a totally new concept, nor a substitute for making hard political choices about alternative water use options and the fair allocation of international rivers. It builds on the long history of treating river basin systems as single units to be developed through comprehensive management regimes characterized by large integrated dams and irrigation and canal systems. IWRM tries to correct the environmental and social myopia of previous concretely focused planning and water resources development models as well as introduce greater public involvement and economic discipline into water management and allocation practice.[205] It seeks to develop a wider range of alternatives to achieve long-term environmentally and socially sustainable water uses compared to previous planning models and practices.[206] For example, a recent study identifies a number of low-cost measures, such as drip irrigation and better drainage, which could allow the state of Maharashtra, India, to avoid the crop losses caused by droughts that are projected to increase in frequency due to GCC.[207]

IWRM has widespread support because it has been adopted by European donor nations as the price for water development aid. It was endorsed in Agenda 21, the environmental action plan for the twenty-first century agreed to at the 1992 United Nations Rio de Janeiro Conference on Environment and Development (UNCED).[208] It was incorporated into the four principles adopted at the 1992 Dublin Conference on Water and the Environment.[209] Between UNCED in 1992 and the follow-up 2002 World Summit on Sustainable Development (WSSD), or Rio Plus 10, in Johannesburg, South Africa, IWRM was endorsed by the Commission on

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204. *Id.* at 123-28.

205. CONCA, *supra* note 203, at 153-58.

206. *Id.* at 131.

207. ECON. OF CLIMATE ADAPTATION WORKING GROUP, SHAPING CLIMATE-RESILIENT DEVELOPMENT 81-85, *available at* http://www.mckinsey.com/App_Media/Images/Page_Images/Offices/SocialSector/PDF/ECA_Shaping_Climate%20Resilient_Development.pdf (last visited Feb. 17, 2010).

208. U.N. Conference on Env't & Dev. (UNCED), Rio de Janeiro, Braz., June 3-14, 1992, *Agenda 21*, § 2 ch. 18, U.N. Doc. A/CONF.151/26/Rev. 1 (Vol. II) [hereinafter *Agenda 21*].

209. Int'l Conference on Water & Env't, Dublin, Ir., Jan. 26-31, 1992, *Dublin Statement on Water and Sustainable Development* (Jan. 31, 1992).

Sustainable Development,[210] the General Assembly of the United Nations,[211] the Ministerial Declaration of the International Conference on Freshwater,[212] and was reaffirmed by the WSSD.[213] The 2000 European Union Water Framework Directive adopts IWRM to improve the water quality of the Union's heavily used rivers.[214] It requires a river basin management plan that prioritizes risks and establishes cost-effective measures to reduce pollution loads and flood damage.[215]

IWRM's substantive message is that new demands for water must be recognized as potential constraints on existing, especially inefficient uses to accommodate new environmental and social equity uses.[216] IWRM posits that freshwater is a finite and vulnerable resource, and calls for holistic management that integrates sectoral water plans and programs within a broader framework of economic and social policy.[217] The specific objectives of IWRM, as articulated in Agenda 21, are:

1 [To] promot[e] . . . a dynamic, interactive, iterative and multisectoral approach to water resources management, including the identification and protection of potential sources of freshwater supply, that integrates technological, socioeconomic, environmental and human health considerations;

2 [To] plan[] . . . strategies for the sustainable and rational utilization, protection, conservation and management of water resources based on community needs and priorities within the framework of national economic development policy;

3 To design, implement and evaluate projects and programmes that are both economically efficient and socially appropriate within

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210. Expert Group Meeting on Strategic Approaches to Fresh Water, Harare, Zimb., Jan. 27-30, 1998, *Report of the Expert Group Meeting on Strategic Approaches to Freshwater Management*, ¶ 11, *available at* http://www.un.org/documents/ecosoc/cn17/1998/background/ecn171998–freshrep.htm (last visited Feb. 17, 2010).

211. G.A. Res. 55/196, U.N. Doc. A/RES/55196 (Feb. 1, 2001).

212. Int'l Conference on Freshwater, Dec. 4, 2001, Bonn, Ger., *Ministerial Declaration*, *available at* http://www.welvertrag.org/e375/e719/e1041/InternationalConferenceonFreshwater_2001_MinisterialDeclaration_ger.pdf (last visited Feb. 17, 2010).

213. World Summit on Sustainable Dev., Aug. 26-Sept. 4, 2002, *Johannesburg Declaration on Sustainable Development*, U.N. Doc. A/CONF.199/20 (Sept. 4, 2002).

214. Water Framework Directive, Council Directive 2000/60/EC, ¶ 9, 2000 O.J. (1327) (EC), *available at* http://www.wfd-info.org/water%20framework%20directive%20UK.pdf.

215. *Id.* ¶ 27.

216. CONCA, *supra* note 203, at 161.

217. *Agenda 21*, *supra* note 208, ¶ 18.6. The problem, of course, is that in many countries, fragmented and incomplete water authority frustrates these objectives. *See* S.M.K. DONKOR & YILMA E. WOLDE, (U.N. ECON. COMM'N FOR AFRICA) INTEGRATED WATER RESOURCES MANAGEMENT IN AFRICA: ISSUES AND OPTIONS, *available at* http://www.gdrc.org/uem/water/iwrm/iwrm-africa.pdf (last visited Feb. 5, 2010).

> clearly defined strategies, based on an approach of full public participation, including that of women, youth, indigenous people and local communities in water management policy-making and decision-making;
>
> 4 [To] identify[] [and] strengthen[] or develop[], as required, in particular in developing countries, the appropriate institutional, legal and financial mechanisms to ensure that water policy and its implementation are [a] catalyst[] for sustainable social progress and economic growth.[218]

Ideally, IWRM would function as a series of nested plans and management strategies starting at the subbasin level and be progressively integrated into a multinational planning and management regime for the entire river basin. However, there are problems at every step of this vision starting with the practice of IWRM at the subbasin level.

A 2009 study of the Red River basin in Vietnam illustrates the problems of putting in place an effective IWRM regime at this level.[219] The first problem was that the institutional structure in Vietnam violated the core principle in IWRM that management and development functions should be separated.[220] At the request of foreign donors, the central ministry responsible for water, the Ministry of Agriculture and Rural Development (MARD), authorized the creation of a river basin organization in a subbasin of the international Red River, which exhibited all the classic water use conflicts.[221] However, early studies found that there was no need for a large basin-wide plan but zeroed in on a specific crucial problem, the reallocation of water from a large reservoir.[222] In short, IWRM proved too clumsy a policy instrument to deal with the scale of problems that the basin faced. The broader lesson is that IWRM is a basin-wide tool which should serve as a consistency standard for smaller-scale decisions but it need not be applied to every water use and allocation decision.

To be effective, especially to address aquatic ecosystem degradation and GCC, IWRM must be supported by adaptive management (AM). AM is a decision tree analysis-based[223] management tool developed in the late 1970s to correct the deficiencies of static or deterministic

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218. *Agenda 21*, *supra* note 208, ¶ 18.g.

219. FRANÇOIS MOLLE & CHU THAI HOANH, INT'L WATER MGMT. INST., IMPLEMENTING INTEGRATED RIVER BASIN MANAGEMENT: LESSONS FROM THE RED RIVER BASIN, VIETNAM (IWMI Research Report No. 131, 2009).

220. *Id.* at vii.

221. *Id.*

222. *Id.*

223. *See* HOWARD RAIFFIA, DECISION ANALYSIS (1968).

environmental assessment. It posits that a "fixed review of an independently designed policy"[224] is inconsistent with the reality that all decisions must be made under varying conditions of uncertainty and with what has come to be called nonequilibrium ecology.[225] "True" AM is a rigorous, continuous process of acquiring, evaluating and acting on scientific information.[226] It is a challenge to scientists because it requires the practice of regulatory science[227] and it is a challenge to managers because it requires continuous decisions. AM is part theology and part science. As an early proponent observed, with perspicacity, "[a]daptive management is not really much more than common sense. But common sense is not always in common use."[228]

VII. CONCLUSION

As transboundary water conflicts intensify, especially in arid areas impacted by GCC, international water law's primary function will be to provide a framework for the development of new institutions. The success of these institutions must be evaluated not solely by the planning processes that they generate but by a substantive standard: Do they result in fair allocations of wet water or fair and effective monetary or in kind substitutes that meet the evolving water needs of riparian states?

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224. ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT 1 (C.S. Holling ed., 1978); *see* PANARCHY: UNDERSTANDING HUMAN TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS (Lance H. Gunderson & C.S. Holling eds., 2002); CARL WALTERS, ADAPTIVE MANAGEMENT OF RENEWABLE RESOURCES (1986).

225. A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOY. L.A. L. REV. 1121, 1129 (1994). The hope is that AM will permit decision makers to avoid the paralysis that scientific uncertainty creates. AM experiments are intended to reduce progressively the initial scientific uncertainty over time. Unfortunately, to date, the experience suggests that AM is seldom actually used or is simply relabeled mitigation and monitoring.

226. *See* NAT'L RESEARCH COUNCIL, DOWNSTREAM: ADAPTIVE MANAGEMENT OF GLEN CANYON DAM AND THE COLORADO ECOSYSTEM 52-54 (1999). The Columbia River provides a depressing example of ineffective AM. *See* John M. Volkman & Willis E. McConnaha, *Through a Glass, Darkly: Columbia River Salmon, the Endangered Species Act, and Adaptive Management*, 23 ENVTL. L. 1249 (1993).

227. Regulatory science answers policy-based questions such as the flows to sustain minimal viable population of an at risk fish species which inform science-based socially desired outcomes. Regulatory science requires scientists to contribute to the establishment of standards that have both a normative and scientific component and then to devise ways to measure whether these standards are being met over time. See A. Dan Tarlock, *Slouching Toward Eden: The Eco-Pragmatic Challenges of Ecosystem Revival*, 87 MINN. L. REV. 1173 (2003), for a more extended discussion of the problems of developing a science-based legal regime to structure river restoration efforts. Nonetheless, these decisions must be informed by science.

228. ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT, *supra* note 224, at 136.