

# HOW WELL CAN INTERNATIONAL WATER ALLOCATION REGIMES ADAPT TO GLOBAL CLIMATE CHANGE?

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## I. INTRODUCTION

The consistent conclusions of climate change modeling exercises are that many of the world's major river basins may experience more severe droughts and floods in the coming decades and that aquatic ecosystems will, therefore, experience increased stresses. This Article examines the relationship between international water law and the projected impacts of global climate change on major river basins. The global climate change policy debate has two interrelated components. The first and major component seeks to find the most efficient and equitable means to reduce the root cause of

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anthropocentric climate change, increasing greenhouse gas emissions,<sup>1</sup> in an effort to mitigate projected temperature increases. The second component accepts the projected increases and seeks to understand both the effects of global climate change and the impacts of those effects in order to adapt to them.<sup>2</sup> The anticipated non-mitigation, global climate change response is adaptation to possible projected changes.

Water use regimes are prime candidates for adaptation for four reasons. First, the projected effects of global climate change may be substantial and dramatic, but they will be geographically unevenly distributed. The projected effects will be positive and negative, depending on the location of the basin. Thus, there is a need for varied local and regional responses rather than a uniform, global response, such as a carbon tax or tradable emission rights. Second, these effects, which may already be occurring, will likely materialize before mitigation becomes effective, if mitigation does, in fact, ever become effective. Third, water management regimes have some capacity to adjust to the projected adverse impacts, and adaptation is likely to be less costly than wholesale greenhouse gas emission rollbacks. Fourth, aquatic ecosystems can tolerate some level of stress for prolonged periods of time and still be good candidates for restoration.

The thesis of this Article is that adaptation to the projected adverse hydrologic impacts of global climate change requires the presence of a reasonably well-developed property rights regime in the effected basin, and that the regime must be supported by public and private adaptive management institutions. A property rights regime is a necessary condition but, alone, is insufficient to create fair risk-sharing and is insufficient to permit equitable adjustments to the inevitable inefficiencies of any sharing regime. A property rights regime can help accomplish the necessary reallocation in a way that allows users to share risks and to shift water fairly and efficiently among competing consumptive and non-consumptive uses, such as hydropower uses. Property rights regimes, however, have not historically performed an effective role in conserving aquatic

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1. See generally Jonathan B. Weiner, *Global Environmental Regulation: Instrument Choice in Legal Context*, 108 YALE L.J. 677 (1999).

2. I adopt the distinction between *effects* and *impacts* offered by Dr. Nigel Arnell. He defines effects as "the biophysical consequences of changes in the climatic variables driving the hydrological system" and impacts as the consequences of the effects on specific resource users. See Nigel Arnell, *The Impact of Climate Change on Water Resources*, THE GLOBE (Dec. 1997) (visited Apr. 30, 2000) <<http://www/nerc.ac.uk/ukgeroff/globe40.htm>>.

ecosystems, because property rights are seldom dedicated to this function. Nonetheless, property rights can play an important role in aquatic ecosystem protection and restoration. There is, however, also a need to manage the flow of river basins, including the maintenance of flows which mimic the system's natural hydrograph, better than we have in the past to accommodate the demand for existing and future consumptive and non-consumptive uses.

International water management and allocation regimes will face more difficult adaptation problems than domestic water law regimes for three primary reasons. First, although property rights must be defined and enforced before adaptation can take place, international water use regimes generally have less developed property rights than domestic regimes.<sup>3</sup> For example, the general principles of international water law, reflected in the 1997 United Nations Convention on the Non-Navigation Uses of International Watercourses, create uncertain national rights regarding the use of shared waters. This uncertainty increases the transaction costs of adaptation because property rights must first be defined with greater precision. Second, international regimes are less flexible than domestic ones. Some international rivers have been allocated by treaties that create firm property rights, but the rights may calcify over time and prevent adjustment to changed conditions. The purpose of an international water allocation treaty is generally to allow the construction of upstream and downstream dams, and the ensuing regimes generally assume a fixed, perpetual water supply and flow allocation regime. No provision is usually made for future changed circumstances. Therefore, the parties to such international treaties are likely to insist that the status quo be maintained, no matter how inefficient, inequitable, or environmentally destructive. Finally, ecosystem protection remains subordinate to multi-purpose regional water development.

## II. THE EFFECTS AND IMPACTS OF GLOBAL CLIMATE CHANGE: A CASCADE OF UNCERTAINTIES

Predictions about the consequences of global climate change in a given watershed or river basin must account for hydrologic, economic, and political uncertainty.<sup>4</sup> Global climate change may

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3. See Joseph W. Dellapenna, *Adapting the Law of Water Management to Global Climate Change and Other Hydropolitical Stresses*, 35 J. AM. WATER RESOURCES ASS'N 1301, 1313 (1999).

4. See generally NATIONAL RESEARCH COUNCIL, GLOBAL ENVIRONMENTAL CHANGE: RESEARCH PATHWAYS FOR THE NEXT DECADE (1999) (explaining the gap between what we know

alter precipitation and run-off patterns throughout the world, and the effects are extremely uncertain. A recent Intergovernmental Panel on Climate Change (IPCC) assessment concluded that "[w]armer temperatures will lead to a more vigorous hydrologic cycle," and, although both the amount and timing of rain fall may change, the geographic and temporal scale of the change is uncertain.<sup>5</sup> Some regions, such as sub-Saharan Africa, may experience decreased precipitation and more extended droughts. Other regions will see increased precipitation and more frequent, more severe floods. Increased precipitation may not, however, translate into more available water supplies in all regions. In water-short areas with historically variable rainfall patterns, increased precipitation may actually exacerbate the problems associated with providing reliable water supplies. More precipitation may fall as winter rain rather than snow, and snowpacks may melt earlier, as warmer average temperatures indicate an earlier spring and faster water evaporation. Increased out-of-cycle rainfall is the projected pattern for parts of the western United States.<sup>6</sup> Wetter, warmer weather could impair the ability of the existing systems of carry-over storage to provide reliable regional water supplies.<sup>7</sup> Existing reservoirs may not be able to capture the increased winter run-off, and serious summer shortages may occur.<sup>8</sup>

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and what we need to know about the relationships between climate change and human and natural systems).

5. Ichtiague Rasool, *Special Issue on the Global Hydrological Cycle*, THE GLOBE (Dec. 1997) (visited Apr. 30, 2000) <<http://www.nerc.ac.uk/ukgeroff/globe40.htm>>.

6. U.S. Global Change Research Program, National Assessment of the Potential Consequences of Climate Variability and Change: Draft Report of the Water Sector (visited Aug. 24, 2000) <<http://www.nacc.usgcrp.gov/sectors/water/draft-report/full-report.html>>.

The National Assessment of the Potential Consequences of Climate Variability and Change for the United States ("National Assessment") was called for by a 1990 federal law and has been conducted under a plan approved by the National Science and Technology Council — the cabinet-level body of agencies responsible for scientific research.

A wide range of activities has been underway for several years under the coordination of the federal agencies of the U.S. Global Change Research Program (USGCRP). Among them are five comprehensive sectoral assessments addressing impacts on water resources, forests, coastal ecosystems, human health, and agriculture. This report addresses the state of the science for assessing the impacts of climate changes and variability for the water resources and water systems of the United States.

7. An early study by an Environmental Defense Fund economist concluded that water deliveries for federal and state water projects that serve California's San Joaquin Valley could be reduced by as much as 25 to 28 percent. *See generally* Daniel J. Dudek, CLIMATE CHANGE IMPACTS UPON AGRICULTURE AND RESOURCES: A CASE STUDY OF CALIFORNIA (1990).

8. *See* Sandra Postel, PILLAR OF SAND: CAN THE IRRIGATION MIRACLE LAST? 85-86 (1999). There is also a significant school that argues that global climate change will be good for the United States and other temperate countries. *See generally* Thomas Gale Moore, CLIMATE OF FEAR: WHY WE SHOULDN'T WORRY ABOUT GLOBAL WARMING (1998) (counting increased water

Many sophisticated modeling experiments exist for predicting the location and timing of the effects of increased temperatures on water resources, but "estimates of the effects and impacts of climate change on water resources are very uncertain."<sup>9</sup> There are three levels of uncertainty. First, there is meta uncertainty over the future rate of greenhouse gas emissions. Second, projected climate change scenarios must be translated into hydrologic ones, and numerous problems abound. Low flow models are more reliable than high flow ones; the confidence level of flow change predictions is high, but the confidence levels for quality and aquatic ecosystem changes are not as high. Third, there is a geographic scale problem. It is difficult to translate large-scale models into specific watersheds and to translate watershed models into regional predictions.

These uncertainties cascade into economic and political ones. River basins are physically and socially-politically dynamic. Changes in hydrology occur simultaneously with social and political change and the attendant landscape change that they may bring.<sup>10</sup> Population-driven, increased demand is the most important variable. In many basins, such as the Colorado River and the Nile, the population's demand for a reliable water supply is increasing. More people compete for the use of existing water entitlements. This competition both creates pressures for increased water use and creates shifts among established uses, often from agricultural uses to municipal and industrial uses.

Population pressure is not the sole source of new claim; in some basins, there are new claimants for uses that are not contemplated in the existing allocation regime. For example, in the Nile basin, upstream states now have the capacity to put waters to use. This capacity did not exist when Egypt and Sudan agreed to share the entire flow of the river. In other basins, environmental advocates are demanding that more water be allocated to uses such as wetlands protection, restoration, and the conservation of endangered species.

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supplies among the estimated \$99 billion benefits that the global climate change will produce for the United States).

9. Arnell, *supra* note 2.

10. For example, a large-scale experiment is underway to attempt to model the relationship between forest clearing and the Amazon River's water balance, which may have a substantial impact on the global water balance. See J.H.C. Gash & A.D. Culf, *The Water Cycle in the Amazon Basin*, THE GLOBE (Dec. 1997) (visited Apr. 30, 2000) <<http://www.nerc.ac.uk/ukgeroff/globe40.htm>>.

### III. AN ADAPTION MODEL

Consumptive water users can adapt to an altered hydrologic regime in four basic ways: reallocation of existing uses; conservation; temporarily forgoing a use; or, permanently foregoing a use. Each strategy requires the existence of a robust property rights regime. A robust property rights regime, augmented by adaptive management institutions, can provide fair and efficient processes for allocating the risks of future shortages among users. Property rights regimes set the ground rules for curtailment and permit the creation of reallocation markets, which are the most likely sources of new supplies. They can also create conservation incentives to compliment conservation mandates, but there are many national and international institutional barriers to the use of this model for adapting to global climate change.

A robust property rights regime must be dynamic. A dynamic regime is one that can respond quickly to changed conditions and to market demand. Therefore, the legal and political barriers to change must be capable of rapid modification, in order for a robust property rights regime to exist. Most property regimes have a limited capacity to adapt to changed conditions, but they respond reasonably well to changes in market demand because property rights are alienable at low transaction costs.

Water law can display the opposite characteristics. Water law is a risk allocation regime, which contemplates periods of reduced entitlements in times of shortage and is premised on constant adaptation to changed conditions. However, the transaction costs of water transfers are higher than other forms of property rights because water rights are correlative and have a community interest component. Nonetheless, water law can be the foundation for adaptation. For example, the western water doctrine of prior appropriation allocates the risks of shortages by a simple principle: priority of use. It also allows the transfer of water rights at an acceptable cost.<sup>11</sup>

The problem is whether the extreme risks of global climate change can be allocated within the framework of existing international water law regimes. International water law is a mixed riparian and appropriative regime. The laws of riparian rights and prior appropriation have different capacities to adjust to an altered

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<sup>11</sup> See generally LAWRENCE J. MACDONNELL, *THE WATER TRANSFER PROCESS AS A MANAGEMENT OPTION FOR MEETING CHANGING DEMANDS* (University of Colorado School of Law Natural Resources Law Center 1990).

hydrologic regime, but both systems share a common problem: major political, institution and legal barriers to declaring winners and losers, which is necessary if water is to be reallocated in times of severe water shortages. International water allocation also faces an additional problem: the inflexibility of most international water allocation regimes. Generally, international water allocation agreements are negotiated so that a dam can be built, and it is expected that any resulting water shortages will be short-term. Therefore, the allocation agreement often provides only for temporary reallocations and contains no mechanism to address long term declines in expected available supply.

Western United States water law, which forms the basis for international water law, is a potential adaptation model. The western doctrine of prior appropriation is premised on shortages allocated by priority schedules that provide a clear and complete risk allocation scheme in advance of the shortages. However, such risks do not materialize with any regularity in major river basins, so the law has not been fully tested for this purpose. For example, the Department of Interior has never had to enforce the priorities of the 'law of the river' on the lower Colorado River; although, it has put California on notice that it can no longer use Arizona's surplus share. The focus of federal and state water policy from the conservation era has been to minimize the risks of shortages by constructing large carry-over storage facilities, as the Bureau of Reclamation has done on the Colorado River. Thus, reservoirs and groundwater basins probably will be subjected to only the mildest form of rationing during droughts. States have tried to accommodate unlimited growth on a limited water budget by providing ample margins of safety against shortages. Most irrigators have been buffered against the harshness of prior appropriation both by carryover storage and formal and informal mechanisms that share the burdens of shortages by pro rata rather than by pro tanto delivery reductions.

The law of prior appropriation is a formal risk allocation mechanism, but the expectation that it will be used during water shortages on a large scale is low. In contrast, riparian rights remains a tort regime that does not declare winners and losers in advance, but it provides some post hoc measure of compensation to losers. Despite the efforts of some to firm up riparian rights, the humid states that have adopted riparian rights have not joined the efforts because they assume that water will continue to be an abundant resource rather than a scarce resource.

## IV. INTERNATIONAL WATER LAW

A. *The United States Origins of Customary and Treaty International Water Law*

Modern international water law is an evolving regime based on the United States model of prior appropriation, as modified by the Supreme Court's doctrine of equitable apportionment. Like United States domestic water law, international water law has historically been designed to promote multiple use development by recognizing that each riparian state has an equal right to use common waters, subject to indeterminate sharing rules. Multiple-use of interstate streams was promoted by the United States law of equitable apportionment, which became the basis for international water law.<sup>12</sup> Equitable apportionment projected the principle that prior uses should be protected across state lines and, ultimately, across national boundaries. In the early twentieth century, original jurisdiction, interstate water use disputes were adjudicated by the United States Supreme Court. Up-stream withdrawals along the Arkansas River in Colorado reduced available supplies downstream in Kansas.<sup>13</sup> Chicago's pollution, which discharged into the Mississippi River as a result of the reversal of the flow of the Chicago River, triggered a lawsuit by Missouri.<sup>14</sup> Missouri alleged that Chicago's discharge contributed to a cholera epidemic in Saint Louis. In this dispute, two lawsuits required the United State Supreme Court to develop a law of interstate water use, resulting in the use of the law of equitable apportionment to resolve conflicts between states.

The Supreme Court initially looked to the classic international law rule that all states have equal legal rights to fashion the principle of equitable apportionment, and the resulting doctrine now forms the basis of the sharing rules said to apply to international rivers. The core idea of equitable apportionment is that each state is entitled to a fair share of a common resource because each state has an equal right to develop the available resource. In the United States federal system, states are only quasi-sovereign; and, thus, it was possible for the Supreme Court to hold that the use of common resources, such as interstate streams and groundwater basins, must be shared among

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12. I have developed this point at greater length in A. Dan Tarlock, *Safeguarding International River Ecosystems in times of Scarcity*, UNIV. OF DENVER WATER L.J. (forthcoming 2000).

13. See *Kansas v. Colorado*, 206 U.S. 46 (1906).

14. See *Missouri v. Illinois*, 200 U.S. 496 (1906).

co-riparian states. Concrete sharing rules are difficult to define, though, because states often have widely different abilities to put inchoate shares to actual use.

The Supreme Court has developed a flexible formula that balances the need to accommodate new uses with the protection of existing economies. The open-ended equitable apportionment formula applied by the Supreme Court purports to weigh the comparative merits of different river uses over a long period of time. In fact, the Court has consistently rewarded early development by protecting prior uses against subsequent uses. For example, although in 1982 the Court suggested that it would deny existing uses protection and, instead, support a new and more efficient use of the water when "reasonable conservation measures by existing users can offset the reduction in supply due to diversion,"<sup>15</sup> two years later, the court preserved the priority of a small reclamation district.<sup>16</sup> The Court, however, did leave open the possibility that a new diversion could displace an existing one if the state made a strong showing of an immediate demand for a highly valued use.

Prior appropriation is not absolute, though, because the Supreme Court generally follows the law of the state in which the conflict arises. In humid states, the Court has not been called upon to protect large numbers of pre-existing consumptive uses, but it has been called upon to allocate mass flows and to protect lake levels.<sup>17</sup> Thus, focus on *in situ* uses provides a precedent for sharing the risks of ecosystem protection that is lacking in prior appropriation regimes. For example, the Supreme Court has protected the ecological integrity of the Great Lakes system by substantially limiting out-of-basin diversions to protect pre-existing navigation uses.<sup>18</sup> The Court has also prevented diversions that could impair the waste assimilative capacities of a river.<sup>19</sup> But, in appropriation states, instream flows have not been protected.

Recent attempts to claim instream flows on the Platte River illustrate the resistance of the law of equitable apportionment to new management concepts. In the 1930's, the Supreme Court adjudicated rights to the North Platte River between Nebraska and Wyoming

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15. *Colorado v. New Mexico*, 459 U.S. 176, 190 (1982).

16. *See Colorado v. New Mexico*, 467 U.S. 310 (1984).

17. *See* A. Dan Tarlock, *The Law of Equitable Apportionment Revisited, Updated, and Restated*, 56 U. COLO. L. REV. 381, 396-398 (1985).

18. *See Wisconsin v. Illinois*, 278 U.S. 367 (1929).

19. *See New Jersey v. New York*, 282 U.S. 336 (1931).

users.<sup>20</sup> In the late 1980s, Nebraska reopened the settled dispute to protest some new diversions by Wyoming.<sup>21</sup> Environmental groups unsuccessfully attempted to intervene by arguing that any new decision must guarantee adequate winter flows, not apportioned, for whooping crane populations. However, the Court's first decision in the reopened litigation did not deal with environmental issues.<sup>22</sup> Fortunately, though, the Court's opinion does not preclude environmental management of the Platte; it only renders it less legally secure. The three basin states, Colorado, Nebraska and Wyoming, ultimately signed a Memorandum of Agreement with the Secretary of Interior to develop a basin-wide wildlife protection plan, and as of mid-2000, they are negotiating a final plan. However, the hard fact is that no public or private entity can claim rights to a wildlife protection flow under the equitable apportionment doctrine.<sup>23</sup>

### *B. The Evolving Regime of Customary International Water Law*

Modern international water law is built upon the assumption that all states whose territories contribute to an international drainage basin have a right to an equitable share of the waters of the basin. The doctrine of equitable utilization or equitable participation is designated as a rule of customary international law.<sup>24</sup> This principle was adopted prior to the rise of the environmental movement in the late 1960s and has been reaffirmed in subsequent non-binding declarations, such as the 1972 Stockholm Conference on the Environment,<sup>25</sup> the 1977 World Water Conference in Mar del Plata,<sup>26</sup> and the 1992 United Nations Conference on Environment and Development in Rio de Janeiro.<sup>27</sup> Commentators have recently advocated an expanded sharing principle, a "community of

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20. See *Nebraska v. Wyoming*, 325 U.S. 589 (1945).

21. See *Nebraska v. Wyoming*, 507 U.S. 584 (1993).

22. See *id.*

23. Instream flow rights have been recognized under both Nebraska law and the federal Endangered Species Act. See J. David Aiken, *Nebraska Instream Appropriation Law and Administration*, *INSTREAM FLOW PROTECTION IN THE WEST*, 16-1 (1993).

24. See Sharon A. Williams, *Public International Law and Water Quality Management in a Common Drainage Basin: The Great Lakes*, 18 *CASE W. RES. J. INT'L L.* 155, 165 (1986).

25. See *Conference on the Human Environment*, June 16, 1972, 11 *I.L.M.* 1416.

26. See *Report of the United Nations Water Conference, Mar del Plata, March 14-25 1977*, U.N. Doc. E/CONF. 70/29 (77.II.A.12), at 3-38 (1977).

27. See *Conference on Environment and Development: Rio Declaration on Environment and Development*, June 14, 1992, 31 *I.L.M.* 874, 879.

property" model, which is premised on co-riparian cooperation.<sup>28</sup> Under this model, the rivers and associated resources would be managed jointly without regard to international borders, and the model is based on the principle that all riparian states are entitled to equitable participation in the development of the resource.<sup>29</sup> However, this more progressive vision is not yet reflected in state practice. International water law remains simply a modest restraint on unilateral water resources development and promotes fair access to a common resource, which nation-states may use with minimal consideration of basin-wide impacts.

The most recent formulation of international water law is the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (the Convention).<sup>30</sup> On May 21, 1997, the United Nations General Assembly approved the Convention.<sup>31</sup> On one level, the Convention will not have a substantial impact on the existing use of international bodies of water, if it ever comes into force, because the Convention is subordinate to existing allocation treaties. Article 3 of the Convention provides that "nothing in the present Convention shall affect the rights and obligations of a watercourse State arising" from prior agreements.<sup>32</sup> This Article only expresses the hope that countries will "consider harmonizing" pre-existing treaties with the Convention.<sup>33</sup>

Existing allocation regimes are premised on the availability of a guaranteed supply of water comprised of the average annual river flow augmented by carry-over storage. If droughts and increased evaporation occur, the available water from international rivers will be consistently less than the parties to the allocation originally expected, but existing allocation regimes generally have no

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28. See Joseph Dellapenna, *Treaties as Instruments for Managing Internationally-Shared Water Resources: Restricted Sovereignty vs. Community of Property*, 26 CASE W. RES. J. INT'L L. 27, 36 (1994).

29. See *id.*

30. *United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses*, U.N. Doc. A/51/869 (1997), reprinted in 36 I.L.M. 700 (1997) [hereinafter *Convention*].

31. See George William Sherk et al., *Water Wars in the Near Future? Reconciling Competing Claims for the World's Diminishing Freshwater Resources - The Challenge of the Next Millennium*, (visited Apr. 3, 2000) <<http://www.dundee.ac.uk/cepmlp/journal/html/article3-2.html>>.

32. See *Convention*, *supra* note 30, at 704.

33. See *id.*

mechanisms to adjust to such changed conditions.<sup>34</sup> Thus, international water law, as reflected in the Convention, will not promote adaptation in international river basins for two principal reasons. First, equitable apportionment shares the principal defect of the doctrine of riparian rights: uncertainty. It is not possible to predict the entitlement that the rules produce. Further adjudication or a treaty is necessary to create firm property rights. Otherwise, states have an incentive to hoard and waste water, rather than to share, reallocate and conserve it.<sup>35</sup> Second, although the Convention is progressive, it still gives comparatively little weight to ecosystem protection. Therefore, it will be difficult to integrate ecosystem protection into any property rights based scheme of adaptation.

The Convention reporters were sensitive to the tension between development and environmental protection and tried to mitigate it.<sup>36</sup> The Convention is progressive in that it seeks to combine the older idea that water law should create secure property rights in order to encourage development with the newer idea that the law should encourage aquatic ecosystem protection and restoration. Also, the final version of the Convention integrates some elements of the idea of ecosystem protection with multiple-use development. However, the integration is incomplete, and the Convention still subordinates ecosystem protection to consumptive use and development.

Pollution reduction and prevention is an important component of ecosystem protection, but focusing on pollution is too narrow, as it ignores the more subtle and long-term threats to ecosystems from diversions, barriers and land use practices. Modern, environmentally sensitive legal regimes attempt to correct this problem by mandating or encouraging long-term, monitored, adaptive ecosystem management that mimics the rivers' hydrograph. The concept, though, remains vague and controversial,<sup>37</sup> as well as very difficult and costly to integrate into

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34. See David J. Lazerwitz, *The Flow of International Water Law: The International Law Commission's Law of the Non-Navigational Uses of International Watercourses*, 1 IND. J. GLOBAL LEGAL STUD. 247, 269-70 (1993).

35. See Lee J. Alston et al., *Land Reform Policies: The Sources of Violent Conflict and Implications for Deforestation in the Brazilian Amazon*, J. ENVTL ECON. & MGT. (forthcoming 2000).

36. See Albert Utton, *Which Rule Should Prevail in International Water Disputes: That of Reasonableness or That of No Harm*, 36 NAT. RES. J. 635, 639 (1996).

37. Many ecologists criticize the concept as simply a restatement of multiple use development. See REED F. NOSS & ALLEN Y. COOPERRIDER, *SAVING NATURES LEGACY: PROTECTING AND RESTORING BIODIVERSITY* 283-290 (1994). Proponents of multiple use development often see the concept as a new anti-development regime. See, e.g., Rebecca Thompson, *Ecosystem Management: Great Idea, But What Is It, Will It Work, and Who Will Pay?*, 9 NAT. RES. & ENV'T 42 (1995).

existing river management regimes. In the end, international rules seem to adopt the view that adverse environmental impacts are an inevitable consequence of development and may be mitigated, rather than prevented, by affirmative management.

Article 7 of the Convention initially enjoined states from using water in such a way that would "cause significant harm to other watercourse states,"<sup>38</sup> but two major objections surfaced, which led to a major revision. Proponents of multiple-use development raised the first objection. They criticized the proposed standard as a departure from the common understanding of equitable apportionment because it made development subordinate to environmental quality. Environmentalists criticized the original language in Article 7 because, in their view, it did not go far enough in prohibiting environmental harm, as it only prohibited harm "capable of being established by objective evidence."<sup>39</sup> Thus, it did not include the crucial concept of risk prevention. The basic solution, proposed by the last reporter, made the duty to prevent pollution subordinate to the right of equitable utilization, while creating a flexible process to resolve disputes.<sup>40</sup> Article 7 was redrafted to impose a process duty on states not to cause significant pollution that was subject to an exception for extraordinary circumstances:

Watercourse States shall exercise due diligence to utilize an international watercourse in such a way as not to cause significant harm to other watercourse States, absent their agreement, except as may be allowable under an equitable and reasonable use of the watercourse. A use which causes significant harm in the form of pollution shall be presumed to be an inequitable and unreasonable use unless there is: (a) a clear showing of special circumstances indicating a compelling need for ad hoc adjustment; and (b) the absence of any imminent threat to human health and safety.<sup>41</sup>

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38. Utton, *supra* note 36, at 636.

39. *See id.*

40. *See* EDITH BROWN WEISS ET AL., INTERNATIONAL ENVIRONMENTAL LAW AND POLICY 878-879 (1998).

41. Robert Rosenstock, *First Report of the Non-Navigational Uses of International Watercourses*, International Law Commission, 45<sup>th</sup> sess. at ¶ 25, U.N. Doc. A/CN.4/451 (1993).

The final version of Article 7 accords equitable utilization a strong preference over the no-harm doctrine and environmental flow maintenance.<sup>42</sup> This final version is a victory for slower developing upstream states, and it provides:

1. Watercourse states shall, in utilizing an international watercourse in their territories, take all appropriate measures to prevent the causing of significant harm to other watercourse states.
2. Where significant harm nevertheless is caused to another watercourse state, the State whose use causes such harm shall, in the absence of agreement to such use, take all appropriate measures, having due regard for the provisions of Articles 5 and 6, in consultation with the affected State, to eliminate or mitigate such harm and, where appropriate, to discuss the question of compensation.<sup>43</sup>

The Convention is also an advance beyond prior formulations of equitable apportionment because it places greater emphasis on conservation and alternatives. Article 6 requires the consideration of “geographic, hydrographic, hydrological, climatic, ecological and other natural factors,” as well as consideration of factors of a national character<sup>44</sup> and makes relevant any available alternatives of “comparable” value when deciding whether a planned use is equitable and reasonable.<sup>45</sup> Unlike United States law, Article 5 (f) makes “[c]onservation, protection, and the economy of use of the water resources”<sup>46</sup> a relevant factor in determining whether a use is reasonable and equitable. Article 5 (b) could be the basis for a state to adapt to a decline in average long term supplies by eliminating wasteful uses.

There is little firm, international, aquatic ecosystem protection law. Both the undeveloped state of the law and the possible emergence of new principles capable of supporting climate-change driven initiatives are illustrated by the International Court of Justice’s decision in the Gabikovo-Nagymaros dam decision which 1)

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42. See Charles B. Bourne, *The Primacy of the Principle of Equitable Utilization in the 1997 Watercourses Convention*, 1997 CANADIAN Y.B. INT’L L. 215, 224.

43. *Convention*, *supra* note 30, at 706.

44. See Sherk, *supra* note 31.

45. *Convention*, *supra* note 30, at 706.

46. *Id.* at 705.

affirmed the primacy of equitable apportionment, 2) suggested that it can include an aquatic ecosystem conservation component, 3) rejected an ecosystem protection claim by a downstream riparian state based on the precautionary principle.<sup>47</sup> The opinion does offer some hope that international environmental and water law will recognize that riparian states have a right to protect their riverine ecosystems from the actions of other states and also will recognize that cooperation and shared management may be required to enjoy this right. The facts of the case were not ideal for the establishment of such a claim, but the foundation for future protection through adaptive aquatic ecosystem management is presented in the majority opinion, as well as in the Separate Opinion of Vice President Weeramantry, which posited that the interrelated principles of environmentally sustainable development and cautionary environmental assessment and management are *erga omnes* customary rules.<sup>48</sup>

### C. Case Studies

#### 1. *The Great Lakes*

The Great Lakes system illustrates a potential adaptation model in which all basin users share fairly the risks of climate variability. The Great Lakes are one of America's largest fresh water reserves and, as such, are comparatively less vulnerable to the projected effects of global climate change. However, the amount of fresh water in the lakes makes them a prime candidate, at least in the eyes of many in Canada and the United States, for trans-basin diversions to augment supplies in water-short areas. Global climate change helps fuel the persistent regional fears that the lakes will be tapped to augment water supplies outside the basin. On one level, the lakes are a classic example of an under-developed property rights regime. However, there is an inchoate Law of the Lakes, and its most interesting feature is the preference it accords to non-consumptive uses over consumptive ones. The Law of the Lakes also gives considerably more weight to the conservation of the lakes' ecological services than other allocation regimes. The seven littoral states, the Canadian provinces of Ontario and Quebec, and the national governments of the United States and Canada have evolved a weak

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47. See *Gabikovo-Nagyymaros Project (Hungary v. Slovakia)*, 1997 I.C.J. 1 (Sept. 25).

48. See *id.* at 88 (giving the separate opinion of Vice president Weeramantry).

legal regime to protect the most important regional component of the lakes, the maintenance of naturally fluctuating levels, which can be the basis for adapting to global climate change. The present regime has minimized conflicts by limiting and discouraging consumptive use, but it has also retarded the development of a firmer property rights regime for the lakes.

The Great Lakes have a variable climate that produces fluctuating lake levels.<sup>49</sup> If warmer weather produces more prolonged droughts, longer periods of low water levels will likely occur.<sup>50</sup> Historically, two strategies have been used to share the risks of fluctuating levels. First, high levels are assumed to pose a risk that all shoreline property owners and commercial navigation must anticipate. For example, in the mid-1980s, a great deal of attention was focused on engineering options, such as dredging, to mitigate the potential and actual flooding caused by high water levels.<sup>51</sup> This high water level issue evaporated, though, during the drought years of the late 1980s. Second, the littoral states and the United States federal government have been more proactive in stabilizing levels by limiting in-basin and out-of-basin diversions. The current law of the Great Lakes assumes that the lakes are fully allocated and that there should be no major, new diversions. A recent International Joint Commission (IJC) report characterizes the lakes as a “nonrenewable resource” because less than one percent of the lakes’ waters are renewed annually by precipitation.<sup>52</sup> The report concludes that “[i]f all interests in the Basin are considered, there is never a surplus of waters in the Great Lakes system.”<sup>53</sup> The question is whether this assumption can sustain itself in the face of prolonged droughts if regional and non-regional users attempt to tap the lakes.

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49. See Stanley A. Changnon, *Understanding The Physical Setting: The Great Lakes Climate and Lake Level Fluctuations*, in *THE LAKE MICHIGAN DIVERSION AT CHICAGO AND URBAN DROUGHT* 39 (Stanley Changnon ed., 1994).

50. See INT’L JOINT COMM’N, PROTECTION OF THE WATERS OF THE GREAT LAKES: FINAL REPORT TO THE GOVERNMENTS OF CANADA AND THE UNITED STATES 24 (Feb. 22, 2000) (visited July 20, 2000) <[www.ijc.org/boards/cde/finalreport/finalreport.html](http://www.ijc.org/boards/cde/finalreport/finalreport.html)>; see also DRAFT REPORT OF THE WATER SECTOR OF THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY, *supra* note 6.

51. A study done pursuant to a 1977 Canada-U.S. Reference to the International Joint Commission on the costs and benefits of limited regulation of Lake Erie to reduce the damage from high water levels, concluded that “no further or more detailed studies of limited Lake Erie regulation for the purpose of reducing high water levels be considered in view of the adverse impacts and the wide disparity between the costs and benefits of such regulation.” INT’L JOINT COMM’N, LIMITED REGULATION OF LAKE ERIE 44 Great Lakes – St. Lawrence Water Level Information Office, Water Issues Division, Meteorological Service of Canada – Ontario, Environment Canada – Ontario Region ed., 1983).

52. See Changnon, *supra* note 49.

53. *Id.*

Lake use is controlled by three overlapping legal regimes: state/provincial, national, and international. All three regimes can be characterized as immature legal regimes in that the use of the Great Lakes is regulated far less than other major water resources. Furthermore, the Great Lakes are physically managed less than other water resource systems such as the Colorado and Columbia Rivers or even the Mississippi River. The Great Lakes are characterized by minimally quantified and managed rights. The reasons for this characterization are both physical and institutional. The basin is basically a closed, balanced system. There are only five major in-basin or out-of-basin diversions. Most diversions are non-consumptive, and there is one major diversion into the basin, which is the Long Lac-Ogoki diversion from the James Bay basin into Lake Superior. The Lakes flow very slowly from Superior to the Saint Lawrence River. At the present time, only the levels of Lakes Ontario and Superior are regulated by dams and locks.<sup>54</sup> The lack of regulation is a function of the fact that "[f]or the most part, the Great Lakes act as a natural system and water will flow through the system only as quickly as nature will allow."<sup>55</sup> Sometimes, water takes as long as twelve to fifteen years to flow through the system. For this reason, the rights of users and littoral states remain largely inchoate, with the exception of the Chicago diversion. As a matter of United States federal common law, all littoral states have an equal right to a fair share of interstate waters along or within their borders, but these rights must be claimed and confirmed by a judicial proceeding or by congressional legislation.

*a. The United States Federal Government's Interest*

The United States federal government has an overarching interest in the allocation and use of the lakes, and, constitutionally, the federal government has much power over the Great Lakes. Disregarding Canadian interests in the lakes, the federal government could do anything from draining the lakes to reestablishing an inland sea in the Great Basin in Idaho, Nevada, and Utah to dedicating their use exclusively to be Great Basin States. The real issue is not, however, what the federal government *could* do, but what it *has done* and is *likely* to do. Federal power over the Great

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54. See Michael J. Donahue et al., *Great Lakes Diversion and Consumptive Use: The Issue in Perspective*, 18 CASE W. RES. J. INT'L L. 19, 25-26 (1986).

55. GREAT LAKES COMM'N, WATER LEVEL CHANGES: FACTORS INFLUENCING THE GREAT LAKES 5 (1986).

Lakes has followed the pattern of federal power over water resources established in the nineteenth century. Aside from navigation protection, the federal government has deferred to state water policy. Congress has allowed the littoral states to develop an anti-basin diversion strategy and has ratified it by legislation,<sup>56</sup> which allows states to prohibit new out-of-basin diversions.

*b. The State Interest*

By virtue of their ownership of the Lake beds (lands underlying the mean high water mark) and their control of littoral access, the seven Great Lakes states and the Provinces of Ontario and Quebec have the primary interest in regulating the Lakes. State and provincial power is, of course, subordinate to the power of the national governments to regulate lake use. The power of the national government to regulate lake use is plenary in the United States, but it is more circumscribed in Canada, due to the greater constitutional powers of the provinces. The littoral states and Canadian provinces have used their political power to control the use of the lakes in two related ways. In 1985, they agreed to the non-binding Great Lakes Charter, which provides that all states consult with each other and the Province of Ontario before they approve an out of basin diversion under state law.<sup>57</sup> The Charter was ratified by Congress in 1986, and this charter, which allows any governor to veto a diversion, presumptively exempts out-of-state diversions from the dormant commerce clause; however, its constitutionality has never been tested.<sup>58</sup>

Since 1986, there have been several small, municipal diversions approved. The potential use of the Charter to control lake use by preventing out-of-basin diversions for the alleviation of a prolonged drought is illustrated by the fate of former Illinois Governor James Thompson's proposal to triple Lake Michigan diversions during the

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56. See 43 U.S.C. § 1926d-20 (1986) (requiring the consent of all of the littoral state governors to an out-of-basin diversion).

57. See 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, 55 (1986).

58. A widely circulated, 1998 joint Canada-United States legal study prepared for the Great Lakes Governors has concluded that the Water Resources Development Act of 1986 violates, inter alia, the dormant commerce clause, the non-delegation doctrine and the due process clause. For a skeptical assessment of these assertion, see Joseph W. Dellapenna, *The International Joint Commission Considers Water Exports From the Great Lakes*, 3 ABA WATER RESOURCES COMMITTEE NEWS LETTER, Jan. 2000 at 10.

summer drought in 1988.<sup>59</sup> As the Mississippi River's water level dropped, barge navigation was impeded, and Governor Thompson wanted the trans-basin diversion to augment the river's record-low flow. The proposal, allegedly drafted to aid downstate grain exporters who were major campaign supporters, was blocked by protests from Ohio, Wisconsin, Minnesota and Canada. Governor Thompson dropped the proposal in the face of intense interstate and foreign opposition.<sup>60</sup> The chief legal basis for the objections to his proposed quick navigation fix was Illinois' failure to follow the Great Lakes Charter consultation procedures.<sup>61</sup>

If prolonged lake level declines occur, the Great Lakes states will invoke the doctrine of equitable apportionment in an attempt to prevent new diversions and to ensure that the natural lake flow regimes continue to function. Each littoral state has an equal right to use interstate waters that border it. This right includes both the right to consume a fair share of the water and the right to be free from pollution. Equitable apportionment is the source of the rights of states which border a common water source to (1) confine use of that resource to littoral or riparian states and (2) develop a framework to share the resource in times of shortage. Equitable apportionment can be a global climate change risk sharing mechanism, but the difficulties of judicial administration severely limit its potential role. Courts are reluctant to anticipate allocation problems, and any courts that do attempt judicial allocations are subject to congressional scrutiny.

Equitable apportionment, of course, cannot create increased lake flows to counter higher possible evaporation levels, but apportionment could perform two more functions. First, it could prevent the use of the Great Lakes to solve other climate change-induced water shortages, such as increased irrigation demand in the Great Plains or diminished navigable capacity along the Mississippi. Second, equitable apportionment could ensure that the costs of lake level decline are shared equally by all of the Great Lake states.

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59. See Maureen Irish, *Canadian Practice in International Law*, 27 CANADIAN Y.B. INT'L L. 407-409 (1989).

60. See STANLEY A. CHANGNON ET AL., DROUGHT AND NATURAL RESOURCES MANAGEMENT IN THE UNITED STATES: IMPACTS AND IMPLICATIONS OF THE 1987-89 DROUGHT 43-112 (1991).

61. See Irish, *supra* note 59, at 407-409 (containing a summary of the Canadian parliamentary debates in opposition to the proposal).

*c. International Interests*

All of the Great Lakes, except Lake Michigan, are international, as well as interstate, waters. In reality, all five Great Lakes are international water bodies, because Lake Michigan drains into international water. Thus, international institutions, as well as those of the states and provinces, have a stake in use decisions. Therefore, the provinces of Ontario and Quebec and the federal government of Canada are stakeholders in any major decision affecting any one of the five lakes. In brief, both customary international law and the 1909 Boundary Waters Treaty<sup>62</sup> limit the power of both the United States and Canada to unilaterally undertake a large diversion.<sup>63</sup> Article I of the 1909 Boundary Waters Treaty affirms the right of free navigation, and Article III requires International Joint Commission approval before the natural level or flow of the boundary waters can be altered.<sup>64</sup> Lake Michigan is excluded from the Treaty. However, the Treaty has been invoked by both sides of the Chicago diversion controversy. The United States and Canada have claimed that a diversion in excess of Chicago's original Army permit violates the Treaty because it lowers the natural levels of the other four lakes, and Chicago has argued that the exclusion of Lake Michigan grandfathered Chicago's pre-treaty proposed diversion of 10,000 c.f.s. The issue was not resolved in the litigation, but the controversy illustrates the relevance of the Treaty to all lake-use decisions.<sup>65</sup>

Customary international water allocation law is equally unsuited for providing a framework for co-riparians to adapt to global climate change. The international community has accepted the principle of equitable apportionment as the ground rule of international water allocation. The core idea of equal development opportunity is at the heart of the Convention and will be the basis for the argument that development has priority over aquatic ecosystem protection. The Convention's innovations are commendable, but the fact remains that the protection of a river system's ecological integrity remains secondary to the promotion of development. Specifically, the Convention makes it difficult to promote the protection of the ecological integrity of river systems for two principal reasons. First,

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

63. See Williams, *supra* note 24, at 156, 163-65.

64. See Boundary Waters Treaty, *supra* note 62.

65. See Herbert H. Naujoks, *The Chicago Diversion Controversy Part II*, 30 MARQ. L. REV. 228, 247-54 (1947) (arguing that *Sanitary District v. United States*, 266 U.S. 405, 426 (1925) rejects Chicago's claim and supports that of the U. S. federal government and Canada).

flood plain protection and wetland protection are largely excluded from these new rules, which are focused almost exclusively on pollution prevention. Second, rivers are still not viewed as ecosystems.

More recently, some legal commentators have suggested that any national effort to prohibit the export of water from its territory violates GATT or NAFTA, but this is an untenable position. International law gives a nation complete control over the development and use of its resources, as long as the nation does not cause or allow trans-boundary pollution.<sup>66</sup> Therefore, GATT and NAFTA should be read only to embody the principle that if a country decides to turn a natural resource into a commodity, it must permit trade in a non-discriminatory manner. International law does not require a country to share its raw resources with other countries. NAFTA countries have addressed this issue by declaring that raw water is not a good,<sup>67</sup> but this declaration is a soft law and does not apply to GATT.

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66. See Bengt Broms, *Sovereignty Over Natural Resources*, in 10 ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW 306 (1987) (giving a history of the relationship between the right to develop and state sovereignty). In modern environmental law, however, the sovereign right to develop continues to be the real practice of the international community. The principle is beginning to play a role in water use controversies. The Canadian Provinces and the United States that border the Great Lakes are concerned about the environmental risks and other risks posed by possible withdrawals for bulk tanker shipments. The right to develop is the conceptual basis for an anti-export strategy. It can be argued that GATT and NAFTA invalidate all flat export bans. GATT, Article XI, bans "prohibitions other than duties, taxes or other charges" on exports and imports, but Article XX allows a state to defend an export ban that is necessary to conserve exhaustible natural resources. The Water Resources Act of 1986, 42 U.S.C. § 1926d-20 (1986), allows any Great Lakes state to veto any withdrawal from the basin. The opposing argument is that neither GATT nor NAFTA changes the basic principle that state sovereignty allows a state to decide whether or not to allow trade in raw natural resources. Several World Trade Organization (WTO) decisions have rejected the conservation defense when a nation has attempted to conserve marine resources outside its territory. However, these decisions do not preclude the application of environmental and other conservation measures to a nation's internal waters because the measures are premised on the protection of state sovereignty over internal resources. See generally WTO Appellate Body Report, *United States-Standard for Reformulated and Conventional Gasoline*, 35 I.L.M. 603 (1966); WTO Appellate Body Report, *United States-Import Prohibitions of Certain Shrimp Products*, WT/DS58/AB/R (1998); see also Bret Puls, *The Murky Waters of International Environmental Jurisprudence: A Critique of Recent WTO Holdings in the Shrimp/Turtle Controversy*, 8 MINN. J. GLOBAL TRADE 343 (1999). Traditional water conservation management does not violate the fundamental premise of trade law that all trade partners be treated in a non-discriminatory manner. See generally INTERNATIONAL JOINT COMMISSION, PROTECTION OF THE WATERS OF THE GREAT LAKES: INTERIM REPORT TO THE GOVERNMENTS OF CANADA AND THE UNITED STATES (Aug. 10, 1999).

67. The three NAFTA countries have agreed to exclude non-bottled water from the agreement. Also, all Canadian provinces, with the exception of Quebec, have agreed to ban bulk water removal from the Canadian portion of the country's major drainage basins. The policy will be implemented by each province and contains several exemptions and exclusions

## 2. *The Two Niles: The African and the American (the Colorado River)*

The stories of the two Niles illustrate the difficulties of adapting existing allocation regimes to global climate change. Both basins suffer similarly in that each is a long, hard working river in an arid region, with rapidly increasing populations,<sup>68</sup> whose water resources must be shared among many competing uses. Thus, each is a possible loser as average temperatures increase.<sup>69</sup> Also, both basins are over-appropriated. For example, the Nile's mean annual discharge is slightly larger than assumed in the 1959 Nile Waters Agreement, but current discharge is still less than the current demand.<sup>70</sup> In each basin, the nations or states that contribute the most to the river use it the least. The disparity is most pronounced regarding the Nile; the upper riparian humid equatorial nations of Burundi, Kenya, Rwanda, Tanzania, Uganda, Zaire, and Ethiopia contribute 86% of the supply but consume less than 10% percent of it.<sup>71</sup> Arid Egypt and Sudan account for over 90% of water withdrawals.<sup>72</sup> The upper Colorado River basin uses water more proportionately, but three of the four basin states, including New Mexico, Wyoming and Utah, are expected to use less than their entitlements for the foreseeable future.

There are also major differences between the two basins. In the Nile basin, the major water use will continue to be irrigation for agriculture, and the question is whether the lower basin states of Sudan and Ethiopia can increase their irrigated acreage given Egypt's present monopolization of the river. The problem is compounded by projected usage increases in Kenya, Tanzania and Uganda. Also, the regimes of the basins are different. The Nile allocation regime is an

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such as bottled water, water packaged in small, portable containers, water used in food production, and water used to meet short term safety, security, or humanitarian needs. See *Accord for the Prohibition of Bulk Water Removal From Drainage Basins*, (visited Aug. 1, 2000) <<http://www.wcel.org/wcelpub/2000/13104.pdf>>.

68. In the twentieth century, the population of Egypt increased from 10 million to 65 plus million and continues to grow rapidly. The total basin population is projected to increase from the present 246 million to 812 million by 2040. See Jule Smith, *Nine Nations, One Nile* (article on file with this journal) <<http://www-personal.umuch.edu/~wddrake/smith.html>>. See generally ROBERT ENGLEMAN, *PROFILES IN CARBON: AN UPDATE ON POPULATION, CONSUMPTION AND CARBON DIOXIDE EMISSIONS* (Population Action International, 1998) (arguing that population control and carbon emission reduction should be linked).

69. See Diana Liverman, *Climate Change and the Borderlands: An Introduction and Assessment*, BORDERLINES (May 1999) (visited Apr. 30, 2000) <<http://www.zianet.com/irc1/borderline/1999/b156/b156clim.html>>.

70. See Smith, *supra* note 68 (stating that the mean annual discharge is calculated at 91.9 km<sup>3</sup>, and the demand among Egypt, Ethiopia and the Sudan is calculated at 102.9 km<sup>3</sup>).

71. See *id.*

72. See *id.*

incomplete regime that breeds intense political conflict. The 1959 Nile Waters Agreement was negotiated between Egypt and its immediate upstream neighbor, the newly independent Sudan, to allow the construction of the High Aswan Dam. The agreement allocates a fixed amount of water to each state and the evaporation losses between Egypt and the Sudan, but it does not appear to bind the other basin states.<sup>73</sup> Ethiopia is the source of 85% of the flow, but Egypt has already put 110% of the river's capacity to use.<sup>74</sup> Furthermore, global climate change may alter the river's flow and exacerbate tensions.<sup>75</sup> Ethiopia has ambitious development plans on the Blue Nile and perceives the treaty to be inequitable.<sup>76</sup> Moreover, the treaty provides only a weak mechanism for short-term drought relief.<sup>77</sup> In short, at present, there is no incentive for all basin states to agree on drought contingency plans until each state has some recognized entitlement.

In contrast to the Nile regime, the Colorado River is completely allocated among the seven basin states and the United States and Mexico by treaty, interstate compacts, congressional statutes, and Supreme Court decisions. The status of this regime suggests that adjusting to changed conditions should be easier. Many experts have suggested that the projected effects of global climate change can be mitigated by increased reliance on water markets or through adjustments in existing allocation regimes. However, international water allocation is a prime example of the lack of adaptation mechanisms in existing allocation institutions. International river agreements are often negotiated so that a dam can be built, and the underlying expectation is that any resulting shortages will be short-

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73. The issue is complicated by several major agreements signed when Italy controlled Ethiopia and countries of the Upper Nile basin were colonies of Belgium and Great Britain. For example, the 1891 Protocols Between the Governments of Great Britain and Italy, for the Demarcation of Their Respective Spheres of Influence in Eastern Africa prohibit Ethiopia from constructing any works that interfere with the flow of the Nile. A 1929 Exchange of Notes Regarding the Use of the Nile waters for Irrigation between Egypt and Great Britain representing her Upper Basin Colonies and the Sudan confirms Egypt's prior rights. Egypt maintains that these agreements are still in force, but the other countries argue that they terminated when Italy was driven out of Ethiopia and when Kenya, Tanzania and Uganda became independent states. See Christina M. Carroll, *Past and Future Legal Framework for the Nile Basin*, 12 GEO. INT'L ENVTL. L. REV. 269, 276-279 (1999).

74. See Sherk, *supra* note 31.

75. See generally Michael Hulme, *Global Climate Change and the Nile Basin*, in THE NILE: SHARING A SCARE RESOURCE 139 (P.P. Howell & J.A. Allan eds., 1994).

76. See Ilan Berman & Paul Michael Wihbey, *The New Water Politics of the Middle East*, STRATEGIC REVIEW 45, 49, Summer, 1999.

77. See A. Dan Tarlock, *Now Think Again about Adaptation*, 9 ARIZ. J. INT'L & COMP. L. 169, 178 (1992).

term and will be mitigated by the reservoir's carry-over storage. The agreements often provide only for temporary reallocations and contain no mechanism to address long term declines in expected available supply. Furthermore, there are usually no provisions for the maintenance of minimum environmental flows. These problems are exacerbated by the fact that once a regime goes into effect, strong reliance interests begin to build, and protection of user expectations is, of course, essential to the legitimacy of any allocation regime. However, expectations can calcify if the parties fear that any change which increases the risk of a decrease in available water will put them in a worse position. Therefore, parties to the agreements will block any proposed reallocation adjustments, no matter how drastically conditions change. The Colorado regime in the United States is an example of a regime suffering from excessive fears of change.

The Mexico-United States allocation regime is a classic example of a regime that provides no effective mechanism for fairly sharing the risks of changed conditions. The Mexican-United States Treaty, which allocates the Colorado River between the two countries, provides that the United States need not fulfill its delivery duty in extraordinary drought.<sup>78</sup> It is not clear whether this provision would apply to global warming, but Mexico may not be guaranteed a long-term firm entitlement. To complicate matters further, if the normal drought mechanisms are used, the resulting allocations may be widely perceived as inefficient and unfair; and, therefore, the allocations will not be followed. In short, adaptation may not be a realistic option when an allocation regime lacks mechanisms to deal with changed conditions.<sup>79</sup> The current interest in restoring the Colorado Delta ecosystem in Mexico raises additional adaptation problems. The most radical potential restoration strategy is to breach the Glen Canyon Dam. There is, however, no guarantee that any of the increased flow of the Colorado River would reach Mexico.<sup>80</sup>

Water marketing has been proposed as an adaptation strategy for overcoming treaty limitations. Economists have long criticized water law because it ignores higher, alternative values of water. They assert that too much water is used to grow surplus or low-valued

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78. See Article X, Treaty Respecting Utilization of Waters of the Colorado and Tijuana Rivers and the Rio Grande, United States-Mexico, 59 Stat. 1219. (1944).

79. See generally Charles J. Meyers & Richard L. Noble, *The Colorado River: The Treaty with Mexico*, 19 STAN. L. REV. 367, (1967).

80. See Scott K. Miller, *Undamming Glen Canyon: Lunacy, Rationality, or Prophecy?*, 19 STAN. ENVTL. L.J. 121, 199-202 (2000).

crops, that too much water is used in a wasteful manner, and argue further that increased transfers are desirable. Prior appropriation allocates the risks of shortages by a simple principle: priority of use. The question, then, is how flexible the water transfer system will be in the future. Two sets of problems must be addressed, one institutional, and the other distributional. The first inquiry is whether water users will respond sufficiently to market incentives. The second and more difficult inquiry is whether the redistributions commanded by the market are fair and consistent with ecosystem sustainability in both the short run and long run.<sup>81</sup>

International water transfers face a number of barriers that differ in degree, if not in kind, from those faced by domestic water transfers. The first barrier is conceptual, or physiological. In order for water to be transferred, it must be perceived as a commodity. Domestic legal systems that allow the creation of semi-exclusive water rights solve this problem. Once a property right exists, the major step toward commodification has been taken. Alienability is a standard, but not inevitable, attribute of a property right. Many countries will exhibit a dual attitude toward water in that water will be recognized as a commodity within the country's borders but not outside its borders. Countries will invoke state sovereignty as the basis for the right to keep water out of the market. Canada has taken this position with respect to its waters as a result of the possibility of the transport of bulk water from the Great Lakes, as well as from other waters, for resale in arid countries.

Articles III and VIII of the 1922 Colorado River Compact have been cited for the proposition that the Compact precludes inter-state, inter-basin, or international water transfers. Article III (a) gives each basin a perpetual right to "the exclusive beneficial consumptive use of 7,500,000 acre-feet per year",<sup>82</sup> and Article VIII provides that all rights, except 5,000,000 acre feet of present perfected rights, shall be satisfied "solely from the water apportioned to that basin in which they are situate."<sup>83</sup> Too much is read into these words; the provisions were primarily intended to preserve the Upper Basin future rights against the faster growing Lower Basin, to block an appropriation of surplus waters beyond those expressly allocated by the compact, and to limit any future Lower Basin rights to the

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81. See Tarlock, *supra* note 77, at 173-178; see generally A. Dan Tarlock, *Western Water Law, Global Warming and Growth Limitations*, 24 LOY. L.A. L. REV. 979 (1991).

82. Colorado River Compact, H.R. Doc. No. 605, at 9.

83. *Id.* at 11.

7,500,000 acre feet, plus the hypothetical 1,000,000 acre foot surplus. These provisions should be waivable by the intended beneficiaries if no other state interest or federal interest is injured. In addition, any water transfer must be consistent with the law of rivers, federal reclamation law, and state transfer law.

The dichotomy between water as a sovereign resource and a commodity is present in water allocation agreements. Transfers of compact surplus entitlements between Upper Basin and Lower Basin states have been proposed to accommodate new environmental and urban needs, and there is movement in this direction. In 1999, the Bureau of Reclamation authorized voluntary transfers of surplus entitlements among Lower Basin states.<sup>84</sup> The Department of Interior's Final Rule for Offstream Storage of Colorado River Water allows authorized state entities in the three lower Colorado River Basin states of Arizona, California and Nevada to store unused Colorado River entitlements water, water within their Compact or surplus entitlements, in off-stream reservoirs and aquifers.<sup>85</sup> After unused surplus entitlements have been offered to entitlement holders in the storing states, the Secretary of Interior may release the water pursuant to a voluntary Interstate Release Agreement for use in another Lower Basin states. It is important to introduce such flexibility into a rigid regime in a way that does not risk impairing existing entitlements, but the idea has been fiercely opposed by many stakeholders in the Basin as inconsistent with the law of the river. For example, American Indian tribes argue that the rules allow the use of water that is subject to federally reserved Indian water rights.<sup>86</sup> Also, environmental groups argue that the rule will have indirect and cumulative negative impacts on wildlife and critical habitat.

The Colorado River basin states and stakeholders must ultimately come to the realization that the scientific and economic assumptions behind the Colorado River compacts must be adjusted to the changing demands on the river, both in the United States and in Mexico. The 1944 treaty between Mexico and the United States has been amended to incorporate maximum salinity levels into the Mexican delivery obligation, so the precedent has been set to address environmental problems on the Mexican portion of the Colorado.

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84. See 43 C.F.R. § 414 (1999).

85. See *id.*

86. See 64 Fed. Reg. 58994 (1999).

Voluntary transfers among basin states and between the United States and Mexico are a fair way to accomplish this.<sup>87</sup>

## V. CONCLUSION

The development of water-related adaptation strategies will have to wait until science provides a better understanding of the relationship between global climate change and normal variations on workable geographic scales. This Article has suggested that property rights-based water allocation regimes have some potential to adapt fairly and efficiently, but these regimes must be supplemented by adaptive management institutions for the protection of vulnerable ecosystems. International water law can best be described as an inchoate property regime balanced by limited ecosystem protection. Before they can be the basis of adaptation to global climate change, existing allocation regimes must be modified to permit more flexible responses to changed conditions, and new regimes must be created within the framework of the United Nations Convention on the Non-Navigational Uses of Watercourses. These new regimes must provide sharing regimes, including water markets, that permit adjustment to changed conditions. They also must provide for the maintenance of base river flows to guarantee the provision of ecosystem services in the face of the possible stresses of global climate change.<sup>88</sup>

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<sup>87</sup> See generally Dale Pontious, WESTERN WATER POLICY REVIEW ADVISORY COMM'N, COLORADO RIVER BASIN STUDY 24 (1997).

<sup>88</sup> See Andre Knoll Kaemper, *The Contribution of the International Water Law Commission to International Water Law: Does it Reverse the Flight From Substance*, 27 NETHERLANDS YEARBOOK OF INTERNATIONAL WATER LAW 39, 62-67 (1996).