

ARTICLES

Middle Eastern and North African Hydropolitics: From Eddies of Indecision to Emerging International Law

ELIZABETH BURLESON*

CONTENTS

I.	Introduction	386
II.	ILC Factors With Which Israelis and Palestinians Can Address Transboundary Groundwater	387
	A. The Natural Condition of the Aquifer or Aquifer System	388
	B. The Social and Economic Needs of the Aquifer States Concerned	390
	C. The Population Dependent on the Aquifer or Aquifer System in Each Aquifer State	396
	D. The Effects of the Utilization of the Aquifer or Aquifer System in One Aquifer State on Other Aquifer States Concerned	400
	E. The Existing and Potential Utilization of the Aquifer or Aquifer System	401
	F. The Development, Protection, and Conservation of the Aquifer or Aquifer System and the Costs of Measures to be Taken to that Effect	402
	G. The Availability of Alternatives, of Comparable Value, to a Particular Existing and Planned Utilization of the Aquifer or Aquifer System	405
	1. Water Transfers	406
	2. Desalination	407
III.	Means by Which Integrated Aquifer Collaboration Can Occur	409
	A. International Agreements	409
	B. Bilateral and Regional Treaties as State Practice of Transboundary Groundwater Law	416
	1. The Genevese Aquifer Agreement	417
	2. The Northwestern Sahara Aquifer System (SASS)	418
	3. Nubian Sandstone Aquifer System (NSAS)	420

* LL.M., London School of Economics and Political Science; J.D., University of Connecticut School of Law. The author has also written reports for UNICEF and UNESCO. © 2006, Elizabeth Burleson

IV. Conclusion	423
--------------------------	-----

I. INTRODUCTION

The groundwater shared by Israelis and Palestinians is not sufficiently covered by international water law, leaving open the issue of reasonable and equitable water use as it relates to the Middle Eastern and North African peace process. The death of Yasser Arafat, election of Hamas, removal of Saddam Hussein, passage of United Nations Security Council Resolution 1483,¹ and conflict in Sudan significantly alter the geopolitics of the region. In 1991, Julio Barberis suggested that international law of transboundary groundwater might follow rules on oil and gas that allocate shares in proportion to the volume of the natural resource underlying each state.² Recent codification efforts have provided a broader framework with which co-aquifer states can address transboundary natural resources through flexible water use provisions, equitable distribution of water benefits, and strong dispute resolution mechanisms.³ The United Nations International Law Commission (ILC) has taken on the task of codifying shared natural resources provisions for groundwater, oil, and gas. In 2005, the ILC's third report proposed a Draft Convention on the Law of Transboundary Aquifers⁴ that seeks to codify established and emerging rules on the use and protection of transboundary groundwater.

This article analyzes Middle Eastern and North African hydrogeopolitics in light of emerging international law. Part II applies the multifactor balancing test of the Draft Convention on the Law of Transboundary Aquifers to the Israeli-Palestinian conflict. The transparency achieved by bringing these factors together and addressing them collectively can help Israelis and Palestinians build consensus. Part III addresses various means by which integrated aquifer collaboration can occur. International law consists of the accretion of co-aquifer agreements as well as international treaties. Existing co-aquifer arrangements can be helpful in resolving Israeli-Palestinian water enmity. Switzerland and France might not shed light on how to transition away from occupation to normalized state relations but can model state practice of collaborative water monitoring by a joint

1. S.C. Res. 1483, ¶ 4, U.N. Doc. S/RES/1483 (May 22, 2003) (calling for effective administration of occupied Iraq).

2. Julio Barberis, *The Development of International Law of Transboundary Groundwater*, 31 NAT. RESOURCES J. 167, 177-78 (1991).

3. For a discussion of conflict and cooperation based upon the level of institutionalism embodied in a river basin, see generally Meredith A. Giordano & Aaron T. Wolf, *Sharing Waters: Post-Rio International Water Management*, 27 NAT. RESOURCES F. 163 (2003). In an earlier analysis, Wolf recommends a regional watersharing agreement for the Jordan River, suggesting possible collaborative infrastructure projects. See generally Aaron Wolf, *Water for Peace in the Jordan River Watershed*, 33 NAT. RESOURCES J. 797 (1993).

4. Chusei Yamada, Int'l Law Comm'n, *Third Report on Shared Natural Resources: Transboundary Groundwaters*, Annex, at 19, U.N. Doc. A/CN.4/551 (Feb. 11, 2005) [hereinafter *Draft Convention on the Law of Transboundary Aquifers*] (providing in full the draft convention).

commission. While recharging and non-recharging aquifers require distinct considerations, North African fossil aquifer agreements offer Palestinians and Israelis examples of state practice between countries emerging from armed conflicts that have marred recent foreign relations. Part IV concludes that emerging water standards and multifactor balancing can enable Israelis and Palestinians to achieve sustained peace and security.

II. ILC FACTORS WITH WHICH ISRAELIS AND PALESTINIANS CAN ADDRESS TRANSBOUNDARY GROUNDWATER

As basin-wide needs are clarified, transboundary water agreements can enhance security. Israelis and Palestinians can use the ILC's international framework as a guide in crafting a regional water-sharing agreement.⁵ According to Article 6 of the Draft Convention on the Law of Transboundary Aquifers, co-aquifer states should assess the following factors: (A) natural condition of an aquifer, (B) social and economic needs, (C) population, (D) impact on co-aquifer states, (E) existing and potential use, (F) development and conservation, and (G) alternative water sources.⁶ Addressing these factors can facilitate good faith negotiations between Israelis and Palestinians. Mutual benefit leads to an array of interactions between governments and nongovernmental actors across economic, legal, and scientific fields. These relations can help sustain cooperative conserva-

5. Created by the General Assembly in 1947, the ILC seeks to establish clear-cut international rules on emerging issues. The General Assembly requested that the ILC address shared natural resources in furtherance of the General Assembly responsibility to "initiate studies and make recommendations for the purpose of . . . encouraging the progressive development of international law and its codification." U.N. Charter art. 13, para. 1(a), *available at* <http://www.un.org/aboutun/charter/>.

6. See *Draft Convention on the Law of Transboundary Aquifers*, *supra* note 4, art. 6, at 21.

Article 6

Factors relevant to equitable and reasonable utilization:

1. Utilization of a transboundary aquifer or aquifer system in an equitable and reasonable manner within the meaning of article 5 requires taking into account all relevant factors and circumstances, including:
 - (a) The natural condition of the aquifer or aquifer system;
 - (b) The social and economic needs of the aquifer States concerned;
 - (c) The population dependent on the aquifer or aquifer system in each aquifer State;
 - (d) The effects of the utilization of the aquifer or aquifer system in one aquifer State on other aquifer States concerned;
 - (e) The existing and potential utilization of the aquifer or aquifer system;
 - (f) The development, protection and conservation of the aquifer or aquifer system and the costs of measures to be taken to that effect;
 - (g) The availability of alternatives, of comparable value, to a particular existing and planned utilization of the aquifer or aquifer system.
2. The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is reasonable and equitable utilization, all relevant factors are to be considered together and conclusion reached on the basis of the whole.

Id.

tion and use of Israeli-Palestinian groundwater.

A. THE NATURAL CONDITION OF THE AQUIFER OR AQUIFER SYSTEM

Israeli-Palestinian water cooperation depends upon a sound understanding of natural conditions. The Draft Convention on the Law of Transboundary Aquifers clarifies that “[a]quifer” means a permeable [water-bearing] geological formation underlain by a less permeable layer and the water contained in the saturated zone of the formation.⁷ Israelis and Palestinians share the coastal aquifer, which extends from Mount Carmel in the north down the Mediterranean coastline to Gaza. They also share the Mountain Aquifer System, including the western, northern, and possibly eastern aquifers. The Mountain Aquifer basin underlies the West Bank and Israel.⁸ The recharge of the Mountain Aquifer occurs primarily within the West Bank while most of the aquifer’s high quality water naturally flows into Israel.⁹ The United Nations Educational, Scientific and Cultural Organization (UNESCO) notes that from a hydrological perspective, groundwater extraction is relatively easy over the foothills and lower mountain slopes of Israel, while engineering capacity needed to drill from the mountain tops of the West Bank would be technically possible but would necessitate deeper wells that would produce less water at a higher cost.¹⁰

Approximately twelve percent of the Gaza Strip and West Bank is desert, eroded, or saline land.¹¹ Scarcity of water increases the need for strong dispute resolution mechanisms between Israelis and Palestinians. The natural condition of the region does not fit easily within the 1997 United Nations Convention on the Law of Non-Navigational Uses of International Watercourses,¹² which defines a watercourse as “a system of surface waters and groundwaters constituting by virtue of their physical relationship a unitary whole and normally flowing into a

7. *Id.* art. 2, at 19.

8. U.N. ENV'T PROGRAMME, DESK STUDY ON THE OCCUPIED PALESTINIAN TERRITORIES 38 (2003), available at <http://www.unep.org/GC/GC22/Document/INF-31-WebOPT.pdf> [hereinafter UNEP, DESK STUDY].

9. U.N. EDUC., SCIENTIFIC & CULTURAL ORG. [UNESCO] ET AL., INTERNATIONALLY SHARED (TRANSBOUNDARY) AQUIFER RESOURCES MANAGEMENT 17 (Shammy Puri ed., 2001), available at <http://unesdoc.unesco.org/images/0012/001243/124386e.pdf>.

10. Hillel I. Shoval, *A Proposal for an Equitable Resolution to the Conflicts Between the Israelis and the Palestinians Over the Shared Water Resources of the Mountain Aquifer*, ARAB STUD. Q., Spring 2000, at 33, 37, available at http://www.findarticles.com/p/articles/mi_m2501/is_2_22/ai_65653663.

11. Soil salinity intensifies as salts accumulate upon eroded land. UNEP, DESK STUDY, *supra* note 8, at 12.

12. Convention on the Law of Non-Navigational Uses of International Watercourses, G.A. Res. 51/229, U.N. GAOR, 51st Sess., U.N. Doc. A/RES/51/229 (1997), reprinted in 36 I.L.M. 700 (1997), available at <http://www.un.org/ga/documents/gares51/ga51-229.htm> [hereinafter 1997 Watercourse Convention]. While the General Assembly’s adoption of the convention gives the convention authority, it has not been ratified by the required thirty-five countries in order for it to come into force. For a discussion of how Iraq, Syria, and Turkey can utilize this convention for a watersharing arrangement, see generally Elizabeth Burleson, *Equitable and Reasonable Use of Water in the Euphrates-Tigris River Basin*, 35 ENVTL. L. REP. 10041 (2005).

common terminus.”¹³ Based upon current hydrological understanding, this definition appears to exclude both the Mountain and Coastal Aquifers because an aquifer must be physically related to a surface body of water to meet the Convention’s definition.¹⁴ Furthermore, the Mountain Aquifer flows toward three divergent termini rather than the common terminus required by the Convention. According to Eckstein and Eckstein the intermittent streams that flow into the Coastal Aquifer do not supply consistent or sufficient recharge for the surface and groundwater to constitute a hydrological system.¹⁵ Irrespective of the degree to which existing international law covers Israeli-Palestinian hydrological systems, a regional water-sharing agreement could address the given natural conditions.

Despite the fact that the Palestinian Authority is not recognized as a sovereign state subject to international law,¹⁶ lack of a defined territory should not impede cooperative water management. Israeli-Palestinian water infrastructure is already intertwined, requiring political recognition and interaction.¹⁷ Following the November 2004 death of Yasir Arafat, Mahmoud Abbas (Abu Mazen) was elected the new Palestinian leader in January 2005. A year later, Hamas won the January 25, 2006 Palestinian parliamentary elections.¹⁸ Remaining committed to negotiations with Israel, President Mahmoud Abbas has suggested that talks be conducted through the Palestine Liberation Organization to bypass a Hamas-led government.¹⁹ It remains to be seen whether this change in leadership can resume the Roadmap’s “[r]evival of multilateral engagement on issues including regional water resources, environment, economic development, refugees, and arms control issues.”²⁰ Israel completed disengagement from the Gaza Strip in September 2005. While there are no longer Israeli settlements in Gaza, Israel remains in control of Gaza’s coast and airspace. The Gaza Strip is still Israeli-occupied. Current status remains subject to the Israeli-Palestinian Interim Agreement, while

13. 1997 Watercourse Convention, *supra* note 12, art. 2(a).

14. Yoram Eckstein & Gabriel E. Eckstein, *Groundwater Resources and International Law in the Middle East Peace Process*, 28 WATER INT’L 154, 159-60 (2003), available at <http://www.internationalwaterlaw.org/Articles/Eckstein-IntlWater.pdf>.

15. *Id.* at 160.

16. Israel agreed to transfer certain powers and responsibilities to the Palestinian Authority as part of the interim self-governing arrangements in the West Bank and Gaza Strip. See Declaration of Principles on Interim Self-Government Arrangements, Isr.-Palestinian Liberation Org., Sept. 13, 1993, 31 I.L.M. 1527 [hereinafter Oslo I].

17. Gershon Baskin & Nader El Khatib, *If Common Sense Prevails*, UNESCO COURIER, Oct. 2001, at 22, available at <http://unesdoc.unesco.org/images/0012/001237/123798e.pdf>.

18. “Hamas came to prominence after the first intifada as the main Palestinian opponent of the Oslo accords—the US-sponsored peace process that oversaw the gradual and partial removal of Israel’s occupation in return for Palestinian guarantees to protect Israeli security.” BBC News, Who are Hamas?, http://news.bbc.co.uk/1/hi/world/middle_east/1654510.stm (last updated Jan. 26, 2006).

19. Steven Erlanger, *Hamas Routs Ruling Faction, Casting Pall on Peace Process*, N.Y. TIMES, Jan. 27, 2006, at A1.

20. MidEastWeb, Quartet Roadmap to Israeli-Palestinian Peace (Apr. 30, 2003), <http://www.mideastweb.org/quartetrm3.htm>.

permanent status depends upon future negotiations. Good faith negotiations that address natural, social, and economic factors can enable Israelis and Palestinians to share the benefits of their transboundary groundwater.

B. THE SOCIAL AND ECONOMIC NEEDS OF THE AQUIFER STATES CONCERNED

The social and economic needs of citizens are governed by international law when armed conflict results in occupation. Israelis and Palestinians have asymmetric technical, economic, and political capacities with which to negotiate.²¹ The Mountain Aquifer currently supplies the best quality drinking water for both Israelis and Palestinians.²² If untreated sewage continues to be disposed upon the land overlying the Mountain Aquifer System, it will cease to be the reliable source of clean groundwater that it is today.²³ Winter rains flow into the Jordan River. Running south along the Jordanian-Israeli border, precious little water from the river still reaches its natural Dead Sea terminus. In-stream flow and recharge of the Coastal and Mountain Aquifers silently give way to increased demand for water. The Israeli Water Commission must reasonably and equitably provide domestic, industrial, agricultural, ecological, and transboundary water allocations.²⁴ The Palestinians seek economic viability requiring sufficient water to supply a growing population. Resettlement of the Palestinian Diaspora within a new state of Palestine strains settlement negotiations. Israelis seek groundwater use that does not over-extract the aquifer systems.²⁵ Yet, both stand to gain from reaching an agreement on water that shares benefits beyond the water itself.²⁶

Water security for societies emerging from conflict requires infrastructure and institutional development.²⁷ While communities lacking piped water have depended upon trucked water, tankered water providers have not met the United

21. Fadia Daibes, *A Progressive Multidisciplinary Approach for Resolving the Palestinian-Israel Conflict Over the Shared Transboundary Groundwater: What Lessons Learned from International Law?*, 8 U. DENV. WATER L. REV. 93, 124 (2004). For a discussion of additional dynamics that affect the outcome of water cooperation, see generally PETER H. GLEICK, *THE WORLD'S WATER 1998-1999: THE BIENNIAL REPORT ON FRESHWATER RESOURCES* (1998) (discussing, *inter alia*, degree of scarcity, interdependence, underlying animosity, options, and power asymmetry).

22. Hilal Elver, *Palestinian/Israeli Water Conflict and Implementation of International Water Law Principles*, 28 HASTINGS INT'L & COMP. L. REV. 421, 425 (2005).

23. Alon Tal, *New Trends in Israel's Water Legislation and Implications for Cooperative Transboundary Management* 3 (Isr./Palestine Ctr. for Research & Info., Water Conference Paper, 2004), available at <http://www.ipcri.org/watconf/papers/alon.pdf>.

24. See Shuval, *supra* note 10, at 44-46.

25. *Id.*

26. Cf. Salman M.A. Salman, *Dams, International Rivers, and Riparian States: An Analysis of the Recommendations of the World Commission on Dams*, 16 AM. U. INT'L L. REV. 1477, 1490-91 (2001) (noting that the Nile Basin Initiative and other co-riparian management efforts emphasize the sharing of benefits rather than solely the allocation of waters).

27. See WORLD BANK, *WATER WEEK 2005—WATER SECURITY: POLICIES & INVESTMENTS, AGENDA AND SESSION DESCRIPTIONS* 20, 30 (2005), available at <http://www.worldbank.org/watsan2/waterweek/WaterWeek2005Agenda.pdf> [hereinafter WORLD BANK, WATER WEEK 2005].

Nations World Health Organization (WHO) drinking water standards and prices for such water rose eighty percent between 2000 and 2003.²⁸ Faced with falling into debt to water providers, families have sought alternative water sources such as dirty spring water and have tried to cope with less water.²⁹

The social and economic needs of Israelis and Palestinians resulting from the ongoing conflict have become a global concern. On May 26, 2005, U.S. President George W. Bush pledged US\$50 million to the Palestinian Authority for Gaza infrastructure and housing projects following Israeli withdrawal. Bush said that,

Israel should not undertake any activity that contravenes road map obligations or prejudices final status negotiations with regard to Gaza, the West Bank and Jerusalem. Therefore, Israel must remove unauthorized outposts and stop settlement expansion.³⁰

Bush clarified that the barrier that Israel is building in the West Bank must not be a political barrier and that any alteration from 1949 armistice lines must be mutually agreed to by both Israelis and Palestinians.³¹ Furthermore, the West Bank must be contiguous and be able to maintain viable links to the Gaza Strip.³² The International Court of Justice (ICJ) found the barrier to be illegal and Israel to be in violation of Article 53 of the Fourth Geneva Convention³³ for destroying water wells and other property in order to build the barrier. The ICJ concluded that, “on the material before it, the Court is not convinced that the destructions carried out contrary to the prohibition in Article 53 of the Fourth Geneva Convention were rendered absolutely necessary by military operations.”³⁴

Maintaining international peace and security depends upon addressing Israeli security and Palestinian socio-economic viability. Israelis and Palestinians both claim sovereignty over natural resources, historical use, and vital human need for

28. WORLD BANK, TWENTY-SEVEN MONTHS—INTIFADA, CLOSURES AND THE PALESTINIAN ECONOMIC CRISIS: AN ASSESSMENT 47 (2003) [hereinafter WORLD BANK, TWENTY-SEVEN MONTHS].

29. *Id.* at 46-47.

30. U.S. President George W. Bush, Remarks Welcoming Palestinian President Abbas to the White House (May 26, 2005), available at <http://www.whitehouse.gov/news/releases/2005/05/20050526.html>.

31. *Id.*

32. *Id.*

33. Article 53 of the Fourth Geneva Convention reads in full: “Any destruction by the Occupying Power of real or personal property belonging individually or collectively to private persons, or to the State, or to other public authorities, or to social or cooperative organizations, is prohibited, except where such destruction is rendered absolutely necessary by military operations.” Geneva Convention (IV) relative to the Protection of Civilian Persons in Time of War art. 53, Aug. 12, 1949, 75 U.N.T.S. 287 (entered into force Oct. 21, 1950), available at <http://www.unhcr.ch/html/menu3/b/92.htm> [hereinafter Fourth Geneva Convention]. For a broader discussion, see HARVARD PROGRAM ON HUMANITARIAN POL’Y & CONFLICT RESEARCH [HPCR], POLICY BRIEF: THE LEGAL STATUS OF ISRAELI SETTLEMENTS UNDER IHL (2004), available at <http://www.reliefweb.int/library/documents/2004/hav-opt-31jan.pdf>. See also David Kretzme, *The Advisory Opinion: The Light Treatment of International Humanitarian Law*, 99 AM. J. INT’L L. 88, 91 (2005).

34. Legal Consequences of the Construction of a Wall in the Occupied Palestinian Territory, Jul. 9, 2004, 2004 I.C.J. No. 130, 43 I.L.M. 1009, 1009.

water. Palestinians argue that post-1967 Israeli extractions of groundwater within the West Bank violate International Humanitarian Law.³⁵ Israeli occupation of the West Bank and Gaza Strip in 1967 placed duties upon Israel pursuant to the 1907 Hague Regulations Respecting the Laws and Customs of War on Land.³⁶ Israel also arguably acquired responsibilities under the 1949 Fourth Geneva Convention Relative to Protection of Civilian Persons in Time of War.³⁷ If groundwater in the occupied territories constitutes public immovable property then Israel has a usufructuary right that preserves the corpus of the property.³⁸ Israel may use natural resources within its occupied territories to support military forces but not Israeli civilian endeavors. While Israel's usufructuary right allows natural resource use in a manner similar to the picking of fruit, groundwater use beyond recharge rates comes closer to cutting down an orchard than consuming the fruit. Israeli arguments that water scarcity warrants limits on Palestinian groundwater extractions are inconsistent with heavy aquifer use by Israeli civilian settlements.³⁹

Even if West Bank and Gaza Strip groundwater is deemed private or state movable property, civilian use of such water by an occupier violates Article 52⁴⁰

35. Palestinian Nat'l Authority, Israeli Occupation and Intifada [sic], http://www.pna.gov.ps/subject_details2.asp?DocId=97 (last visited Apr. 17, 2006).

36. 1907 Hague Convention (IV) Respecting the Laws and Customs of War on Land, Annex, Oct. 18, 1907, 36 Stat. 2295, T.S. No. 539, available at <http://www.icrc.org/ihl.nsf/0/1d1726425f6955aec125641e0038bfd6?OpenDocument> [hereinafter Hague Regulations]. Although Israel is not a party to the Fourth Hague Convention, Israel recognizes the customary law status of the Hague Regulations. For a broader discussion, see Harold Dichter, *Israel's Water Policies in the Occupied Territories*, 35 HARV. INT'L L.J. 565, 574 n.67 (1994). See also CLAUDE BRUDERLEIN, HPCR, LEGAL AND POLICY BRIEF: LEGAL ASPECTS OF ISRAEL'S DISENGAGEMENT PLAN UNDER INTERNATIONAL HUMANITARIAN LAW (IHL) (2004), available at <http://www.ihlresearch.org/opt/pdfs/briefing3466.pdf>.

The law on military occupations inadequately addresses prolonged occupation and the risk that political and economic stagnation may occur due to a lack of development decisions on water source issues and integration into global markets. For a discussion of the law of prolonged military occupation by Israel, see Adam Roberts, *Prolonged Military Occupation: The Israeli-Occupied Territories Since 1967*, 84 AM. J. INT'L L. 44 (1990).

37. Fourth Geneva Convention, *supra* note 33.

38. See Hague Regulations, *supra* note 36, Annex, art. 55, stating that:

The occupying State shall be regarded only as administrator and usufructuary of public buildings, real estate, forests, and agricultural estates belonging to the hostile State, and situated in the occupied country. It must safeguard the capital of these properties, and administer them in accordance with the rules of usufruct.

39. Antonio Cassese, *Powers and Duties of an Occupant in Relation to Land and Natural Resources*, in INTERNATIONAL LAW AND THE ADMINISTRATION OF OCCUPIED TERRITORIES 419, 430-432 (Emma Playfair ed., 1992); see also Roberts, *supra* note 36, at 89-95; Dichter, *supra* note 36, at 592-93.

40. See Hague Regulations, *supra* note 36, Annex, art. 52, stating that:

Requisitions in kind and services shall not be demanded from municipalities or inhabitants except for the needs of the army of occupation. They shall be in proportion to the resources of the country, and of such a nature as not to involve the inhabitants in the obligation of taking part in military operations against their own country.

Such requisitions and services shall only be demanded on the authority of the commander in the locality occupied.

or Article 53⁴¹ of the Hague Regulations. Article 53 designates the circumstances under which state movable property may be used for military purposes, while Article 52 provides a military necessity exception to the Article 46 prohibition on the confiscation of private property. Arguing that Israeli settlements meet International Humanitarian Law's requirement of military necessity is difficult.⁴² The 2004 Israeli Disengagement Plan proposes unilateral withdrawal from the Gaza Strip and the northern part of the West Bank. Given that Security Council recognition of an end of occupation occurred after the transfer of authority to a sovereign government in Lebanon and Iraq, Israel might continue to be viewed as responsible for the welfare of Palestinians in the Gaza Strip.⁴³ Security Council Resolution 1483 requires an occupier to effectively administer a territory. This suggests that Israel has a responsibility to ensure Palestinian access to clean water of sufficient quality. *Jus ad bellum* principles of international law would emerge with an end of occupation, including the United Nations Charter Article 2(4) prohibition against use of force.⁴⁴ In contrast to the Disengagement Plan, Israel would be bound by the United Nations Charter Article 51 provisions on self-defense rather than preventive military measures within the Gaza Strip.⁴⁵ The Government of Israel notes that Security Council Resolution 1373 of September 2001 has extended the meaning of an armed attack to cover terrorism by recognizing a state's inherent right to self-defense in response to acts of terrorism.⁴⁶ Even under the laws of armed conflict, however, the military necessity of the separation barrier has been refuted.

Only eleven percent of the planned barrier follows the Green Line. This 1949 Armistice Line between Israel and Jordan is internationally recognized as the Israel/West Bank boundary. By 2004, 37.3 kilometers (km) of water networks

Contributions in kind shall as far as possible be paid for in cash; if not, a receipt shall be given and the payment of the amount due shall be made as soon as possible.

41. See *id.* Annex, art. 53, stating that:

An army of occupation can only take possession of cash, funds, and realizable securities which are strictly the property of the State, depots of arms, means of transport, stores and supplies, and, generally, all movable property belonging to the State which may be used for military operations.

All appliances, whether on land, at sea, or in the air, adapted for the transmission of news, or for the transport of persons or things, exclusive of cases governed by naval law, depots of arms, and, generally, all kinds of munitions of war, may be seized, even if they belong to private individuals, but must be restored and compensation fixed when peace is made.

42. Cassese, *supra* note 39.

43. S.C. Res. 1483, *supra* note 1. For a discussion of the effect of Security Council Resolution 1483 upon the law of occupation, see Eyal Benvenisti, *Water Conflicts During the Occupation of Iraq*, 97 AM. J. INT'L L. 860 (2003).

44. "All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations." U.N. Charter art. 2, para. 4, available at <http://www.un.org/aboutun/charter/>.

45. BRUDERLEIN, *supra* note 36.

46. S.C. Res. 1373, U.N. SCOR, 56th Sess., 4385th mtg., U.N. Doc. S/RES/1373 (2001).

had already been destroyed to construct the barrier.⁴⁷ The Economic and Social Commission for Western Asia states that, “[w]ith the barrier, Israel effectively will annex most of the western aquifer system (which provides 51 per cent of the West Bank’s water resources).”⁴⁸ The World Bank notes that the “estimated physical damage to the water and wastewater sector is around US\$140 million (around US\$60 million in water and US\$80 million in wastewater).”⁴⁹ The past half-century has shown that crisis management is not the stage at which complex water supply and treatment issues can be resolved effectively. Accordingly, the Israeli-Palestinian Joint Declaration for Keeping the Water Infrastructure out of the Cycle of Violence provides an encouraging sign that genuine collaboration is occurring.⁵⁰ A Permanent Status Agreement, based on United Nations Security Council Resolutions 242, 338, and 1397, would end the Israeli occupation that began in 1967.⁵¹

In 1993, Israeli and Palestinian representatives signed a Declaration of Principles (Oslo I) on the interim period of Palestinian self-rule.⁵² Annex III to Oslo I calls for an Israeli-Palestinian Committee on Economic Cooperation that would address such issues as water and create an environmental protection plan. The Israeli-Palestinian Interim Agreement (Oslo II) partitioned the West Bank and Gaza strip into three categories: areas A under Palestinian control, areas B under joint Israeli-Palestinian control, and areas C under Israeli control.⁵³ In areas B the Palestinian Authority is in charge of Palestinian public order and Israel is responsible for internal security. Israel also retains control over Jerusalem, West Bank and Gaza settlements, and external borders and security.⁵⁴

The United Nations Truce Supervision Organization facilitated the Israeli-Jordanian peace process by providing a forum for water coordination. The Israeli-Jordanian Peace Treaty has increased trust between Israel and Jordan,

47. HPCR, POLICY BRIEF: THE SEPARATION BARRIER AND INTERNATIONAL HUMANITARIAN LAW 3 (2004), available at <http://www.ihlresearch.org/opt/pdfs/briefing3300.pdf>.

48. Econ. & Soc. Comm’n for Western Asia [ESCWA], *Economic and Social Repercussions of the Israeli Occupation on the Living Conditions of the Palestinian People in the Occupied Palestinian Territory, Including Jerusalem, and of the Arab Population in the Occupied Syrian Golan*, ¶¶ 25-26, U.N. Doc. A/59/89 E/2004/21 (June 7, 2004).

49. WORLD BANK, TWENTY-SEVEN MONTHS, *supra* note 28, at 46 n.97.

50. Israeli-Palestinian Joint Water Comm., Joint Declaration for Keeping the Water Infrastructure out of the Cycle of Violence, Jan. 31, 2001, *reprinted in* Press Release, Isr. Ministry of Foreign Affairs, Joint Israel-Palestinian Call to Protect Water Supply (Feb. 1, 2001), available at http://www.mfa.gov.il/MFA/MFAArchive/2000_2009/2001/2/Joint%20Israel-Palestinian%20Call%20to%20Protect%20Water%20Sup.

51. S.C. Res. 242, U.N. Doc. S/8247 (1967); S.C. Res. 338, U.N. Doc. S/RES/338 (1973); S.C. Res. 1397, U.N. Doc. S/RES/1397 (2002).

52. Oslo I, *supra* note 16.

53. Interim Agreement on the West Bank and Gaza Strip, Isr.-Palestine Liberation Org., arts. IX-XIII, Sept. 28, 1995, 36 I.L.M. 551, 582-87, available at <http://www.mfa.gov.il/MFA/Peace+Process/Guide+to+the+Peace+Process/the+israeli-palestinian+interim+agreement.htm> [hereinafter Oslo II].

54. UNEP, DESK STUDY, *supra* note 8, at 18.

despite tension resulting from the lack of a drought provision.⁵⁵ While further negotiation is required to address Palestinian riparian status on the lower Jordan River, the Israeli-Jordanian peace process can be looked to as a model for Israeli-Palestinian cooperation. Given that an interim agreement leaves a great deal more ambiguity than a final peace treaty, the sooner Palestinians and Israelis can finalize permanent status the sooner the violence is likely to end.⁵⁶

Israelis and Palestinians must gather the political will with which to agree upon common objectives and establish a permanent institutional framework. Each party must then ratify an agreement. This requires each side not only to enact domestic laws and regulations but also to fund and staff implementation effectively. Infrastructure must be financially sustainable and development must meet the needs of both urban and rural communities. Preventive maintenance can save enormous infrastructure costs but requires recurrent budgets.⁵⁷ Alon Tal notes that, "having the domestic legal frameworks required to address transboundary problems intact and operating will expedite the next stage of progress at the bi-lateral diplomatic level."⁵⁸ He further observes that, while the political issue of water quantity was left for final status negotiations, Oslo II provides a viable basis for transboundary water management.⁵⁹

The first principle set forth in Oslo II, Annex III, Article 40 is that "Israel recognizes the Palestinian water rights in the West Bank. These will be negotiated in the permanent status negotiations and settled in the Permanent Status Agreement relating to the various water resources."⁶⁰ While permanent status negotiations are on hold, the Joint Water Committee established under Article 40 has continued to meet. This institution has sufficient authority to go beyond information exchange to issue permits to drill wells, monitor aquifer depletion, make decisions, and resolve disputes.⁶¹ Israeli and Palestinian understanding that disengagement on water would be catastrophic is due in part to the Joint Water Committee, which is composed of an equal number of Palestinian and Israeli members.⁶² The Joint Water Committee continues to function as nearly all the other Oslo mechanisms have ground to a halt due to the ongoing al-Quds intifada

55. Treaty of Peace Between the State of Israel and the Hashemite Kingdom of Jordan, Isr.-Jordan, Oct. 26, 1994, 34 I.L.M. 43 (1995), available at <http://www.mfa.gov.il/MFA/Peace%20Process/Guide%20to%20the%20Peace%20Process/Israel-Jordan%20Peace%20Treaty>.

56. Anders Jägerskog, *Why States Co-operate Over Shared Water: The Water Negotiations in the Jordan River Basin 4* (Isr./Palestine Ctr. for Research & Info., Water Conference Paper, 2004), available at <http://www.ipcri.org/watconf/papers/anders.pdf>.

57. See WORLD BANK, WATER WEEK 2005, *supra* note 27, at 62.

58. Tal, *supra* note 23, at 3.

59. *Id.* at 2.

60. Oslo II, *supra* note 53, Annex III, app. 1, art. 40, princ. 1.

61. *Id.*; see also *id.* Annex III, app. 1, sched. 8 (Joint Water Committee); *id.* Annex III, app. 1, sched. 9 (Supervision and Enforcement Mechanism).

62. *Id.* Annex III, app. 1, art. 40, cl. 13.

that began in 2000.⁶³

By describing the situation since the second intifada as an armed conflict, Israel has decided that the International Covenant on Civil and Political Rights (ICCPR)⁶⁴ and the International Covenant on Economic, Social and Cultural Rights (ICESCR)⁶⁵ are inapplicable to the Palestinian Occupied Territories. In resolving water conflicts, Article 10 of the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses required states to give special regard to “vital human needs.”⁶⁶ Similarly, Article 11(2) of the Draft Convention on the Law of Transboundary Aquifers states that, “[i]n the event of a conflict between utilization of a transboundary aquifer or aquifer system, it shall be resolved with special regard being given to the requirements of vital human needs.”⁶⁷ In contrast, the United Nations Committee on Economic, Social and Cultural Rights uses the broader term “personal and domestic uses” rather than “vital human needs” in its General Comment No. 15.⁶⁸ The General Comment acknowledges the right to water as implicit in the Article 11 right to an adequate standard of living and the Article 12 right to health of the International Covenant on Economic, Social and Cultural Rights.⁶⁹ Regardless of the definition of an armed conflict and the boundary between *jus ad bellum* and *jus in bello*, Israel and the Palestinian Authority must cooperate—addressing social and economic factors as well as security concerns. Access to a basic level of clean water is at the heart of both Israeli-Palestinian animosity and its resolution.

C. THE POPULATION DEPENDENT ON THE AQUIFER OR AQUIFER SYSTEM IN EACH AQUIFER STATE

Rapid population growth affects access to limited water resources. Aquifer agreements that address both existing and future populations have the greatest likelihood of long-term success. Without West Bank groundwater, neither Israelis nor Palestinians can meet drinking water needs for even the present population. WHO recommends that each person receive at least twenty liters of clean water

63. Jägerskog, *supra* note 56, at 4.

64. International Covenant on Civil and Political Rights, Dec. 19, 1966, 999 U.N.T.S. 171, 6 I.L.M. 368.

65. International Covenant on Economic, Social and Cultural Rights, Dec. 16, 1966, 993 U.N.T.S. 3, 6 I.L.M. 360.

66. 1997 Watercourse Convention, *supra* note 12, art. 10.

67. *Id.* art. 11(2).

68. U.N. Econ. & Soc. Council, Comm. on Econ., Soc. & Cultural Rights, *Substantive Issues Arising in the Implementation of the International Covenant on Economic, Social and Cultural Rights, General Comment 15, The Right to Water*, U.N. Doc. E/C.12/2002/11 (Nov. 26, 2002), available at <http://www.unhchr.ch/html/menu2/6/gc15.doc>.

69. *See id.* ¶ 3 (“The right to water clearly falls within the category of guarantees essential for securing an adequate standard of living, particularly since it is one of the most fundamental conditions for survival.”); *see also id.* ¶ 12(a) (stating that “personal and domestic uses” includes drinking, sanitation, food preparation, and hygiene).

per day.⁷⁰ Hillel Shuval has suggested an allocation of 125 cubic meters per person per year based upon the amount of water used in Israel's domestic, urban, and industrial sectors in 1998.⁷¹

Table 1 provides the July 2005 demography estimate of the Israeli-Palestinian conflict.

TABLE 1:
ISRAELI AND PALESTINIAN POPULATION GROWTH⁷²

	West Bank + Gaza Strip	Israel
Population	1,376,289	6,276,883
Population Growth Rate	3.77%	1.2%
% Population Under 15	48.5%	26.5%

Palestinian society is very young and expanding rapidly.⁷³ Approximately sixty-seven percent of the Palestinian Occupied Territory population is twenty-four years old or younger.⁷⁴ The Palestinian Authority is struggling to expand educational services to an increasing number of school age children every year. In the wake of increased suicide bombings, closures and curfews have hindered school attendance. The United Nations Relief and Works Agency for Palestine

70. WORLD HEALTH ORG. [WHO], TECHNICAL NOTE: POST-TSUNAMI FLOODING AND COMMUNICABLE DISEASE RISK IN AFFECTED ASIAN COUNTRIES 3 (2004), available at http://www.wpro.who.int/NR/rdonlyres/BDA62920-B5FD-49D9-9E84-6C01200A33B1/0/tsunami_flooding.pdf. WHO has based this figure on the observation that if water is collected from approximately one kilometer away then about twenty liters per person per day is typically collected, whereas water supplied through a single tap within the household typically leads to fifty liters of water being collected per person per day. WHO, THE RIGHT TO WATER 12-13 (2003), available at http://www.who.int/water_sanitation_health/rtwrev.pdf. "The minimum amount of water needed for drinking ranges from about 2 litres in temperate climates to about 4.5 litres per day for people in hot climates who have to carry out manual work." *Id.* at 17. WHO goes on to state that "most people need at least 2 litres of safe water per capita per day for food preparation" and that basic sanitation also requires water. *Id.*

The U.N. Educational, Scientific & Cultural Organization compiled the following cubic meter comparison of water availability per person per year: Turkey (3439 cubic meters), Iraq (3287 cubic meters), Lebanon (1261 cubic meters), Egypt (859 cubic meters), Israel (276 cubic meters), Jordan (179 cubic meters), Syrian Arab Republic (1622 cubic meters), Gaza Strip (52 cubic meters). UNESCO, Water Availability Per Person Per Year, http://www.unesco.org/bpi/wwwdr/WWDR_chart1_eng.pdf (last visited Apr. 17, 2006).

71. Shuval, *supra* note 10, at 46.

72. Table derived from July 2005 information provided by Cent. Intelligence Agency [CIA], World Factbook—Israel, <http://www.cia.gov/cia/publications/factbook/geos/is.html#People> (last visited July 30, 2005). The Israeli population figure of 6,276,883 includes estimates of 187,000 Israeli settlers in the West Bank, 20,000 in the Israeli-occupied Golan Heights, more than 5000 in the Gaza Strip (removed from Gaza by September 2005), and fewer than 177,000 in East Jerusalem. *Id.*

73. WORLD BANK, TWENTY-SEVEN MONTHS, *supra* note 28, at 43.

74. ESCWA, *supra* note 48, ¶ 40.

Refugees in the Near East (UNRWA) and the United Nations Children's Fund (UNICEF) have found that passing grades in Arabic declined from seventy-one percent in 1999–2000 to thirty-eight percent in 2000–2001 and in mathematics from fifty-four percent to twenty-six percent.⁷⁵ Catch-up days and makeshift classrooms in mosques and basements have not met the needs of Palestinian children.⁷⁶ The Palestine Authority will need an educated and resourceful citizenry to meet the intensifying challenges of water scarcity and rapid population growth.

In relation to water, Israelis are concerned about the impact of Palestine's 3.77% population growth rate.⁷⁷ Increased expectations and actual standards of living combined with intensified irrigation will further threaten vulnerable water resources.⁷⁸ Outgoing World Bank president James Wolfensohn notes that, "the total amount of money spent on development annually by the world is 50 to 60 billion dollars a year. The total amount of money spent on military expenditure is a thousand billion dollars a year, 20 times that amount."⁷⁹ The United Nations, United States, European Union, and Russia have appointed Wolfensohn as a mediator on the withdrawal from Gaza and the West Bank. Wolfensohn notes that in the next twenty-five years developing countries' population will increase from five billion to seven billion.⁸⁰ The Middle East and North Africa's population has already more than doubled between 1970 and 2001, more than halving the average amount of freshwater available per capita to 1640 cubic meters per person per year.⁸¹ Most Middle Eastern and North African countries are significantly below this average as three-fourths of the region's available freshwater can be found in Iran, Iraq, Syria, and Turkey.⁸² With the dubious distinction of being the most water-scarce region on the globe, the Middle East and North Africa

75. WORLD BANK, TWENTY-SEVEN MONTHS, *supra* note 28, at 44.

76. *Id.*; see also ESCWA, *supra* note 48, ¶ 40.

77. CIA, *supra* note 72.

78. See MARK SANCTUARY & HÅKAN TROPP, STOCKHOLM INT'L WATER INST., MAKING WATER A PART OF ECONOMIC DEVELOPMENT: THE ECONOMIC BENEFITS OF IMPROVED WATER MANAGEMENT AND SERVICES 17 (2005), available at http://www.siwi.org/downloads/Reports/CSD_Economics.pdf (report commissioned by the Governments of Norway and Sweden as input for the Commission on Sustainable Development (CSD) and its 2004–2005 focus on water, sanitation, and related issues).

Irrigated land currently produces 40% of the world's food on 17% of the world's agricultural land. A broadening of irrigation and more effective rain fed agriculture will be necessary to meet the food demand. This will require significant investments in irrigation, water storage, water distribution and drainage, particularly if demand for water from other sectors is to be met.

Id.

79. *The News Hour with Jim Lehrer, Newsmaker: Wolfensohn* (PBS television broadcast May 30, 2005), transcript available at http://www.pbs.org/newshour/bb/international/jan-june05/wolfensohn_5-30.html.

80. *Id.*

81. FARZANEH ROUDI-FAHIMI, LIZ CREEL, & ROGER-MARK DE SOUZA, POPULATION REFERENCE BUREAU, FINDING THE BALANCE: POPULATION AND WATER SCARCITY IN THE MIDDLE EAST AND NORTH AFRICA 4 (2002), available at http://www.prb.org/pdf/FindingTheBalance_Eng.pdf.

82. *Id.* at 2.

contain a mere 1.4% of the world's renewable freshwater.⁸³ As new natural freshwater supplies decline or become too expensive to utilize, countries have invested in desalination and wastewater recycling technologies.⁸⁴ The process by which pressing issues are able to gain and maintain limelight is a political one. Water has only recently made its debut and may be unceremoniously dispensed with once more. Population growth has yet to be taken seriously as the root cause of many interrelated challenges. Table 2 illustrates the exponential rate at which global population continues to grow.

TABLE 2:
WORLD POPULATION GROWTH⁸⁵

World Population	1820	1930	1960	1974	1988	2000
	1 billion	2 billion	3 billion	4 billion	5 billion	6 billion

In July 2005 there were approximately 6.45 billion people in the world, growing at a rate of 1.14% per annum.⁸⁶ Rapid urbanization and increasing consumption patterns have increased water demand at a pace beyond which governments have been able to supply water infrastructure. Nearly two out of every ten people in the world do not have access to safe drinking water.⁸⁷ This ratio can increase or decrease depending upon the ability of states to build consensus. To facilitate progressive policy development the United Nations has declared 2005–2015 the water decade.⁸⁸ On a regional level, a final Israeli-Palestinian peace agreement should allocate water use rights, taking into account the respective Israeli and Palestinian populations. Negotiation over Palestinian refugee repatriation is likely to complicate this process. Lack of consensus regarding such difficult political issues should not prevent interim water coopera-

83. *Id.* at 1.

84. Burlison, *supra* note 12, at 10048.

85. Table based upon July 2005 figures. See CIA, World Factbook—World, <http://www.cia.gov/cia/publications/factbook/geos/xx.html> (last visited Apr. 17, 2006); see also U.N. FOOD & AGRIC. ORG. [FAO], WORLD AGRICULTURE: TOWARDS 2015/2030—SUMMARY REPORT 86 (2002), available at http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/004/y3557e/y3557e00.htm (providing population projections through 2050).

86. CIA, *supra* note 85.

87. U.N. MILLENNIUM PROJECT TASK FORCE ON WATER & SANITATION, HEALTH, DIGNITY, AND DEVELOPMENT: WHAT WILL IT TAKE? ACHIEVING THE MILLENNIUM DEVELOPMENT GOALS 1 (2005), available at <http://www.unmillenniumproject.org/documents/WaterComplete-lowres.pdf>.

88. “At its 58th session, the United Nations General Assembly adopted a draft resolution, without a vote (A/RES/58/217), proclaiming 2005 to 2015 as the International Decade for Action – Water for Life,” ensuring participation of women in water-related development efforts and recommitting countries to the 2000 Millennium Declaration, the 2002 Johannesburg Plan of Implementation, and Agenda 21. Global Dev. Research Ctr., “Water for Life”, http://www.gdrc.org/uem/water/decade_05-15/ (last visited Apr. 17, 2006).

tion. Regardless of the agreement's final allocation of water, aquifer use should be both reasonable and equitable.

D. THE EFFECTS OF THE UTILIZATION OF THE AQUIFER OR AQUIFER SYSTEM IN ONE AQUIFER STATE ON OTHER AQUIFER STATES CONCERNED

Israeli water policies have impacted Palestinian water use. Eckstein and Eckstein note that Israel and the Israeli settlements within the West Bank use 495 million cubic meters of water annually, constituting 82.5% of extracted Mountain Aquifer water.⁸⁹ Palestinians only have access to 105 million cubic meters annually.⁹⁰ The disparity in per capita water consumption between Israelis and Palestinians fuels intense animosity. Drawing lines in the sand is easier than establishing integrated transboundary groundwater management, for which there is little national or international law.

Polluting existing sources of freshwater can place a source of drinking water beyond a country's fiscal capacity to ensure safe use. Conservation of both water quality and quantity can decrease water stress. Israeli restrictions on Palestinian pumping clearly impact use of groundwater in the West Bank. Land-based activities by both Israelis and Palestinians are polluting the Mountain and Coastal Aquifer systems.⁹¹ Both governmental and nongovernmental international development efforts should facilitate the widespread use of drip irrigation technology, which would in turn substantially reduce agricultural water use. Most of the Middle East's scarce water has been used in agriculture. According to the Population Reference Bureau,

drip irrigation cuts water use by between 30 percent and 70 percent and increases crop yields by between 20 percent and 90 percent, compared with traditional irrigation. Drip systems deliver water directly to plants' roots, through a network of perforated plastic tubing installed on or below the soil surface. Another successful technique, fertigation, involves applying fertilizer to irrigation water through the use of computer-controlled drip techniques. It economizes on water and fertilizer use, and limits soil salination and groundwater pollution. Israeli farmers, who use highly efficient drip-irrigation techniques, have more than doubled their food production in the last 20 years without increasing their use of water.⁹²

89. Eckstein & Eckstein, *Groundwater Resources and International Law in the Middle East Peace Process*, *supra* note 14, at 154.

90. *Id.*

91. UNEP, DESK STUDY, *supra* note 8, at 34; *see also* Moshe Hirsch, *Game Theory, International Law, and Future Environmental Cooperation in the Middle East*, 27 *DENV. J. INT'L L. & POL'Y* 75, 101-106 (1998). *See also generally* HAL FEIVESON ET AL., *ALLOCATIONS OF WATER AND RESPONSIBILITIES IN AN ISRAELI-PALESTINIAN WATER ACCORD* (1999), available at <http://www.wws.princeton.edu/wws401c/accord.pdf> (Final Report of WWS 401c taskforce); U. Kafri et al., *Geochemical Characterization and Pollution Phenomena of Aquifer Waters in Northern Israel*, 42 *ENVTL. GEOLOGY* 370, 370-386 (2002).

92. ROUDI-FAHIMI, CREEL & DE SOUZA, *supra* note 81, at 6.

Rainfall and surface flow naturally recharge aquifers. People have found ways to enhance recharge through the use of dams, contour ploughing, and diversion channels. Water can also be added to wells to artificially recharge aquifers. Both intentional recharge and indirect inputs from storm, wastewater, and agricultural runoff are sources of pollution. Beyond monitoring industrial discharges, an aquifer agreement should address increased commercial and residential construction. While artificial recharge can prevent saline intrusion by re-pressurizing depleted aquifers, understanding local hydrological conditions is imperative to aquifer conservation and management.

E. THE EXISTING AND POTENTIAL UTILIZATION OF THE AQUIFER OR AQUIFER SYSTEM

Existing and potential aquifer use is limited. At fifty-two cubic meters per year, Gaza residents have the second lowest water availability per person per year in the world.⁹³ Local recharge to the Coastal Aquifer is fifty-five million cubic meters per year.⁹⁴ Only seven million cubic meters per year of groundwater naturally recharges the Coastal Aquifer from water sources originating in Israel, less than ten percent of the almost eighty million cubic meters of annual overdrawn extraction.⁹⁵ Future demand for water in the densely populated Gaza Strip is likely to rise sharply.

Without permanent surface water, Gaza Strip residents rely upon aquifers for drinking water and agriculture. Unfortunately, in addition to rainfall, recharge occurs through sewage and agricultural runoff and seawater intrusion. The United Nations Food and Agriculture Organization (FAO) notes that, “[o]ver-extraction of groundwater leads to a lowering of the groundwater table and a deterioration of the groundwater quality due to sea water intrusion and/or the upward diffusion of deeper saline water. Using saline groundwater for irrigation may increase soil salinity.”⁹⁶ Evaporation of irrigation water leaves salt on fields, which in turn contaminates the aquifer when irrigation water seeps into the ground directly or flows into surface waters that recharge the aquifer.⁹⁷ Intensifying the use of treated effluents to irrigate fields increases soil salination and pollutes aquifers. Untreated sewage and excessive use of fertilizer have caused high nitrate levels.⁹⁸ Chloride and nitrate levels in Gaza Strip drinking water

93. UNESCO, *supra* note 70.

94. Eckstein & Eckstein, *Groundwater Resources and International Law in the Middle East Peace Process*, *supra* note 14, at 157.

95. *Id.* at 154.

96. FAO, AQUASTAT, General Summary Near East Region, <http://www.fao.org/ag/agl/aglw/aquastat/regions/neast/index9.stm> (last visited Apr. 17, 2006).

97. *Id.*

98. Seventy to eighty percent of domestic wastewater from Gaza is discharged into the environment untreated. Amani Alfarra & Sami Lubad, *Health Effect Due to Poor Wastewater Treatments in Gaza Strip*, (Isr./Palestine Ctr. for Research & Info., Water Conference Paper, 2004), available at <http://www.ipcri.org/watconf/papers/amani.pdf>.

wells between 1990–2002 were significantly higher than WHO guidelines.⁹⁹ Groundwater salinity and nitrate concentrations have risen to levels beyond which humans can tolerate.¹⁰⁰ Loss of wetlands and increased use of chemical fertilizers lead to excessive nitrate concentrations in drinking water, causing methemoglobinemia (blue baby syndrome).¹⁰¹ Israel has shut down many drinking water wells, built desalination plants, and in March of 2005 finalized an agreement with Turkey to import fifty million cubic meters of water per year over the next twenty years.¹⁰² Existing aquifer use should not jeopardize the quality of the groundwater available in the future.

F. THE DEVELOPMENT, PROTECTION, AND CONSERVATION OF THE AQUIFER OR AQUIFER SYSTEM AND THE COSTS OF MEASURES TO BE TAKEN TO THAT EFFECT

Ancient rain harvesting methods combined with cutting-edge monitoring technology would enable Israelis and Palestinians to optimize water use. The United Nations Environmental Programme (UNEP) recommends that new urban construction regulations require on-site storm-water retention in order to decrease flooding and increase water reserves.¹⁰³ Jordanian building codes require that all newly built homes have a rain harvesting system installed. Such systems allow people to collect and store torrential rainfall.¹⁰⁴ A rooftop rain harvesting system usually consists of minor plumbing hardware, plastic piping, a storage tank, a small pump, and a power supply.¹⁰⁵ With these relatively inexpensive supplies, rainfall can be collected and stored for later use.¹⁰⁶ As part of the Middle East Peace Process, human rights and conservation nongovernmental organizations are engaged in joint community outreach. Together with the Multilateral Working Group on Water Resources, nongovernmental organiza-

99. Fayeq I. El-Madhoun, *Drinking Water Quality: Evaluation of Chloride and Nitrate Concentration of Wells Supplies Gaza Governorates (1990-2002)-Palestine* 14 (Isr./Palestine Ctr. for Research & Info., Water Conference Paper, 2004), available at <http://www.ipcri.org/watconf/papers/fayeq.pdf>.

100. Denise Brehm, Mass. Inst. of Tech., *Salt in Gaza Strip Water Could Destroy Agriculture in 20 Years* (Jan. 20, 2001), <http://web.mit.edu/newsoffice/2001/water-0110.html>.

The local aquifer underlying the Gaza Strip is perhaps one of the most stressed resources in the Mediterranean basin in terms of water quantity and quality: Chloride concentrations reach 1,500 milligrams per liter (six times the E.U. standard); nitrate concentrations reach 400 milligrams per liter (eight times the E.U. standard); and boron concentrations reach 3.5 milligrams per liter (more than three times the E.U. standard).

Avner Vengosh et al., *Natural Boron Contamination in Mediterranean Groundwater*, GEOTIMES, May 2004, http://www.geotimes.org/may04/feature_boron.html.

101. El-Madhoun, *supra* note 99, at 3.

102. Vengosh et al., *supra* note 100.

103. UNEP, *DESK STUDY*, *supra* note 8, at 31.

104. Multilateral Working Group on Water Resources, *RainCatcher: An Israeli-Jordanian-Palestinian Pilot Project for Rain Harvesting*, <http://www.watercare.org/RainCatcher/index.htm> (last visited Apr. 17, 2006).

105. *Id.*

106. *Id.*

tions such as WaterCare are facilitating the instillation of weather stations and rain harvesting systems. The RainCatcher pilot project is underway in half a dozen schools in Palestinian, Jordanian, and Israeli communities.¹⁰⁷ After designing a rain harvesting system specifically for their school, students participate in monitoring experiments. With United States Geological Survey guidance, RainCatcher gathers students, teachers, the Palestinian Water Authority, the Israeli Water Commission, and the Jordanian Ministry of Water and Irrigation.¹⁰⁸

By consolidating water management into the Ministry of Water and Irrigation, Jordan has addressed the ineffectual planning and monitoring that arose due to lack of coordination between an array of governmental agencies. Water management does not have to be undermined by splintered institutional authority. Similarly, Israel increased the effectiveness of its water management by moving the Water Commissioner from the Ministry of Agriculture to the Ministry of Infrastructure.¹⁰⁹ Since then Israel's Knesset enacted Water Law Amendment 19 in 1994, adding a sixth use of water for the "protection of natural values and landscape, including springs, streams and aquatic-habitats."¹¹⁰ Pursuant to the centralized prioritization system of the Water Law,¹¹¹ the Israeli Water Commissioner must allocate use of public water of sufficient quantity and quality to nature as well as domestic, industrial, and agricultural users.¹¹² Ensuring in-stream flow while maximizing rainwater harvesting and sectoral recycling requires a commitment to sustainable water management that is difficult to sustain as competition for water intensifies.

Saving water minimizes the expense of new supply-side infrastructure for water transfers and desalinization.¹¹³ Monitoring water use can help increase water savings. Each side should be able to have real-time access to abstraction rates, precipitation, stream flow, water surface elevation, and other relevant data. The use of integrated management could also enable the parties to compare groundwater extraction rates and other factors from year to year.¹¹⁴ A Joint Water Committee would be able to calibrate water allocations based upon fluctuations

107. *Id.*

108. "With the proper storage facility, the rain falling on a 15 m x 15 m roof top located in an area where the average annual rainfall is about 600 mm, will yield about 135 m³ of water (135,000 liters), enough to supply water in the house for two people for about one year!" *Id.*

109. Tal, *supra* note 23, at 5.

110. *Id.* at 8.

111. *Id.* (citing the Water Law, (1959) Sefer Hokim 288, p. 169 (13 LSI 173)).

112. Isr. Ministry of the Env't, The Right of Nature to Water in Israel (Feb. 2005), <http://www.unep.org/gc23/documents/Israel.pdf>.

113. ARTURO LÓPEZ ORNAT & CARMEN MORALES, IUCN, INTEGRATED WATER MANAGEMENT TO ADDRESS ENVIRONMENTAL DEGRADATION IN THE MEDITERRANEAN REGION 10 (2002), available at <http://www.iucn.org/places/medoffice/CD2003/conten/pdf/WaterFinalDoc.pdf>.

114. For a broader discussion of water monitoring, see David J.H. Phillips et al., *Factors Relating to the Equitable Distribution of Water in Israel and Palestine* (Isr./Palestine Ctr. for Research & Info., Water Conference Paper, 2004), available at <http://www.ipcri.org/watconf/papers/davidp.pdf>.

in water supply. Joint decisions regarding pollution and depletion of the Coastal and Mountain Aquifers could specify maximum parts per million of specific dissolved substances such as chloride and nitrate. The use of an integrated Geographic Information System (GIS) model that links the behavioral, biophysical, and institutional aspects of a hydrologic system allows decisionmakers to evaluate raw data more effectively. This in turn reduces the uncertainty that hinders consensus building.

What few water databases and models that exist seldom contain information at the scale upon which a community can rely to ensure that water use is both efficient and equitable.¹¹⁵ Determining where groundwater protection zones should be located requires specific surface infiltration information that can change dramatically across several meters. A variable scale that can change based upon geographic location is crucial for groundwater protection. Generalization rises as map scale decreases, often leading to the grouping of data points. When units are averaged or otherwise aggregated valuable information is lost. A biophysical model can show the interplay between a given physical environment and a hydrologic system but requires a great deal of input data.¹¹⁶ Uncertainty results when factors such as land use, soil type, climate, hydrology, slope, and elevation data cannot be modeled at sufficiently fine spatial and temporal scales.¹¹⁷

GIS uses a map overlay in which data layers are analyzed. In addition to showing different resolutions at different areas, hierarchical raster structures permit decisionmakers to zoom in on areas of particular concern, such as the exact location of a water diversion. Decisionmakers can make a change to one cell of the GIS model and see the array of ramifications for other cells. The effects of agricultural runoff and other impacts upon a given water resource can be simulated. Decisionmakers can also model the movement of water and evaluate the impact of such a change.¹¹⁸

Protecting and conserving water can be as simple as rooftop rain harvesting and as complex as GIS modeling. Traditional methods of collecting water offer an inexpensive means by which to increase water availability. Israelis and Palestinians have the capacity to determine whether GIS modeling is a sound investment. New technology provides an opportunity to overcome political stalemates that result from insufficient information about a shared natural resource. Fear and anger do not disappear overnight but transparency can lead to cooperation.

115. Olen Paul Matthews et al., *Marketing Western Water: Can a Process Based Geographic Information System Improve Reallocation Decisions?*, 41 NAT. RESOURCES J. 329, 355 (2001).

116. *Id.* at 359-360.

117. *Id.*

118. *Id.* at 368.

G. THE AVAILABILITY OF ALTERNATIVES, OF COMPARABLE VALUE, TO A PARTICULAR EXISTING AND PLANNED UTILIZATION OF THE AQUIFER OR AQUIFER SYSTEM

Israelis and Palestinians can import water, desalinate ocean water, and explore water benefit alternatives to aquifer use. Describing Israel as a mature water economy functioning under acute water stress, Saleth and Dinar note that, "Israel has already exhausted its freshwater supply, [and] the only additional supply sources available within its borders are the indirect supplies from treated sewerage and water saving effected from strict demand-side management."¹¹⁹ Significant water savings could be accomplished through water reallocation among sectors. While farmers may not be amenable to altering subsidies or reallocating water away from agriculture, parties could find common ground regarding effective distribution mechanisms.

Alternative crops could also alleviate water scarcity. Planting less water-intensive crops would conserve water. Food self-sufficiency policies have led to heavy cereal production.¹²⁰ The FAO indicates that a ton of water is required to produce a kilogram of wheat.¹²¹ While three-fourths of Eastern Mediterranean freshwater is used for irrigation, considering whether a shift away from agriculture will be market based and, if so, whether those affected will be offered transition assistance is important.¹²² Israelis already import eighty percent and Palestinians import sixty-five percent of their caloric intake.¹²³ Sequential water use in Israel directs the cleanest water to domestic use, after which recycled water is used for irrigation. By 2002, treated wastewater accounted for thirty percent of Israeli water supply, primarily to irrigate crops not directly consumed by people.¹²⁴ Thus, opportunities to shift water use away from agriculture and to intensify water recycling remain but cannot continue to offset comprehensive water management indefinitely.

119. R. Maria Saleth & Ariel Dinar, *Water Challenge and Institutional Response: A Cross-Country Perspective* 14-15 (World Bank, Policy Research Working Paper, 1999), available at <http://www.worldbank.org/html/dec/Publications/Workpapers/wps2000series/wps2045/wps2045.pdf>.

120. FAO, 'Water for Life' Decade: Appropriate Policies Needed to Make Better Use of Water (Mar. 21, 2005), <http://www.fao.org/newsroom/en/news/2005/100274/index.html>; see also Burleson, *supra* note 12, at 10045.

121. FAO, *supra* note 120; see also *Marking World Water Day, UN to Launch Water for Life Decade*, U.N. NEWS SERVICE, Mar. 21, 2005, <http://www.un.org/apps/news/story.asp?NewsID=13724> [hereinafter *Marking World Water Day*].

122. David B. Brooks, *Keynote Address: Access to Water in the Eastern Mediterranean*, in *WATER BALANCES IN THE EASTERN MEDITERRANEAN* 1, 7 (David B. Brooks & Ozay Mehmet eds., 2000).

123. Hillel Shuval, *The Role of 'Virtual Water' in the Water Resources Management of the Arid Middle East* 1 (Isr./Palestine Ctr. for Research & Info., Water Conference Paper, 2004), available at <http://www.ipcri.org/watconf/papers/hillel.pdf>. However, "[t]he growing of limited amounts of fresh vegetables and salad crops for local consumption requires very little water and I have estimated that with an allocation of fresh water of some 25 m³/cap/yr, a country can grow most if not all of the fresh vegetables and salad crops used locally." *Id.* at 7.

124. LÓPEZ ORNAT & MORALES, *supra* at 113, at 28.

1. Water Transfers

Water can be shipped to the Israeli-Palestinian region in hulls by boat, towed in large Medusa bags, piped, or trucked. Israel signed an intergovernmental agreement in March 2004 to purchase fifty million cubic meters of water per year from Turkey for twenty years.¹²⁵ Water from the mouth of the Manavgat River in southern Turkey can be shipped to the Ashkelon Port, 600 km away. The Israeli Ministry of National Infrastructure estimates supertanker shipment costs to be between US\$0.80 and US\$1.00 per cubic meter of water versus seawater desalination costs ranging from US\$0.75 to US\$1.25 per cubic meter of water.¹²⁶ The Israeli Ministry states that, "the excessive cost, reliability and the doubt about uninterrupted supply and long-term availability, render importation a less desirable option for solving Israel's water deficit."¹²⁷ Yet, Israel values continued economic ties with Turkey and is in need of a stopgap measure to meet its current water needs. Regional cooperation could enable a much less expensive means by which Turkish water could reach Israelis and Palestinians. A joint Israeli-Palestinian team proposed the following alternative in 1993.¹²⁸ If Turkey increased the Tigris River flow into Syria, then water could reach Palestinians without an extensive pipeline. Syria would increase the flow of the Jordan River into Jordan via the Yarmuk River. Jordan would divert water to the Abdullah Canal. The only new infrastructure needed would be the construction of the Western Ghor Canal that would bring water from the Abdullah Canal to the West Bank. If Jordan and Syria gained increased water allocations then they would likely agree to such an arrangement between Turkey, Syria, Jordan, and the

125. Ibrahim Güler & Mehmet Ülger, *Manavgat River Water as a Limited But Alternative Water Resource for Domestic Use in Middle East 3* (Isr./Palestine Ctr. for Research & Info., Water Conference Paper, 2004), available at <http://www.ipcri.org/watconf/papers/ibrahim.pdf>. The March 2004 water purchase agreement will enter into force when Israel, Turkey, and the winner of a water transport contract sign an additional tri-lateral agreement on Manavgat water shipments to Israel. See *id.*; see also Isr. Ministry of Foreign Affairs, Israel's Chronic Water Problem (Aug. 10, 2002), <http://www.mfa.gov.il/mfa> (follow "Facts of Israel: Land" hyperlink); see also Turkey Ministry of Foreign Affairs, Turkey's Policy on Water Issues, <http://www.mfa.gov.tr/MFA/ForeignPolicy/MainIssues/WaterIssues/WaterIssuessubmenu1.htm> (last visited Apr. 17, 2006).

126. Isr. Ministry of Nat'l Infrastructure, The Water Sector – Water Import, <http://eng.mni.gov.il/english/units/water/waterimport.shtml> (last visited Apr. 17, 2006). See also UNESCO's statement that:

Developed countries show a wide range of variation in water pricing: in Germany m³ costs \$1.91 (USD), in Denmark it cost \$1.64, in Belgium \$1.54, in the Netherlands \$1.25, in France \$1.23, in the UK \$1.18, in Italy \$0.76, in Finland \$0.69, in Ireland \$0.63, in Sweden \$0.58, in Spain \$0.57, in the United States \$0.51, in Australia \$0.50 and in Canada \$0.40. When the supply systems are deficient, the poor are the first to suffer. Water from informal vendors is more than 100 times more expensive than water supplied by house connection.

Did You Know . . . ? 100 Facts and Figures About Water, WATER PORTAL WKLY. UPDATE (UNESCO), July 1, 2005, <http://www.unesco.org/water/news/newsletter/index.shtml> (Special Issue: 100th UNESCO Water Portal).

127. Isr. Ministry of Nat'l Infrastructure, *supra* note 126.

128. Shuval, *supra* note 10, at 56.

Palestinians.¹²⁹ Turkey, Syria, and Iraq would need to resolve their differences over Tigris-Euphrates water use.¹³⁰ Jordan River riparians would also need to reach consensus regarding transboundary water management.¹³¹ In the meantime, Middle Eastern countries have turned to desalination to meet urgent water needs.

2. Desalination

Desalination can increase Israeli-Palestinian water availability. Israel plans to build enough desalination plants along the Mediterranean coast to desalinate approximately 200 to 300 million cubic meters of water by 2020.¹³² Desalination removes dissolved minerals from water. It has been an expensive solution for coastal arid countries that could afford increased energy generation in order to obtain domestic freshwater.¹³³ Aggressively pursuing desalination will place Israel in a difficult position to abide by the Kyoto Protocol, which it signed in 1998 and ratified in 2004.¹³⁴ The 400-meter decline in elevation between the Mediterranean and the Dead Sea could be used to produce hydropower with which Israelis and Palestinians could desalinate seawater without increasing greenhouse gas emissions.¹³⁵

Another option would be for Turkey to provide electricity rather than expensive transported water. This would increase the flow of water to Iraq and Syria and allow Israel and Turkey to continue as trade partners without either being put at an economic disadvantage. Such a multi-state solution would be less expensive but more politically vulnerable. Israel has settled for desalination even though in an armed conflict desalination plants would be likely targets, making

129. *Id.*

130. *See generally* Burlison, *supra* note 12.

131. *See* Aaron Wolf, *Water for Peace in the Jordan River Watershed*, *supra* note 3, at 820; *see also* Raya Marina Stephan, *The Legal Framework of Groundwater Management in the Middle East (Israel, Jordan, Lebanon, Syria and the Palestinian Territories)* 10 (Isr./Palestine Ctr. for Research & Info., Water Conference Paper, 2004), available at <http://www.ipcri.org/watconf/papers/raya.pdf>.

132. Isr. Ministry of Nat'l Infrastructure, *The Water Sector: Planned Major Projects (2000-2005)*, [http://eng.mni.gov.il/english/units/Water/PlannedMajorProjects\(2000-2005\).shtml](http://eng.mni.gov.il/english/units/Water/PlannedMajorProjects(2000-2005).shtml) (last visited Apr. 17, 2006).

133. Desalination requires a great deal of energy. For further information on various desalination technologies, *see* CAL. COASTAL COMM'N, *SEAWATER DESALINATION IN CALIFORNIA (2003)*, available at <http://www.coastal.ca.gov/desalrpt/dtitle.html>.

134. The Kyoto Protocol is an amendment to the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty on global warming that was produced at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992. The Kyoto Protocol entered into force on February 16, 2005. Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 11, 1997, U.N. Doc. FCCC/CP/1997/L.7/Add.1, *reprinted in* 37 I.L.M. 22, available at <http://unfccc.int/resource/docs/convkp/kpeng.pdf>.

135. Ismail Serageldin of the World Bank notes that "[h]ydropower, a clean and renewable energy source, supplies nearly 20 percent of global electricity." Ismail Serageldin, Vice President for Special Programs, World Bank, *Moving from Conflict to Cooperation*, Presentation Before the Center for the Global South, American Univ. (Oct. 12-13, 1998), available at <http://gurukul.ucc.american.edu/maksoud/water98/present5.htm#Serag>.

desalting the sea no more secure a means of obtaining freshwater than relying upon neighboring countries.¹³⁶

Use of the Mediterranean Sea as a drinking source requires that a number of concerns be addressed. The corrosion of copper-nickel heat exchanger surfaces in the water distillation process can lead to heavy metal contamination of the Mediterranean Sea. Chlorine and antiscalants also contribute to marine pollution.¹³⁷ While important for preventing scaling of machinery, the use of antiscalants should be controlled. A desalination plant's use of cleaning solutions and other potential pollutants needs to be regulated. Israel has proceeded with infrastructure in the absence of environmental impact assessments and a comprehensive regulatory system. Desalination will have a cumulative impact upon the entire Mediterranean coastline. Alon Tal notes that, "Israel has begun to build a series of massive facilities that could increase water supply by as much as 30% at a price that is currently the lowest in the world (55 cents/ cubic meter [sic])."¹³⁸ The Palestinian Authority has completed two small desalination plants. The Israeli-Palestinian Interim Agreement, Annex III, clause 12, states that, "Both sides shall ensure that a comprehensive Environmental Impact Assessment (EIA) shall be conducted for major development programs."¹³⁹ Similarly, Article 17 of the ILC's Draft Convention on the Law of Transboundary Aquifers calls for an environmental impact assessment to be conducted for planned activities, which may have a significant adverse effect upon other aquifer states.¹⁴⁰

Mediterranean societies once fought over the process of extracting precious salt from seawater. Now the objective is to rid seawater of salt. Technological advances have enabled water-scarce countries to produce drinking water by desalinating the sea. Yet, reversing saltwater infiltration of aquifers requires an engineering capacity beyond current feasibility and disposal of residual brine from large-scale desalination plants presents formidable challenges. Fossil fuel, wind, hydro, and solar processes all have advantages and disadvantages that should be considered in a comprehensive environmental impact assessment. Increasing water availability to Palestinians will require that Israel conserve water, look for alternative new sources, and consider water use trading in the region.¹⁴¹ Addressing the natural, social, and economic factors of the Draft

136. For a general discussion of inter-state electrical networks, see WORLD BANK, ENERGY IN MENA (2004), available at [http://lnweb18.worldbank.org/mna/mena.nsf/Attachments/Energy+Brief-ENG/\\$File/energy-eng+2004am.pdf](http://lnweb18.worldbank.org/mna/mena.nsf/Attachments/Energy+Brief-ENG/$File/energy-eng+2004am.pdf).

137. Tal, *supra* note 23, at 12.

138. *Id.*

139. Oslo II, *supra* note 53, Annex III, art. 12, cl. 7.

140. *Draft Convention on the Law of Transboundary Aquifers*, *supra* note 4, at 16.

141. An ILC working group has suggested two additional factors that the ILC will review in 2006. The first additional factor is "[t]he contribution to the formation and recharge of the aquifer or aquifer system." Palestinians would be able to note that their region supplies much of the water flowing into the Mountain Aquifer. The second additional factor is "the place of the aquifer or aquifer system in the related ecosystem." A watershed approach has met with stiff resistance in codifying international water law to date. It remains to be

Convention on the Law of Transboundary Aquifers can help Israelis and Palestinians negotiate viable alternatives in light of limited water resources.

III. MEANS BY WHICH INTEGRATED AQUIFER COLLABORATION CAN OCCUR

Israelis and Palestinians can look to international law for guidance in crafting a water agreement. The Convention on the Rights of the Child (CRC), for example, requires states to provide safe drinking water to children and addresses the decisionmaking process.¹⁴² Israelis and Palestinians can also look to the water management schemes enacted by other states for guidance. France and Switzerland have established a joint water authority the likes of which might protect the Coastal and Mountain Aquifers. Although post-conflict cooperation can be elusive, Israel and the Palestinian Authority may find the approach followed by North African states useful in forging a working relationship. The process of drawing upon international models and addressing local needs should involve civil society. Comprehensive multilateral water management can be achieved by increasing deliberative interactions between stakeholders. Public participation in international decisionmaking engages governmental and nongovernmental experts from all walks of life. Access to clean water, information about clean water, and a forum in which to discuss various means by which to sustain access to clean water—these are the ingredients of peace.

A. INTERNATIONAL AGREEMENTS

Rights to use shared transboundary water involve an obligation not to reduce the quality of the water for future generations. The CRC requires states to provide safe drinking water as part of every child's right to health.¹⁴³ The CRC was adopted on November 20, 1989. With the ratification of twenty countries, it entered into force on September 2, 1990. At present, 192 countries have ratified it.¹⁴⁴ The only two members of the United Nations that have not ratified the CRC

seen whether states are ready to embrace such a comprehensive method. See Int'l Law Comm'n, Working Group on Shared Natural Resources (Groundwaters), *Report of the Working Group*, U.N. Doc. A/CN.4/L.681 (July 28, 2005).

142. U.N. Convention on the Rights of the Child, Nov. 20, 1989, 1577 U.N.T.S. 3 (entered into force Sept. 2, 1990), available at <http://www.unhchr.ch/html/menu3/b/k2crc.htm> [hereinafter CRC].

143. The CRC states that countries shall pursue full implementation of the rights of the child to the enjoyment of the highest attainable standards of health. It requires nations to take appropriate measures "to combat disease and malnutrition, including within the framework of primary health care, through, *inter alia*, the application of readily available technology and through the provision of adequate nutritious foods and clean drinking-water, taking into consideration the dangers and risks of environmental pollution . . ." *Id.* art. 24(2)(c).

The only other convention that includes such a water right pursuant to every child's right to health is the African Charter on the Rights and Welfare of the Child, OAU Doc. CAB/LEG/24.9/49 (July 11, 1990) (entered into force Nov. 29, 1999), available at <http://www1.umn.edu/humanrts/africa/afchild.htm>.

144. The Secretary General, *Report of the Secretary General on the Status of the Convention on the Rights of*

are the United States and Somalia.¹⁴⁵ A greater number of states have ratified the CRC than any other human rights instrument. Furthermore, they have done so with unprecedented speed.

The CRC recognizes that children have a right to participate and be heard. Article 12 declares that,

States Parties shall assure to the child who is capable of forming his or her own views the right to express those views freely in all matters affecting the child, the views of the child being given due weight in accordance with the age and maturity of the child.¹⁴⁶

David Brooks notes that, “difficult though it may be, public review processes not only give stakeholders the ‘stake’ that the term implies but also lead to more efficient and more equitable decisions.”¹⁴⁷ Yet, he goes on to observe that democratic processes are not well established in the eastern Mediterranean. Palestinian boys hurling rocks and Israeli youths responding with gunfire illustrate that youth are already engaged in the issues. Rather than seeing youth as either dangerous or dead, governments must remember that children are the water providers throughout much of the world and that many girls risk personal safety every time they set out to collect water. Young people need to be involved in resolving the Israeli-Palestinian conflict, especially since 48.5% of Palestinians are under the age of 15.¹⁴⁸ U.N. Secretary General Kofi Annan notes that, “[w]e need to free women and girls from the daily chore of hauling water, often over great distances. We must involve them in decision-making on water management.”¹⁴⁹ Integrating civil society into the decisionmaking process can strengthen state-society relations and improve the effective management of water.¹⁵⁰

the Child, ¶ 2, U.N. Doc. A/58/282 (Aug. 14, 2003).

145. See Office of the U.N. High Comm’r on Human Rights, Ratifications and Reservations, Convention on the Rights of the Child New York, 20 November 1989, <http://www.ohchr.org/english/countries/ratification/11.htm> (last visited Apr. 17, 2006).

146. CRC, *supra* note 142, art. 12(1).

147. Brooks, *supra* note 122, at 1.

148. CIA, World Factbook—Gaza Strip, <http://www.cia.gov/cia/publications/factbook/geos/gz.html#People> (last visited Apr. 17, 2006).

149. Kofi Annan, Secretary General, Message to Launch the “Water For Life” Decade (Mar. 22, 2005), available at <http://www.un.org/waterforlifedecade/>; see also Convention on the Elimination of All Forms of Discrimination Against Women, G.A. Res. 34/180, U.N. GAOR 34th Sess., Supp. No. 46, U.N. Doc. A/34/46 (entered into force Sept. 3, 1981), available at <http://www.un.org/womenwatch/daw/cedaw/text/econvention.htm>.

150. In providing a framework groundwater convention, Robert Hayton and Albert Utton note that public participation is an important part of the process of conserving and managing transboundary groundwater. Robert D. Hayton & Albert E. Utton, *Transboundary Groundwaters: The Bellagio Draft Treaty*, 29 NAT. RESOURCES J. 663, 673 (1989). The Bellagio Draft Treaty was modeled after the 1944 International Boundary and Water Commission (IBWC) between Mexico and the United States. Minute No. 242 of the IBWC required a prior consultation provision and groundwater extraction cap for a transboundary aquifer shared by Arizona and Sonora. Int’l Law Comm’n, *Shared Natural Resources: Comments and Observations Received from Governments and Relevant Intergovernmental Organizations*, at 12-17, U.N. Doc. A/CN.4/555 (Apr. 29, 2005).

The Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, known as the Århus Convention, establishes a public participation process for crafting and implementing international agreements.¹⁵¹ The Århus Convention provides a model for integrating environmental and human rights.¹⁵² The G8 summit of July 2005 marked the first time that developing nations and civil society were involved in G8 negotiations.¹⁵³ In addition to G8 nations agreeing to debt cancellation for 18 African countries, the G8 has pledged US\$3 billion in aid for the Palestinian Authority.¹⁵⁴

Improper management, cost recovery failures, and farming subsidies are politically charged topics. Decades of debate have yet to culminate in consensus in a world still ideologically divided between public and private approaches. Complex water supply and sanitation services need to be built and maintained. Whether the public or private sector can accomplish these feats with a greater degree of efficiency and equity remains a controversial question for which many dedicated experts have case studies and statistical analysis but lack conclusive guarantees.

Water markets require enforceable water rights that are both stable and clearly defined. Equity concerns are valid when the right to groundwater lacks definition, ownership is insecure, and enforcement is hampered by the hidden nature of the resource.¹⁵⁵ Groundwater marketing requires carefully designed measurements

151. The United Nations Economic Commission on Europe (UNECE) developed the Århus Convention. While most signatories are European, the Århus Convention is open to non-UNECE countries. *See* Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, June 25, 1998, 38 I.L.M. 517 (entered into force Oct. 30, 2001), available at <http://www.unece.org/env/pp/documents/cep43e.pdf>. All of the member states of the European Union and the E.U. itself have signed the convention.

152. Similarly, the Convention on Environmental Impact Assessment in a Transboundary Context, Feb. 25, 1991, 1989 U.N.T.S. 309 (1997), 30 I.L.M. 800 (1991) (entered into force Sept. 10, 1997) (Espoo Convention), calls for civil society participation in transboundary Environmental Impact Assessments. *See also* Convention on the Protection and Use of Transboundary Watercourses and International Lakes art. 16(1), Mar. 17, 1992, 31 I.L.M. 1312, 1322 [hereinafter Helsinki Convention] (requiring public access to information); Angela Z. Cassar & Carl E. Bruch, *Transboundary Environmental Impact Assessment in International Watercourse Management*, 12 N.Y.U. ENVTL. L.J. 169 (2003). The European Union has also provided water law leadership—the Water Framework Directive takes a precautionary approach in relation to groundwater pollution. Rather than setting chemical quality standards it presumes that aquifers should not be polluted at all. Thus, it proscribes discharges to groundwater and requires Member States to monitor groundwater for altered chemical composition. The Directive provides a framework for integrated management of surface and groundwater for the first time at the European Union level, calling for groundwater extraction not to adversely limit the recharge needed to support the ecology. *See* Council Directive 2000/60/EC, Establishing a Framework for Community Action in the Field of Water Policy, art. 1, 2000 O.J. (L 327) 1, 5, available at http://www.bmu.de/files/water_framework_directive.pdf.

153. Steve Schifferes, *Can G8 be Considered a Success?*, BBC NEWS, July 8, 2005, <http://news.bbc.co.uk/1/hi/business/4663659.stm>.

154. *G8 Pledges \$3bn to Palestinians*, BBC NEWS, July 8, 2005, http://news.bbc.co.uk/1/hi/world/middle_east/4664479.stm.

155. *See* Miguel Solanes, *Institutional and Legal Issues Relevant to the Implementation of Water Markets*, in

that effectively address drawdown externalities. Inter-temporal externalities such as declining water tables and saline intrusion should not be inflicted upon future generations who will have less water per person with which to devise dynamic water management systems. Groundwater markets in the absence of a comprehensive understanding of a given aquifer system and sustainable water management will intensify the socio-ecological crisis.¹⁵⁶

With the advent of technologies enabling electric pumping, governments began regulating aquifer depletion by declaring groundwater to be public property. Thus, individuals have the right to use water rather than own the water outright. Use of water can be traded without granting a permanent right to the water itself. In this way a property right to use water can increase incentives to invest in the infrastructure and institutional capacity needed to manage water sustainably.¹⁵⁷ Yet, measures that limit the concentration of water rights into monopolies must be effective in order for markets to be both efficient and equitable.

Once seen as private property that runs with the overlying land, groundwater-user rights now derive from government grants in an increasing number of countries. Stefano Burchi notes that, “[t]he public domain status of groundwater underpins the usufructuary nature of individual groundwater rights and the authority of the Government to grant such rights.”¹⁵⁸ Regulated rights in groundwater enable flexible management in response to changing water quantity and quality. Groundwater extraction can be sustainably developed without effecting security of tenure. Monitoring extraction in order to set an effective user charge is not a difficult proposition in industrialized countries but it has proven to be prohibitively costly in developing countries. Exempting small users from charges or measuring electricity as an indirect indicator of groundwater extraction presents equity, efficiency, and accuracy concerns but may be the only feasible way to gauge aquifer depletion in initial stages of management.¹⁵⁹ Meter charges and tradable permits may be seen as complimentary with traditional regulation in one community yet unacceptable to another. Aquifers on different continents, the inhabitants of which have irreconcilable socioeconomic views, need not mirror one another’s water management approaches.

Precision is important within a given aquifer system and agreement upon an effective means of sustaining groundwater quality and quantity is essential. Users

GROUNDWATER: LEGAL AND POLICY PERSPECTIVES—PROCEEDINGS OF A WORLD BANK SEMINAR 69, 72, 76-77 (Salman M.A. Salman ed., 1999), available at <http://www.thewaterpage.com/SolanesWaterMarkets.html>.

156. *Id.* at 76-77.

157. *Id.* at 69-70.

158. Stefano Burchi, *National Regulations for Groundwater: Options, Issues and Best Practices*, in GROUNDWATER: LEGAL AND POLICY PERSPECTIVES—PROCEEDINGS OF A WORLD BANK SEMINAR, *supra* note 155, at 55, 66.

159. Stephen Foster, *Essential Concepts for Groundwater Regulators*, in GROUNDWATER: LEGAL AND POLICY PERSPECTIVES—PROCEEDINGS OF A WORLD BANK SEMINAR, *supra* note 155, at 15, 21-22.

of an aquifer may benefit by an incremental process that begins with identification of aquifer characteristics achieved through data and information exchange and development of a plan for sustainable extraction and pollution levels. At a second stage, a transboundary commission would craft regulatory and non-regulatory mechanisms that correspond to the specific needs of a given aquifer scenario while remaining flexible to changing circumstances. How groundwater is protected and who decides what planning mechanisms will be implemented affect the success of groundwater safeguards. User participation in decisionmaking is imperative to strike a balance between the divergent needs of those reliant upon a given aquifer.¹⁶⁰

Groundwater is a public good in that individual users cannot save water for their own future use. As a result, controlling overall exploitation of a given aquifer is challenging. Groundwater becomes more expensive to extract when water tables decline. Low-income users often do not have the wherewithal to dig deeper wells. Moreover, hidden costs related to an unseen natural resource do not shock the conscience until something as tangible as saltwater intrusion occurs. Even when drinking water is rendered unusable due to increased salinity, the highly-dispersed nature of groundwater extraction and the fact that saltwater can intrude at a great distance from where groundwater is being over-extracted result in social inequities.

The Millennium Development Goals provide a framework for measuring development progress.¹⁶¹ Target 10 calls for the international community to “[r]educe by half the proportion of people without sustainable access to safe drinking water.”¹⁶² In 2005, the thirteenth session of the United Nations Commission on Sustainable Development focused upon water, sanitation, and human settlements.¹⁶³ Sanctuary and Tropp note that, “the urban population of developing countries is expected to nearly double between 2000 and 2030 from 2 billion to almost 4 billion.”¹⁶⁴ Rapid population growth is increasing water demand at a pace that is outstripping countries’ abilities to meet the Millennium Development Goals.

160. Jacob Burke et al., *Groundwater and Society: Problems in Variability and Points of Engagement*, in GROUNDWATER: LEGAL AND POLICY PERSPECTIVES—PROCEEDINGS OF A WORLD BANK SEMINAR, *supra* note 155, at 31, 49.

161. See World Bank, Millennium Development Goals, <http://www.developmentgoals.org> (last visited Apr. 17, 2006).

162. For a U.N. Development Programme discussion of gender and energy issues in relation to the Millennium Development Goals, see U.N. DEV. PROGRAMME, GENDER AND ENERGY FOR SUSTAINABLE DEVELOPMENT: A TOOLKIT AND RESOURCE GUIDE 17-20 (2004), available at <http://www.undp.org/energy/genenergykit/genderengtoolkit.pdf>.

163. U.N. Dep’t of Econ. & Soc. Affairs, Div. of Sustainable Dev., CSD-13: Policy Session, <http://www.un.org/esa/sustdev/csd/csd13/csd13.htm> (last visited Apr. 17, 2006).

164. SANCTUARY & TROPP, *supra* note 78, at 9; see also World Summit on Sustainable Dev., Aug. 26-Sept. 4, 2002, *Johannesburg Declaration on Sustainable Development*, ch. 1, Annex, at 1, U.N. Doc. A/Conf.199/20 (2002), available at http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POI_PD.htm (recognizing water as one the most important global concerns).

Countries have taken an array of approaches to water allocation. South Africa's Department of Water Affairs and Forestry has set twenty-five liters of clean water per person per day as the Human Rights Reserve to be freely delivered to poor households.¹⁶⁵ Chile provides targeted, means-tested direct subsidies to the poor and Egypt provides cross-subsidies to address the sanitation needs of the poor.¹⁶⁶ Alternatively, peak pricing policies, water-use restrictions, and treatment standards can alter sectoral incentives, decreasing irrigation inefficiencies as well as agricultural and industrial pollution. Economic approaches range from charging for groundwater extraction to giving conservation subsidies. Pricing water at cost may seem straightforward in an economic model but the debate that threatens to stall international cooperation on alleviating the impact of water scarcity indicates otherwise. In some regions there is a strong cultural tradition that water must be free.¹⁶⁷ Pricing water at true cost can create incentives to conserve at the same time as placing a basic necessity for life out of many people's reach. Difficult social and economic decisions require a joint process of deliberation. A race to exhaust a resource leads to land and water degradation, which in turn decreases access to water in a spiral that lowers trust. Beyond slowing the overall rate of extraction, priorities must be agreed upon between various uses. Depletion of groundwater should be coordinated across both existing and future needs. Such value judgments require the thoughtful consideration of both public and private users. While state practice varies widely with regard to water distribution, international institutional leadership and framework conventions can help societies share transboundary groundwater.

The Draft Convention on the Law of Transboundary Aquifers will augment current international groundwater law, which is based predominantly upon a pattern of state practice. The International Law Association's (ILA) Seoul Rules on International Groundwaters (1986)¹⁶⁸ and the Berlin Rules on Water Re-

165. S. Afr. Dep't of Water Affairs & Forestry, Regulations Relating to Compulsory National Standards and Measures to Conserve Water, § 3, GN R509 of 8 June 2001, available at <http://www.info.gov.za/gazette/regulation/2001/22355.pdf>; see also S. Afr. National Water Act 36 of 1998, available at <http://www.info.gov.za/gazette/acts/1998/a36-98.pdf>; S. Afr. Water Services Act 108 of 1997, available at <http://www.info.gov.za/gazette/acts/1997/a108-97.pdf>; S. AFR. DEP'T OF WATER AFFAIRS & FORESTRY, STRATEGIC FRAMEWORK FOR WATER SERVICES: WATER IS LIFE, SANITATION IS DIGNITY (2003), available at <http://www.dwaf.gov.za/Documents/Policies/Strategic%20Framework%20approved.pdf>.

166. *Marking World Water Day*, *supra* note 121.

167. MIGUEL SOLANES & FERNANDO GONZALEZ-VILLAREAL, GLOBAL WATER P'SHIP TECHNICAL ADVISORY COMM., THE DUBLIN PRINCIPLES FOR WATER AS REFLECTED IN A COMPARATIVE ASSESSMENT OF INSTITUTIONAL AND LEGAL ARRANGEMENTS FOR INTEGRATED WATER RESOURCES MANAGEMENT (1999), available at http://www.wca-infonet.org/servlet/BinaryDownloaderServlet?filename=1062432003274_policy.pdf.

168. Int'l L. Ass'n [ILA], Sixty-Second Conference, Seoul, S. Korea, *Seoul Rules on International Groundwaters* (1986), available at http://www.internationalwaterlaw.org/IntlDocs/Seoul_Rules.htm [hereinafter *Seoul Rules*]; see also ILA, Fifty-Second Conference, Helsinki, Fin. *Helsinki Rules on the Uses of the Waters of International Rivers* (1966), available at http://www.internationalwaterlaw.org/IntlDocs/Helsinki_Rules.htm [hereinafter *Helsinki Rules*].

sources (2004)¹⁶⁹ also provide guidance with which states can establish collaborative water-sharing agreements. Based upon these international water-sharing provisions, states within a given region can agree upon fine-tuned measures.¹⁷⁰ Additionally, the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses addresses certain kinds of aquifers. While limited territorial sovereignty is emerging as the guiding principle of transboundary water law, uncertainty continues to exist regarding hydrology, climatology, demographic trends, and political stability.¹⁷¹ Balancing sovereignty and territorial integrity water claims between co-aquifer states requires cooperation. Emerging international groundwater standards that Israelis and Palestinians should call for include: collaboration between states in managing water resources,¹⁷² managing groundwater and land in a unified manner,¹⁷³ limits on aquifer drawdown,¹⁷⁴ aquifer protection from land-based sources of pollution,¹⁷⁵ and sustainable use of non-confined aquifers.¹⁷⁶

169. ILA, Berlin Conference, *Berlin Rules on Water Resources* (2004), available at <http://www.asil.org/ilib/WaterReport2004.pdf> [hereinafter *Berlin Rules*].

170. See Stefano Burchi & Kerstin Mechlem, FAO Legal Office, Legal Instruments for Transboundary Groundwater Resources Management, Presentation at UNESCO-ISARM-MED Consultative Meeting on Key Issues for Sustainable Management of Transboundary Aquifers in the Mediterranean and in Southern Europe, Thessaloniki, Greece, Oct. 21-23, 2004, at 20-22, available at http://www.inweb.gr/workshops/presentations_pdf/groundwater/Burchi.pdf.

171. See Bursleson, *supra* note 12, at 10042-45. "International freshwater law remains in its infancy due to polarization between the doctrines of absolute territorial sovereignty . . . and absolute territorial integrity. An emerging doctrine of limited territorial sovereignty requires riparians to share water based on equitable utilization." *Id.* at 10042.

172. See Burchi & Mechlem, *supra* note 170. The Revised African Convention, Carpathians Convention, and Sava Agreement all call for integrated water resources management. See African Convention on the Conservation of Nature and Natural Resources (Revised) art. VII(3), July 11, 2003, available at <http://www.africa-union.org/root/au/Documents/Treaties/Text/nature%20and%20natural%20recesource.pdf> [hereinafter Revised African Convention]; Framework Convention on the Protection and Sustainable Development of the Carpathians arts. 2(e), 6, May 22, 2003, available at <http://www.carpathianconvention.org/text.htm>; Framework Agreement on the Sava River Basin art. 2, Dec. 3, 2002, available at <http://www.rec.org/rec/programs/sava/pdf/FrameworkAgreement.pdf>.

173. Berlin Rule 41.5 calls for groundwater and land to be managed together. *Berlin Rules*, *supra* note 169, art. 41(5). The Helsinki Convention, Seoul Rule 3.1, and Berlin Rule 41 consider groundwater vulnerability. See Helsinki Convention, *supra* note 152; *Seoul Rules*, *supra* note 168, art. III(1); *Berlin Rules*, *supra* note 169, art. 41.

174. Berlin Rule 42.4 limits drawdown of groundwater, as does the Genevese Aquifer Agreement, discussed *infra* text accompanying notes 187-192. *Berlin Rules*, *supra* note 169, art. 42(4); Arrangement relatif a la Protection, a l'Utilization et a la Realimentation de la Nappe Souterraine Franco-Suisse du Genevois (Arrangement on the Protection, Utilization and Recharge of the Franco-Swiss Genevese Aquifer) art. 9, June 9, 1977 (entered into force Jan. 1, 1978), available at <http://www.internationalwaterlaw.org/RegionalDocs/Franko-Swiss-Aquifer.htm> (unofficial English translation) [hereinafter Genevese Aquifer Agreement]. The Genevese Aquifer Agreement is also available in its official, French form, in Ludwik A. Teclaff & Eileen Teclaff, *Documents*, in INTERNATIONAL GROUNDWATER LAW 189, 464 (Ludwik A. Teclaff & Albert E. Utton eds., 1981).

175. The Helsinki Convention, Seoul Rule 3.1, and Berlin Rule 41 address the vulnerability of groundwater to pollution. See Helsinki Convention, *supra* note 152; *Seoul Rules*, *supra* note 168, art. III(1); *Berlin Rules*, *supra* note 169, art. 41. Berlin Rule 41 and the Danube Convention protect groundwater from land-based activities that cause pollution. See *id.*; Convention on Cooperation for the Protection and Sustainable Use of the

B. BILATERAL AND REGIONAL TREATIES AS STATE PRACTICE OF TRANSBOUNDARY
GROUNDWATER LAW

Over the past twenty-five years, Mediterranean water demand has risen by sixty percent.¹⁷⁷ Countries have met this demand by increasing groundwater extraction beyond regional aquifer capacity.¹⁷⁸ The populations of many countries are becoming younger¹⁷⁹ as water infrastructure ages. Tourists visit during water scarce months and congregate along vulnerable coastlines that are becoming deserts at an alarming rate.¹⁸⁰ Cooperation is needed to balance the needs of increasing industrialization, intensifying agricultural production, escalating population growth, and fragmenting ecosystems.¹⁸¹ Integrated management of the Mediterranean basin is complicated by the fact that its inhabitants speak over fifteen different languages. Religious and cultural values vary widely. Yet, in 1976 the Mediterranean states succeeded in crafting one of the first models of regional cooperation to protect a shared natural resource. Negotiating the Convention for the Protection of the Mediterranean Sea Against Pollution, known as the Barcelona Convention,¹⁸² enabled Israeli and Arab representatives to engage in substantive discussions despite intense animosity.¹⁸³ The following three treaties are among the few agreements that have been entered into solely to manage transboundary groundwater: (1) the 1978 agreement between France and Switzerland on the utilization of the Genevese Aquifer;¹⁸⁴ (2) the 2000 agreement between Algeria, Libya, and Tunisia to establish a joint commission for the

Danube River, June 24, 1994, *available at* <http://faolex.fao.org/docs/pdf/mul17444.pdf> [hereinafter Danube Convention].

176. Danube Convention, *supra* note 175; *Berlin Rules*, *supra* note 169, arts. 38, 40 (requiring sustainable use).

177. LÓPEZ ORNAT & MORALES, *supra* note 113, at 16.

178. *Id.* at 17, 29.

179. VICTOR J. SCHOENBACH & WAYNE D. ROSAMOND, UNDERSTANDING THE FUNDAMENTALS OF EPIDEMIOLOGY: AN EVOLVING TEXT 33-34 (2000), *available at* <http://www.epidemiolog.net/evolving/DemographyBasics.pdf>.

180. As with oil drilling, groundwater extraction that surpasses a given aquifer's recharge ability becomes unavailable for future use. Unlike petroleum extraction, aquifer depletion can lead to desertification of the surface land. The United Nations has proclaimed 2006 as the International Year of Deserts and Desertification. G.A. Res. 58/211, U.N. Doc. A/Res/58/211 (Feb. 9, 2004). Note as well the 1994 U.N. Convention to Combat Desertification. Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, Sept. 12, 1994, U.N. Doc. A/Ac.241/27, *reprinted in* 33 I.L.M. 1332; *see also* Barton Thompson, *Tragically Difficult: The Obstacles to Governing the Commons*, 30 ENVTL. L. 241, 250 (2000).

181. Approximately 500 rivers carry pollutants into the Mediterranean, a closed sea. LÓPEZ ORNAT & MORALES, *supra* note 113, at 23.

182. Convention for the Protection of the Mediterranean Sea Against Pollution, Feb. 16, 1976, 1102 U.N.T.S. 27, 15 I.L.M. 290 (entered into force Feb. 12, 1978) (Barcelona Convention).

183. For a broader discussion of the Barcelona Convention, see Dorit Talitman, Alon Tal, & Shmuel Brenner, *The Devil is in the Details: Increasing International Law's Influence on Domestic Environmental Performance—The Case of Israel and the Mediterranean Sea*, 11 N.Y.U. ENVTL. L.J. 414 (2003).

184. Genevese Aquifer Agreement, *supra* note 174.

Northwestern Sahara Aquifer System (SASS);¹⁸⁵ and (3) the 2000 agreement between Chad, Egypt, Libya, and Sudan to establish a joint commission for the Nubian Sandstone Aquifer System.¹⁸⁶ These agreements exemplify the means by which integrated aquifer collaboration can occur. Existing Swiss-French State practice models management by joint commission, while North African fossil aquifer agreements provide a guide for post-conflict negotiations.

1. The Genevese Aquifer Agreement

The treaty between the Canton of Geneva and the French Prefect de Haute-Savoie on the Genevese Aquifer in 1978 created a cost-sharing arrangement regulating recharge of and limiting withdrawal from the Genevese Aquifer based upon the collection and exchange of hydrological data.¹⁸⁷ The treaty also established a joint commission, to which France and Switzerland each appoint three members.¹⁸⁸ Two out of three of the appointments must be technical water specialists.¹⁸⁹ Each year, water users must notify the commission of proposed groundwater drawdowns.¹⁹⁰ The commission then proposes a depletion plan based upon this information. It also analyzes the quality of the water extracted and recharged into the Geneva aquifer.¹⁹¹ This agreement provides a model with which Israelis and Palestinians can manage transboundary groundwater quality and depletion through a joint commission.¹⁹²

185. Relevant excerpts of the agreement, which was formed at a meeting at the FAO headquarters in December 2002, are found in Stefano Burchi & Kerstin Mechlem, *Groundwater in International Law Compilation of Treaties and Other Legal Instruments* 6-8 (FAO Legislative Study 86, 2005), available at <ftp://ftp.fao.org/docrep/fao/008/y5739e/y5739e00.pdf> [hereinafter SASS Agreement Excerpt] (citing “[e]xcerpts of the procès verbal (Minutes) of a meeting of representatives of Algeria, Libya and Tunisia held at the Headquarters of the Food and Agriculture Organization of the United Nations (FAO) in Rome, Italy, on 19 and 20 December 2002. The procès verbal was subsequently endorsed by Algeria on 6 January 2003, Tunisia on 15 February 2003 and Libya on 23 February 2003. The Minutes and the subsequent letters of endorsement signified an agreement to establish the Consultation Mechanism.”).

186. Agreement 1—Terms of Reference For the Monitoring and Exchange of Information Related to the Groundwater of the Nubian Sandstone Aquifer System, Chad–Egypt–Libya–Sudan, Oct. 5, 2000, available at <http://faolex.fao.org/docs/pdf/int39094E.pdf>; Agreement 2—Terms of Reference for Monitoring and Data Sharing, Chad–Egypt–Libya–Sudan, Oct. 5, 2000, available at <http://faolex.fao.org/docs/pdf/int39095E.pdf>; see also SASS Agreement Excerpt, *supra* note 185, at 4-6.

187. Genevese Aquifer Agreement, *supra* note 174.

188. *Id.* arts. 1(1), 1(2).

189. *Id.* art. 1(2).

190. *Id.* art. 10(1).

191. *Id.* art. 16(1).

192. See Barberis, *supra* note 2, at 178; see also Bernard J. Wohlwend, *An Overview of Groundwater in International Law—A Case Study: The Franco-Swiss Genevese Aquifer* (ESCWA, Workshop III: Harmonization of Diverging Interests in the Use of Shared Water Resources, Dec. 17-19, 2002), available at <http://www.bjwconsult.com/The%20Genevese%20Aquifer.pdf>.

2. The Northwestern Sahara Aquifer System (SASS)

Access to water has become an increasingly significant development issue throughout North Africa and the Middle East. Committing to joint management of shared natural resources requires trust. North African countries have begun to coordinate transboundary aquifer monitoring despite fragile diplomatic relations. Algeria, Libya, and Tunisia have agreed to a joint institution to collect and exchange data for aquifer modeling of the Northwestern Sahara Aquifer System (SASS).¹⁹³ The Swiss government, FAO, and International Fund for Agricultural Development have provided technical and institutional assistance in collecting hydro-geological data. Known by the French acronym "SASS," the Northwestern Sahara Aquifer System receives negligible recharge. UNESCO notes that, "while many experts will justify the use of fossil water for drinking and municipal needs, they consider it unethical and unduly expensive to direct such a precious resource for irrigation, especially in arid zones where half the water can be lost to evaporation."¹⁹⁴ In order to plan drawdown, a geo-referenced database of hydro-geological data and a mathematical aquifer model have been created. Algeria, Libya, and Tunisia have also established an intergovernmental organization, the Observatoire du Sahara et du Sahel (OSS), which will host a simple coordinating unit to understand more about shared use of the Northwestern Sahara Aquifer System.¹⁹⁵ This unit will maintain and upgrade the aquifer database and model. Its risk assessment will be guided by a steering committee made up of water agency representatives from each country.¹⁹⁶ A joint commission with authority to make independent water management decisions may emerge out of the present institution if Algeria, Libya, and Tunisia continue to strengthen regional trust.

Algerians are overwhelmingly Berber in origin rather than Arab. While only a small minority of Algerians currently identify themselves as Berber, distinctions remain between Algerian, Libyan, and Tunisian cultures. Algeria still has border disputes with Libya over roughly 32,000 square km in southeastern Algeria.¹⁹⁷ At the base of the Jébel en-Negeb ranges and close to the Tunisian-Algerian border, Chebika was once part of a Roman defensive line against Saharan tribes. Relying on a stream cascading out of a mountain, Berbers inhabited the ancient homes until 1969. The fortified mountain village, known as a ksour, now lies in ruins. Walls that were over a foot thick insulated villagers from sandstorms and severe

193. SASS Agreement Excerpt, *supra* note 185.

194. Press Release, UNESCO, Africa's Hidden Groundwater Resources (June 4, 2002), *available at* <http://www.unesco.org/bpi/eng/unescopress/2002/02-39e.shtml>.

195. SASS Agreement Excerpt, *supra* note 185, at 7; *see also* Observatoire du Sahara et du Sahel, <http://www.unesco.org/oss> (last visited Apr. 17, 2006).

196. SASS Agreement Excerpt, *supra* note 185, at 8.

197. CIA, World Factbook—Libya, <http://www.cia.gov/cia/publications/factbook/geos/ly.html> (last visited Apr. 17, 2006).

temperature variations until twenty-two days of driving rain turned these clusters of earthen dwellings to mud. Built in ravines and narrow gorges of an arid country, mountain oases in the area were devastated; a reminder that too much water can be as catastrophic as too little water.¹⁹⁸

The first Roman colony of Africa, named after a Berber tribe called the Afri, spanned the northeastern third of Tunisia.¹⁹⁹ In the seventh century, the Arabs called those who adopted Roman and Byzantine culture “Africans,” while rebels became known as “Berbers,” from the Greek word for foreign.²⁰⁰ Under Ottoman rule, Tunis was the nerve center of the Barbary Coast from which Turks pirated European ships.²⁰¹ A secular cosmopolitan experiment, much of Tunis is now a modern Mediterranean city.²⁰²

Producing both olive oil and wheat, El Jem became the center of the Roman Empire’s granary.²⁰³ The plains of the Tell used to be forested by Aleppo pine. Elephants and lions vanished with the trees as Carthaginians and Romans cleared the Tell.²⁰⁴ Carthage, the main power in the Western Mediterranean, was the breadbasket of the Roman Empire.²⁰⁵ Building several million-gallon cisterns, the Romans prevented floodwater from disappearing into desert sand. Their irrigation system transformed the Sahel into fertile agricultural land. More than 2500 years of deforestation and overgrazing has led to desertification and erosion.²⁰⁶ Supplying most the empire’s wheat likely turned Tunisia’s pre-Saharan savannas into desert. Roman aqueducts altered natural flow patterns but the Empire’s large-scale experimentation became unsustainable.

Modern-day Italy, conversely, has been a leader in regional water restoration projects as varied as restoring the Mesopotamian Marshlands to Mediterranean institutional capacity building.²⁰⁷ The Government of Italy notes that maintaining

198. Personal observation of author.

199. See Robert Rinehart, *Historical Setting*, in *TUNISIA: A COUNTRY STUDY* 3, 3 (Harold D. Nelson ed., 1988). For a timeline of Tunisian history, see BBC News, *Timeline: Tunisia*, http://news.bbc.co.uk/1/hi/world/south_asia/country_profiles/2506465.stm (last updated Nov. 19, 2005).

200. See LaVerle Berry & Robert Rinehart, *The Society and Its Environment*, in *TUNISIA: A COUNTRY STUDY*, *supra* note 199, at 71, 84; see also BBC News, *BBC Q&A: The Berbers*, <http://news.bbc.co.uk/1/hi/world/africa/3509799.stm> (last updated Mar. 12, 2004).

201. See Rinehart, *supra* note 199, at 22.

202. KENNETH J. PERKINS, *A HISTORY OF MODERN TUNISIA* 2-3 (2004). For a general profile of Tunisia, see U.S. Dep’t of State, *Background Note: Tunisia*, <http://www.state.gov/r/pa/ei/bgn/5439.htm> (last visited Apr. 17, 2006).

203. See Rinehart, *supra* note 199, at 10.

204. ANTHONY SYLVESTER, *TUNISIA* 27 (1969).

205. J.D. FAGE, *A HISTORY OF AFRICA* 50 (1st ed. 1978).

206. “In parts of southern Tunisia as much as 60% of annual precipitation may fall on a single day.” LÓPEZ ORNAT & MORALES, *supra* note 113, at 17.

207. See H. E. Ambassador Aldo Mantovani, Italy, Statement to the High Level Segment, Thirteenth Session of the U.N. Commission for Sustainable Development (Apr. 20, 2005), *available at* http://www.un.org/esa/sustdev/csd/csd13/statements/2004_italy.pdf (discussing Italy’s support for the New Eden Project in Iraq and other institutional capacity building endeavors).

peace and security involves supporting local technical expertise to construct, operate, monitor, and maintain water systems. Conflict prevention can be facilitated on a regional basis by establishing joint commissions that have sufficient mandates to address transboundary aquifer management.²⁰⁸

Italy warns that decisionmakers should not over-rely upon desalination projections to the exclusion of intensified conservation measures.²⁰⁹ This is in contrast to the traditional Roman principle that anyone who owned the surface land also owned the groundwater beneath that land.²¹⁰ This principle does not provide stable water rights, as aquifer users have an incentive to over-pump before other users deplete the aquifer to an untenable level. Each individual only has security over the water actually pumped out of the aquifer.

In Tunisia, nine out of ten individuals depend upon prehistoric groundwater.²¹¹ Across central Tunisia's semi-arid steppe plateau of olive groves and seasonal salt lakes, the Chott El Jerid divides Tunisia in half. Knee high cones of salt dry in the breeze. Tunisians hollow date-palm trunks in order to channel water. Trunks support homes while branches become roofs and fences. Onions, beans, and barley grow in the shade of citrus groves, which, in turn, find protection beneath pomegranate trees. Date palms tower over all, a welcome sight for travelers across a sea of sand. Sustaining life in a desert is a fragile prospect but one that is possible if co-aquifer states can retain perspective and build trust.

3. Nubian Sandstone Aquifer System (NSAS)

Despite ongoing-armed conflict, North African States sharing the Nubian Sandstone Aquifer System have entered into one of the few groundwater agreements to date. In 2000, Chad, Egypt, Libya, and Sudan agreed to establish a joint commission for the Nubian Sandstone Aquifer System authorized to collect and exchange data with which to model the aquifer.²¹² The International Fund for Agricultural Development, a specialized agency of the United Nations, has funded a program on the Nubian Aquifer. Water has been extracted for irrigation in Egypt and Libya. Groundwater has also been piped to where most inhabitants

208. ITALIAN MINISTRY FOR THE ENV'T & TERRITORY & UNESCO INT'L HYDROLOGICAL PROGRAMME, WATER PROGRAMME FOR AFRICA, ARID AND WATER SCARCE ZONES 2004-2006, at 2 (2005), available at <http://unesdoc.unesco.org/images/0013/001391/139124e.pdf>.

209. YEMEN MINISTRY OF WATER & ENV'T & ITALIAN MINISTRY FOR ENV'T & TERRITORY, REGIONAL WORKSHOP ON DESALINATION AND RENEWABLE ENERGY: INVITATION 3 (2004), available at http://www.unesco.org/water/ihp/events/yemen_desa/workshop.pdf.

210. For a discussion of the history of Middle Eastern Water Law, see Ludwik A. Teclaff, *Fiat or Custom: The Checkered Development of International Water Law*, 31 NAT. RESOURCES J. 45 (1991).

211. Hayton & Utton, *supra* note 150, at 674.

212. See The Nubian Sandstone Aquifer System, <http://isu2.cedare.org.eg/nubian> (last visited Apr. 17, 2006); see also Gabriel Eckstein & Yoram Eckstein, *A Hydrogeological Approach to Transboundary Ground Water Resources and International Law*, 19 AM. U. INT'L L. REV. 201, 248 (2003).

live in the North, since extracting groundwater along the coast risks drawing saltwater into the freshwater aquifer.

Only a narrow coastal strip of North Africa receives adequate rainfall for olive and citrus orchards. Largely uninhabited desert spans much of the interior of North African countries. Small Saharan oasis communities cultivate date palms and figs. Lacking permanent rivers, Libya is ninety percent desertified and the other ten percent is at risk of desertification.²¹³ The Great Manmade River Project bringing prehistoric groundwater north has proven to be one of the most expansive and expensive engineering efforts ever.²¹⁴ Non-renewable fossil aquifers in the Sahara provide eighty-seven percent of the water that Libyans use.²¹⁵

In Chad, thirty years of civil war and invasions by Libya finally settled into an absence of armed conflict in 1990. A new rebellion erupted in 1998 and has not dissipated. The population is approximately fifty percent Muslim and has been able to mediate the Sudanese conflict to some degree. The Janjawid armed militia and Sudanese military have forced roughly 200,000 refugees from Darfur to flee to Chad since 2003.²¹⁶

Sudan is Africa's largest country, comparable in size to western Europe. The United Nations peacekeeping mission in Sierra Leone required 17,000 troops, constituting one of the most extensive United Nations peacekeeping forces ever and costing several billion dollars.²¹⁷ The United Nations was daunted by the prospect of launching a mission in a country thirty-five times the size of Sierra Leone, questioning the ability to be effective across Sudan's vast distances without infrastructure. Over 180,000 people have died and an estimated two million people are trying to survive in refugee camps as a result of the Darfur crisis.²¹⁸ Low rainfall over the past year led to critical water shortages in refugee camps.²¹⁹

Negotiations to end the twenty-one year civil war in southern Sudan possibly

213. LÓPEZ ORNAT & MORALES, *supra* note 113, at 15.

214. Libya's violent Pan-Arabism and military intervention in neighboring countries appears to have given way to a new era of cooperation marked by the 1999 lifting of U.N. sanctions, 2003 acceptance of responsibility for the Lockerbie bombing, and Colonel Mu' ammar Gaddafi's repudiation of weapons of mass destruction.

215. LÓPEZ ORNAT & MORALES, *supra* note 113, at 15.

216. CIA, World Factbook—Sudan, <http://www.cia.gov/cia/publications/factbook/geos/su.html> (last visited Apr. 17, 2006).

217. Mark Doyle, *Sudan: Big Country, Big Problems*, BBC NEWS, June 10, 2004, <http://news.bbc.co.uk/1/hi/world/africa/3795269.stm>.

218. BBC News, Q & A: Sudan's Darfur Conflict, <http://news.bbc.co.uk/1/hi/world/africa/3496731.stm> (last updated May 26, 2005). Human Rights Watch notes that "[m]ore than two million people, one-third of Darfur's entire population, have been forcefully displaced from their homes since February 2003 after the Khartoum government responded to a local insurgency by launching a massive campaign of 'ethnic cleansing.'" Human Rights Watch, Darfur: ICC Prosecutor Briefs Security Council (June 29, 2005), <http://hrw.org/english/docs/2005/06/29/sudan11233.htm>.

219. Martin Plaut, *Chad Refugees Face Water Shortage*, BBC NEWS, Apr. 23, 2005, <http://news.bbc.co.uk/1/hi/world/africa/4477653.stm>.

intensified violence in Darfur.²²⁰ Darfur rebels felt left out of the power-sharing negotiations between the North and the South.²²¹ Sudan's civil war has raged for roughly half a century between powerful Muslims in the north and disempowered non-Arab Christians and Sudanese who practice traditional religions in the south.²²² Ishbel Matheson of the BBC notes that Africa's longest civil war has been fought over race, religion, and resources.²²³ Matheson goes on to point out that, "[s]ince independence in 1956, the country has known only 11 years of peace."²²⁴ The death toll climbed to 1.5 million people in 2005.²²⁵ Osama Bin Laden lived in Khartoum in the early 1990s and there is widespread concern that terrorists could operate from Sudan.

International pressure quickened the pace of a North-South peace agreement that led to the former southern rebel leader, John Garang, being sworn in as vice president. The civil unrest that followed his death in a helicopter crash did not derail the peace process.²²⁶ The Security Council has mandated the United Nations Mission in Sudan (UNMIS) to monitor and support the implementation of the Comprehensive Peace Agreement in Sudan. Political and logistical support for the African Union Mission in Darfur (AMIS) is also part of the UNMIS peacekeeping mission.²²⁷ By December 2005 the United Nations had helped repatriate the first group of southern Sudan's refugees.²²⁸ Roughly 3000 African Union troops are in Darfur.²²⁹ Islamic Sharia law will not be applied in the south, Sudan's new oil export revenues will be shared between north and south, and the south will hold a referendum on secession in six years.²³⁰

Egypt opposes southern Sudan becoming a new country that would be a riparian on the Nile.²³¹ Egypt's total dependence upon water originating in other

220. Human Rights Watch, Sudan: World Report 2005, <http://hrw.org/english/docs/2005/01/13/sudan9885.htm> (last visited Apr. 17, 2006).

221. Doyle, *supra* note 217.

222. CIA, *supra* note 216.

223. Ishbel Matheson, *Sudan Peace Pact Marks New Chapter*, BBC NEWS, Jan. 10, 2005, <http://news.bbc.co.uk/1/hi/world/africa/4157897.stm>.

224. *Id.*

225. *Sudan State of Emergency Lifted*, BBC NEWS, July 11, 2005, <http://news.bbc.co.uk/1/hi/world/africa/4670231.stm>.

226. See, e.g., Glenn Kessler, *U.S. Prods, Makes Promises to End Violence in Sudan's Darfur Region*, WASH. POST, Nov. 4, 2005, at A17.

227. United Nations Mission in Sudan, <http://www.unmis.org/english/en-main.htm> (last visited Apr. 17, 2006).

228. *First UN-Organized Repatriation of Southern Sudan's Refugees Gets Under Way*, U.N. NEWS SERVICE, Dec. 19, 2005, <http://www.un.org/apps/news/story.asp?NewsID=16970&Cr=Sudan&Cr1>.

229. BBC News, *supra* note 218. According to the United Nations, as of December 2005 there are still several thousand African Union troops in Sudan. *UN Refugee Chief Calls for Global Support for Peacekeeping in Sudan's Darfur*, U.N. NEWS SERVICE, Dec. 19, 2005, <http://www.un.org/apps/news/story.asp?NewsID=16981&Cr=Darfur&Cr1=UNHCR>.

230. *Sudan State of Emergency Lifted*, *supra* note 225.

231. Richard Dowden, *Sudan's Peace Balancing Act*, BBC NEWS, May, 27 2004, <http://news.bbc.co.uk/1/hi/world/africa/3420809.stm>.

countries and limited arable land affect Egyptians' capacity to compromise over groundwater or the Nile.²³² Just as Sudan, Eritrea, and Ethiopia are low-income economies that have to negotiate with Egypt as a co-riparian on the Blue Nile, Sudan and Chad are low-income economies that have to contend with Egypt's greater economic and political power in negotiations over the Nubian Sandstone Aquifer System.²³³ Libya may be financially more stable than Sudan and Chad but struggles to shed pariah status in its foreign relations.

Despite an array of obstacles, North African countries are building upon the progress of the African Convention on the Conservation of Nature and Natural Resources to form cooperative groundwater arrangements.²³⁴ Chad, Egypt, Libya, and Sudan have agreed to collect, process, analyze, display, and update data relevant to their shared groundwater resources. The Nubian Aquifer Regional Information System (NARIS) facilitates the exchange of such information as yearly extraction and electrical conductivity to determine salinity.²³⁵ This information sharing arrangement can build the foundation for more extensive transboundary aquifer management. In the midst of ongoing armed conflict, the Joint Authority for the Study and Development of the Nubian Sandstone Aquifer has been able to collect and analyze information on aquifer quality and quantity. Israeli-Palestinian reconciliation requires the kind of trust that Nubian Sandstone Aquifer States have been strengthening by developing water utilization plans and executing a common water policy.²³⁶

IV. CONCLUSION

This article has applied the multifactor balancing test of the Draft Convention on the Law of Transboundary Aquifers to the Israeli-Palestinian conflict and analyzed Middle Eastern and North African hydropolitics in light of emerging international law. Existing co-aquifer arrangements indicate that establishing a joint management institution would enable versatile and timely responses to

232. National Civil Society Forums have helped build consensus within the Nile basin. Flowing across one tenth of Africa, the Nile and its tributaries pass through the following ten countries: Burundi, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda. For a discussion of the Nile Basin Initiative, see Jutta Brunzke & Stephen J. Toope, *The Changing Nile Basin Regime*, 43 HARV. INT'L. L.J. 105 (2002).

233. Chad and Sudan are low-income countries while Egypt, Iran, Iraq, Jordan, Syria, Tunisia, and Turkey are lower-middle-income economies according to the World Bank. In contrast, Israel is a high-income economy. See World Bank, Data & Statistics, Country Classification, http://www.worldbank.org/data/countryclass/classgroups.htm#Low_income (last visited Apr. 17, 2006).

234. The African Union Assembly recently adopted a revised African Convention on the Conservation of Nature and Natural Resources (updating the 1968 convention), calling for public participation and water management. Revised African Convention, *supra* note 172, *revising* African Convention on the Conservation of Nature and Natural Resources, Sept. 15, 1968, 1001 U.N.T.S. 3.

235. Algeria, Libya, and Tunisia have agreed to a joint institution that will collect data and model the SASS aquifer. See SASS Agreement Excerpt, *supra* note 185, at 6.

236. Int'l Law Comm'n, *supra* note 150, at 23.

variable water conditions. North African states have shown that armed conflict does not have to impede aquifer cooperation. Mikhail Gorbachev notes that, “[t]here are decisions that we make and there are decisions that time and circumstances make for us.”²³⁷ The degree of scarcity, interdependence, underlying animosity, and power asymmetry has affected the ability of Israel and the Palestinian Authority to reach agreement on groundwater management. Individuals who do not feel as though they have a stake in the future lose respect for the rule of law. Thus, civil society and legislators must exchange perspectives diplomatically and begin the task of drafting a generally acceptable Israeli-Palestinian water-sharing agreement.

237. Mikhail Gorbachev, Chairman of the Board, Green Cross Int'l, Statement at the United Nations (Apr. 5, 2005), *available at* http://www.gorby.ru/en/rubrs.asp?art_id=24195&rubr_id=306&page=1.