

COMMENT

THE NUBIAN SANDSTONE AQUIFER: AN INSTITUTIONAL APPROACH TO WATER MANAGEMENT

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I. INTRODUCTION

Easter Island, once densely populated with thousands of lush-trees, is now a barren landscape.¹ Polynesians, the original inhabitants, recklessly destroyed Easter Island's environment to make the large statues that now bring the island fame.² As the legend goes, tree after tree was cut down, until only a single tree was left standing. Without fearing the consequences, a man went up and cut down the last standing tree. Some ecologists believe the society fell into utter chaos and eventually collapsed from cannibalism and starvation.³

Many ecologists, like Jared Diamond, a highly published scholar, have compared the legend of Easter Island's demise with our current consumption of the world's natural resources.⁴ Diamond and others correctly believe that the current depletion of our world's natural resources will result in the collapse of modern society if not managed quickly.⁵ Currently, freshwater resources are exploited at an alarming rate, and it is becoming increasingly necessary to develop effective and manageable frameworks between states.

This article attempts to create an institutional framework to manage transboundary ground water resources by examining the Nubian Sandstone Aquifer's water management system. Part I is an overview of groundwater (or aquifers) and the importance of protecting these resources. Part II is an overview of the institutional theory and how the institutional theory applies to the Nubian Aquifer. Part III gives

1. See TERRY HUNT, STATUTES THAT WALKED: UNRAVELING THE MYSTERY OF EASTER ISLAND (Counterpoint Press 2012).

2. Terry Hunt & Carl Lipo, *Revisiting Rapa Nui (Easter Island) "Ecocide"*, 63 PACIFIC SCIENCE 601 (2009).

3. See LENORE WEISS, CUTTING DOWN THE LAST TREE ON EASTER ISLAND 12 (2012).

4. See JARED DIAMOND, COLLAPSE: THE RISE AND FALL OF SOCIETIES 107 (2013).

5. *Id.* at 3.

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background on the natural characteristics of the Nubian Aquifer. Part IV discusses the current state of international law regarding shared water resources, specifically regarding sovereignty and suggested management principles. Part V analyzes the most successful mechanisms in the Nubian Aquifer's Strategic Action Programme (SAP) and identifies potential threats to SAP's future in the region. Finally, Part VI creates an institutional framework based on SAP and other international norms for future states to implement. This section also identifies other threatened transboundary aquifers that should apply these types of institutions.

II. OVERVIEW OF AQUIFERS AND WATER

Water is essential to life and is a fundamental resource that is seriously depleting.⁶ Currently, over 2.5 billion people are without access to adequate sanitation;⁷ 900 million people have no access to freshwater;⁸ and, 2 million people die every year from diseases spawned by unsafe drinking water and inadequate sanitation.⁹ Unfortunately, most of the world with access to freshwater continue to consume it at an

6. *See generally* U.N. Committee on Economic, Social and Cultural Rights, General Comment No. 15: The Right to Water, U.N. Doc. E/C.12/2002/11 (Jan. 20, 2003); *see also*, U.N. Charter art. 55; International Covenant on Economic, Social and Cultural Rights, arts. 11 and 12, Dec. 16, 1966, 993 U.N.T.S. 3; G.A. Res 217 (III) A, Universal Declaration of Human Rights, U.N. Doc. A/810 (Dec. 10, 1948); U.N. Office of the High Comm'r for Human Rights, Fact Sheet No. 35, *The Right to Water* (2010).

7. World Health Organization & U.N. Children's Fund, Progress on Sanitation and Drinking-Water: 2013 Update, 3, 5, and 8 (2013), https://www.unicef.org/wash/files/JMP2013final_en.pdf.

8. World Health Organization & U.N. Children's Fund, Drinking Water: Equity, Safety and Sustainability, 17 (2011), https://www.wssinfo.org/fileadmin/user_upload/resources/report_wash_low.pdf.

9. *Id.*

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unsustainable rate,¹⁰ and they are unaware of the true freshwater crisis we are facing.¹¹

Most who are aware of the freshwater crisis do not understand the true scarcity of water.¹² Over 97% of the world's water is unusable salt water,¹³ and most freshwater is inaccessible, frozen in glaciers and ice caps.¹⁴ The second largest stores of freshwater on Earth are in underground aquifers: some 99% is contained in the 275 known aquifers around the world.¹⁵

A common misconception is that aquifers are underground water tanks filled with freshwater. Aquifers are layers of unconsolidated and consolidated material, for example sand and sandstone, respectively.¹⁶ Aquifers are usually bound by an impermeable bed, which must be directly drilled into to extract water.¹⁷ Unlike traditional watercourses, such as rivers, aquifers will likely not be replenished, especially after the

10. The international community has recognized as much. On the first World Water Day, in 1993, the importance of freshwater was first globally recognized. *See* G.A. Res. 47/193, Observance of World Day for Water (Dec. 22, 1992). However, due to the limited availability of freshwater, it continues to be difficult for many states, both developing and industrialized, to gain access to freshwater, let alone implement methods for sustainable water use. *See id.*; *see also* G.A. Res. 70/1, Transforming Our World: the 2030 Agenda for Sustainable Development, Goal No. 6 (Oct. 21, 2015). Most recently, in 2015, the United Nations adopted Sustainable Development Goal 6, which “ensure availability and sustainable management of water and sanitation for all.” *Id.*

11. Renee Martin-Nagle, *Fossil Aquifers: A Common Heritage of Mankind*, 2 GEO. WASH. J. ENERGY & ENVTL. L. 39 (2011).

12. PETER GLEICK, *An Introduction to Global Fresh Water Issues*, in WATER IN CRISIS: A GUIDE TO THE WORLD'S FRESH WATER RESOURCES 3 (Peter Gleick ed., 1993).

13. *Id.*

14. IGOR A. SHIKLOMANOV, *World Fresh Water Resources*, in WATER IN CRISIS: A GUIDE TO THE WORLD'S FRESH WATER RESOURCES 13 (Peter Gleick ed., 1993).

15. United Nations Educational, Scientific, and Cultural Organization, International Hydrological Programme, Atlas of Transboundary Aquifers: Global maps, regional cooperation and local inventories, 16 and 61, U.N. Doc. SC-2009/WS/22 (2009) [hereinafter UNESCO-IHP Atlas of Transboundary Aquifers] (a projected launched by UNESCO-IHP in 1999 to collect hydrogeological information at a global scale on these specific types of resources).

16. *See* PHILLIPPE QUEVAUVILLER, *General Introduction: The Need to Protect Groundwater*, in GROUNDWATER SCIENCE AND POLICY 3, 5 (Phillippe Quevaullviller ed., 2008) [hereinafter QUEVAUVILLER].

17. *Id.*

groundwater is fully extracted.¹⁸ This is important because groundwater is a major source of surface water that countries and their populations around the world rely on.¹⁹

There are many different classifications of aquifer, however this article looks specifically at non-rechargeable aquifers—aquifers not connected to surface water. Non-rechargeable aquifers are similar to fossil fuels because once water is extracted from the ground the water is essentially permanently removed.²⁰ However, unlike fossil fuels there is no alternative to water.²¹

Given the limited nature of water and the consequences of permanent depletion, governing the use of non-rechargeable aquifers is especially difficult.²² Gabriel Eckstein, a preeminent scholar of transboundary aquifers, explained, non-rechargeable aquifers by definition “cannot be sustainably exploited.”²³ Any management plan must consider this unique characteristic when determining how aquifer countries may fairly utilize these vital freshwater resources.²⁴

Since aquifers are underground, a lack of information about their contents and visual notice of depletion has led numerous states to reckless exploitation.²⁵ Up until the United Nations Economic, Scientific

18. See generally Yoram Eckstein & Gabriel E. Eckstein, *Transboundary Aquifers: Conceptual Models for Development of International Law*, 43 NAT’L GROUND WATER ASS’N 679, 685 (2005) [hereinafter *Conceptual Models for Transboundary Aquifers*].

19. QUEVAULVILLER, *supra* note 16, at 3.

20. *Conceptual Models for Transboundary Aquifers*, *supra* note 18, at 685.

21. *Id.*

22. JOEL R. GAT, *ISOTOPE HYDROLOGY: A STUDY OF THE WATER CYCLE* 136 (2010). Non-rechargeable aquifers are difficult to govern in an adequate and sustainable way because there is a limited amount of water that will not be replenished by a normal water cycle. *Id.*

23. *Conceptual Models for Transboundary Aquifers*, *supra* note 18, at 685.

24. See G.A. Res. 64/10, Draft Articles on Transboundary Aquifers, 42 (May 29, 2008) [hereinafter TBA Articles]; Francesco Sindico & Gabriel Eckstein, *The Law of Transboundary Aquifers: Many Ways of Going Forward, but Only One Way of Standing Still*, 23 REV. EUR. COMM. INTL’L EVTL. L. 32, 33 (2014).

25. See FRED PEARCE, *WHEN THE RIVERS RUN DRY* 35-39 (2006) (discussing how major sections of the world are pumping water from underground sources at an uncontrolled and reckless pace); see also Aaron Worthen, *Resolving International Water Disputes Lessons from American and Canadian Federalism*, 11 BYU INT’L L. MGMT. REV. 132, 135 (2015).

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and Cultural Organization's ("UNESCO") *Atlas of Transboundary Aquifers* in 2009, there was no comprehensive identification or mapping of these vital resources.²⁶ Presently, aquifer utilization ranges from total reliance on groundwater for a state's survival²⁷ to extraction of water for purely profitable purposes.²⁸

III. OVERVIEW OF INSTITUTIONALISM

In international law, institutions have long been used as a way to promote and maintain co-operation between otherwise self-interested states.²⁹ Institutions are defined as "persistent and connected set of rules (formal and informal) that prescribe behavioral roles, constrain activity, and shape expectations."³⁰ Institutions contribute to co-operation in two major ways. First, institutions force actors to think about the long-term relationship between interested parties.³¹ Second, institutions increase the importance of reciprocity and a state's reputation in international law.³² Moreover, institutions have the power to create neutral and stable environments that promote decisions that are mutually beneficial and guide state behavior.³³

This Comment takes an institutionalist approach to examine the framework created to protect and manage the Nubian Sandstone Aquifer ("Nubian Aquifer"). The Nubian Aquifer is located in one of the world's driest regions: Northeastern Africa. Famines, droughts, civil wars, demographic pressures, and political instability continue to plague the region.³⁴ Despite such overwhelming obstacles, Chad, Libya, Sudan, and

26. Resolving International Water Disputes, *supra* note 25, at 135–136.

27. UNESCO-IHP Atlas on Transboundary Aquifers, *supra* note 15, at 16 (nearly two million people rely totally on groundwater extracted from the aquifers to survive).

28. *Conceptual Models for Transboundary Aquifers*, *supra* note 18, at 685.

29. Barbara Koremenos, *Institutionalism and International Law* (Aug. 29, 2011), <https://ssrn.com/abstract=1919309>.

30. William J. Aceves, *Institutionalist Theory and International Legal Scholarship*, 12 AM. UNIV. INT'L L. REV. 227, 241 (1997) (quoting Robert O. Keohane, *International Institutions: Two Approaches*, 32 INT'L STUD. Q. 379, 386 (1988)).

31. Aceves, *supra* note 30, at 242; *see also* Worthen, *supra* note 25, at 133.

32. *See* Worthen, *supra* note 25, at 133.

33. *See* Duncan Snidal, *Political Economy and International Institutions*, 16 INT'L REV. L. ECON. 121, 127 (1996).

34. *See* discussion *infra* sec. V.C.2.

Egypt—the countries that share the Nubian Aquifer—have successfully created and implemented a regional framework, the Nubian Aquifer’s SAP, to manage the Nubian Aquifer.³⁵ These four states’ success with SAP in a region with limited economic resources and increasing demographic pressure, makes it a worthy case study.

The two most successful institutional mechanisms of the Nubian Aquifer’s SAP are the administrative body (Joint Authority) and the informational system (Nubian Aquifer Regional Information System).³⁶ This article will explain how international law has created a platform for SAP to be successful, and will draw from the SAP example to ultimately identify three institutions necessary for any future framework managing non-rechargeable transboundary aquifers: (1) independent administrative bodies; (2) a regional informational system; and (3) fair apportionment factors.

III. BACKGROUND ON THE NUBIAN SANDSTONE AQUIFER SYSTEM

The Nubian Aquifer has been described as a “liquid gold mine” for Chad, Libya, Sudan, and Egypt (Aquifer States).³⁷ It is one of the largest aquifers in the world, ranging nearly 2.2 million square kilometers in size and is utilized by the four water-strapped countries.³⁸ The Nubian Aquifer is a non-rechargeable confined aquifer, which means it is not connected to surface water and any water utilized will not replenish.³⁹ Currently, the Nubian Aquifer contains 6.5 million cubic mega meters of water.⁴⁰ However, within the past forty years, the Aquifer States have exponentially increased their extraction of water from the Aquifer.⁴¹

35. See discussion *infra* sec. V.C.

36. See discussion *infra* sec. V.B. and VI.

37. Russell Sticklor, *Libya Unrest Threatens to Derail Water Diplomacy in North Africa*, World Pol. Rev. (July 2015), <http://www.worldpoliticsreview.com/articles/16148/libya-unrest-threatens-to-derail-water-diplomacy-in-north-africa>.

38. *Conceptual Models for Transboundary Aquifers*, *supra* note 18, at 685.

39. UNESCO-IHP Atlas of Transboundary Aquifers, *supra* note 15, at 276.

40. UNESCO INTERNATIONAL HYDROLOGICAL PROGRAM, NON-RENEWABLE GROUNDWATER RESOURCES: A GUIDEBOOK ON SOCIALLY-SUSTAINABLE MANAGEMENT FOR WATER-POLICY MAKERS, 32, U.N. Doc. SC-2007/WS/4 (eds. Stephen Foster & Daniel P. Loucks, 2006) [hereinafter UNESCO GUIDEBOOK].

41. UNESCO-IHP Atlas of Transboundary Aquifers, *supra* note 15, at 277.

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Despite the dramatic increase in utilization of the Nubian Aquifer, both Egypt and Libya have used a miniscule portion of the water.⁴² Egypt's New Valley Project and Libya's Great Man-Made River are responsible for increased extraction, but there is no historical data for Chad and Sudan's use of the Nubian Aquifer.⁴³ However, given the large supply of confined water, it is only a matter of time before they too begin utilizing the Aquifer, making it susceptible to reckless exploitation. Therefore, it is critical the four states cooperate to ensure equitable use.

IV. INTERNATIONAL LAW REGARDING AQUIFERS AND OTHER WATER RESOURCES

The principles of international law governing management and utilization of water sources can be derived from a variety of sources. The current guidelines for international watercourses are important to analyze because the frameworks for various transboundary aquifers, including the Nubian Aquifer, are largely derived from these international norms. It should be noted, however, that while these sources set international norms regarding transboundary aquifers, they do not provide a solution to the natural conflict between states' sovereign rights to utilize water in a transboundary aquifer and their obligations towards other aquifer states.⁴⁴ Therefore, the focus of this section is the norm of territorial sovereignty, how the concept has been introduced in international water management, and how these sources of law facilitated a platform for regional water management agreements.

A. *International Law Regarding Territorial Sovereignty*

International law is fundamentally based on the territorial sovereignty of states.⁴⁵ It provides states the "inalienable right"⁴⁶ to

42. UNESCO Guidebook, *supra* note 40, at 32.

43. *Id.*

44. See Martin-Nagle, *supra* note 11, at 42.

45. See, e.g., S.S. "Lotus" (Fr. v. Turk.), Judgment, 1927 P.C.I.J. (ser. A) No. 10, at 47 (Sept. 7).

46. G.A. Res. 1803 (XVII), Permanent Sovereignty Over Natural Resources (Dec. 14, 1962) (adopted by an 87 – 2 vote with 12 abstentions and 9 non-voting members), http://legal.un.org/avl/ha/ga_1803/ga_1803.html; see, e.g., U.N. Charter arts. 2, 55, and 73; see generally United Nations Convention on the Law of the Seas [UNCLOS] art. 2, Dec. 10, 1982, 1833 U.N.T.S. 397; Vienna Convention on

freely utilize natural resources located within their territory and to economically develop the country.⁴⁷ This has important implications for a state's right of self-determination within the international community.⁴⁸ Moreover, sovereignty over natural resources is arguably a state's most powerful tool to provide citizens with basic human rights,⁴⁹ of relevance here, the right to an adequate standard of living, including safe, clean water.⁵⁰

However, sovereignty over transboundary shared resources invokes the sovereign equality of all states within whose territory the resource is located.⁵¹ In this context, sovereignty is inherently limited because a state must exercise its rights without interfering with another state's

Succession of States in Respect of Treaties [VCSST] art. 13, Aug. 23, 1978 *entered into force* Nov. 6, 1996, 1946 U.N.T.S. 3 ("every state has permanent sovereignty over its natural wealth and resources").

47. See United Nations Framework Convention on Climate Change preamble, Mar. 21, 1994, 1771 U.N.T.S. 166; Vienna Convention for Protection of the Ozone Layer preamble, Mar. 22, 1985, 1771 U.N.T.S. 407; Convention on Biological Diversity preamble, June 5, 1992, 1760 U.N.T.S. 79; Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa preamble, Oct. 14, 1994, 1954 U.N.T.S. 3; Convention on the Sustainable Management of Lake Tanganyika preamble, June 12, 2003, 2338 U.N.T.S. 43; African (Banjul) Charter on Human and Peoples' Rights art. 21, *adopted* June 27, 1981, *entered into force* Oct. 21, 1986, 21 I.L.M. 58; Convention for the Protection of the Natural Resources and Environment of the South Pacific Region art. 4, *adopted* Nov. 24, 1986, *entered into force* Aug. 22, 1990, 26 I.L.M. 38; Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes art. 5, June 17, 1999, 2331 U.N.T.S. 202; African Convention on the Conservation of Nature and Natural Resources art. 7, Sept. 15, 1968, 1001 U.N.T.S. 3.

48. G.A. Res. 1803 (XVII), *supra* note 46.

49. SIBYLLE SCHEIPERS, *NEGOTIATING SOVEREIGNTY AND HUMAN RIGHTS: INTERNATIONAL SOCIETY AND THE INTERNATIONAL CRIMINAL COURT* 6, 82 (2013). See also TBA Articles, *supra* note 24, arts. 3 and 5(2).

50. See, e.g., UDHR, *supra* note 6; ICESCR, *supra* note 6, arts. 11, 12; U.N. Committee on Economic, Social and Cultural Rights, General Comment No. 15: The Right to Water, U.N. Doc. E/C.12/2002/11 (Jan. 20, 2003); see also, U.N. Charter art. 55; G.A. Res 217 (III) A, Universal Declaration of Human Rights, U.N. Doc. A/810 (Dec. 10, 1948); U.N. Office of the High Comm'r for Human Rights, Fact Sheet No. 35, *The Right to Water* (2010).

51. See SCHEIPERS, *supra* note 49, at 82; see also U.N. Charter arts. 1, 2, 55, and 78.

rights to the same resource.⁵² International law provides two essential limitations to sovereignty in this regard with respect to water resources: (1) equitable utilization,⁵³ and (2) an obligation not to cause significant harm.⁵⁴ However, these principles do not fully solve the fundamental conflict that exists between a state's right to utilize its natural resources and another state's rights to use the same resource.⁵⁵

Naturally, states have used the concept of territorial sovereignty to protect their respective interests over transboundary aquifers.⁵⁶ Limiting state sovereignty through regional institutions is one practical solution.⁵⁷ The next section will discuss the importance of regional institutions established through various international treaties that attempt to govern international watercourses.

B. International Law Association's Rules on Groundwater

In 1967, the International Law Association (ILA), a non-governmental organization, was tasked with codifying international law regarding watercourses.⁵⁸ ILA created the first modern framework to manage shared water resources through the adoption of the Helsinki

52. See, e.g., *Corfu Channel (U.K. v. Alb.)*, Judgment, 1949 I.C.J. 4 (Apr. 9); *Pulp Mills on the River Uruguay (Arg. v. Uru.)*, Judgment, 2010 I.C.J. 14 (Apr. 20).

53. See, e.g., *Gabčíkovo-Nagymaros Project (Hung. v. Slov.)*, Judgment, 1997 I.C.J. 7 (Sept. 25) (recognizing the rights of states who share natural resources); TBA Articles, *supra* note 24, arts. 4 and 5; G.A. Res. 51/149, Convention on the Law of Non-navigational Uses of International Watercourses art. 4–6, *adopted* May 21, 1997 *entered into force* Aug. 17, 2014 U.N. Doc. A/RES/51/149 [hereinafter *Watercourse Convention*].

54. TBA Articles, *supra* note 24, art. 6; UNCLOS, *supra* note 46, art. 2; *Watercourse Convention*, *supra* note 53, art. 7.

55. See generally TBA Articles, *supra* note 24, art. 3, cmt. 3; see also Nadia Sánchez Castillo, *Differentiating between Sovereignty over Exclusive and Shared Resources in the Light of Future Discussion on the Law of Transboundary Aquifers*, 24 REV. EUR. COMM. INT'L ENVTL. L. (R.E.C.I.E.L) 1 (2015) (It is also important to note that the principle not to cause harm is not an absolute limitation on sovereignty; it only requires a state to take "all appropriate measures" to not harm another state's rights).

56. Castillo, *supra* note 55, at 2.

57. Elizabeth Burleson, *Middle Eastern and North African Hydropolitics: From Eddies of Indecision to Emerging International Law*, 18 GEO. INT'L ENVTL. L. REV. 385, 423–24 (2006).

58. See generally, International Law Association, *Constitution of the Association (adopted in 1873 revised in 2016)*.

Rules on the Uses of the Waters of International Rivers.⁵⁹ These rules apply to both surface and ground water and discuss various topics, such as equitable utilization, water pollution, and procedures to prevent and settle disputes.⁶⁰

Most notably, a large portion of the provisions in the Helsinki Rules are devoted to creating a framework for the prevention and settlement of disputes.⁶¹ Article 29 recommends that states communicate with one another regarding proposed constructions and activities, relevant data, and any alteration in the government's policy toward the shared resource to avoid disputes altogether.⁶² Moreover, Article 31 recognizes and recommends the use of a "joint agency" to manage disputes and report on issues regarding the resource.⁶³

In 1986, the ILA adopted the Seoul Rules on International Groundwater, which specifically looked at the interdependence of international aquifers and the best ways to protect and manage aquifers.⁶⁴ Since the Seoul Rules only contained four articles, the articles lack an in-depth analysis and groundwater policy;⁶⁵ however, they echo the same recommendation of the Helsinki Rules—transparency of information and regional management institutions.⁶⁶

59. See Int'l Law Ass'n [ILA], Rep. on the Work of its Fifty-Second Conf., Michelle R. Sergent, *Comparison of the Helsinki Rules to the 1997 U.N. Draft Articles: Will the Progression of International Watercourse Law be Dammed?*, 8 VILL. ENVTL. L.J. 435, 437 (1997) [hereinafter Helsinki Rules]; see also Justin Carlson, Note, *A Critical Resource or Just a Wishing Well? A Proposal to Codify the Law on Transboundary Aquifers and Establish an Explicit Human Right to Water*, 26 AM. U. INT'L L. REV. 1409, 1415 (2011).

60. Helsinki Rules, *supra* note 59, arts. 2, 4, and 16.

61. See generally *id.* arts. 26–37.

62. *Id.* art. 29.

63. *Id.* art. 31; ILA, Rep. on the Work of its Fifty-Second Conf., The Helsinki Rules on the Uses of the Waters of International Rivers, art. XXXI (1966).

64. ILA, Rep. on the Work of its Sixty-Second Conf., The Seoul Rules on International Groundwaters, (1968) [hereinafter Seoul Rules].

65. See generally *id.*

66. *Id.* arts. III-IV (Article III recommends basin states exchange information and cooperate with each other about shared groundwater. Article IV calls for states to enter into integrated management frameworks regarding the specific resources).

Most recently, in 2004, the ILA adopted the Berlin Rules on Water Resources.⁶⁷ The Berlin Rules are seventy-three articles identifying the international law applicable to the management of all types of watercourses. Although not legally binding, the Berlin Rules focus on the human right to water and how to responsibly manage these depleting resources.⁶⁸ Responsible management focuses on recognizing the need for public information,⁶⁹ equitable cooperation between states,⁷⁰ and identified preferences on how to use water resources.⁷¹ Although the ILA sources create a clear framework for utilization and management of transboundary aquifers, there are no enforcement mechanisms to compel states to comply with the Helsinki, Seoul, or Berlin Rules.

C. Convention on Non-navigational Uses of International Watercourses

In 1970, the International Law Commission (“ILC”), a subsidiary body of the U.N. General Assembly,⁷² was given the task of codifying customary law regarding international watercourses.⁷³ The ILC drew on many of the principles laid out in the Helsinki and Seoul Rules to ultimately develop the Convention on the Law of Non-navigational Uses of International Watercourse (Watercourse Convention), which the U.N. General Assembly formally adopted in 1997.⁷⁴

Similar to the Helsinki Rules, the Watercourse Convention explicitly recommends the use of a “joint management mechanism” to sustainably develop and promote the optimal utilization of shared watercourses.⁷⁵ However, there was a deliberate move among countries not to include non-rechargeable aquifers from the Watercourse Convention due to the lack of scientific research and information regarding these unique

67. See ILA, Berlin Conference, *Water Resources Law*, Fourth Rep. of the Water Resources Committee (2004) [hereinafter Berlin Rules].

68. See *id.* arts. 10–17.

69. *Id.* arts. 18–19.

70. *Id.* arts. 10–12.

71. *Id.* arts. 12–15.

72. See G.A. Res. 174 (II) (Nov. 21, 1947) (statute of the International Law Commission).

73. G.A. Res. 2669 (XXV) (Dec. 8, 1970).

74. See generally Watercourse Convention, *supra* note 53.

75. *Id.* art. 24.

resources.⁷⁶ The Convention remains relevant to non-rechargeable aquifer governance, however, because it reinforces the principles of cooperation,⁷⁷ equitable utilization,⁷⁸ and the obligation not to cause significant harm⁷⁹ as central to utilizing shared resources.

D. Draft Articles on Transboundary Aquifers

After six years of extensive research on groundwater resources, the conversation regarding non-rechargeable aquifers had another chance for recognition when the ILC proposed the Draft Articles on Transboundary Aquifers (TBA Articles) in 2008.⁸⁰ Significantly, these rules set out many of the same policies reflected in the ILA Rules and Watercourse Convention.⁸¹ However, the TBA Articles also do not explicitly address non-rechargeable aquifers.

The TBA Articles expand the ideas of sovereignty and water management for transboundary aquifers in two major ways. First, Article 3 specifically recognizes a state's sovereign right to the portion of a shared resource within that state's territory.⁸² Article 3 embodies the inherent conflict between a state's sovereign right and the exercise of that right, because Article 3 notes the "exercise of sovereignty" shall be "in accordance with international law."⁸³ In other words, a state has a sovereign right to the resources in its own territory, but that right is limited by other principles of international law.⁸⁴

Second, there is a notable expansion in the explicit endorsement of bilateral and regional institutions to manage these types of unique

76. See Int'l Law Comm'n, Rep. on the Work of its Forty-Sixth Session, ¶¶ 6, 15, 17, and 43, U.N. Doc. A/CN.4/SER.A/1994/Add.1 (Part 2) (Nov. 29, 1994); Int'l Law Comm'n, Resolution on Confined Transboundary Groundwater, 135, U.N. Doc. A/CN.4/459 (Apr. 4, 1994).

77. Watercourse Convention, *supra* note 53, art. 8.

78. *Id.* arts. 5–6.

79. *Id.* art. 7.

80. See TBA Articles, *supra* note 24.

81. *Id.*

82. *Id.* art. 3 (the first article to mention sovereignty in regards to shared water resources).

83. *Id.*

84. See generally David D. Brooks, Prioritizing "No Significant Harm" over "Reasonable and Equitable" in Governance of Aquifers, Int'l Inst. for Sustainable Dev. Commentary (Mar. 2015).

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resources.⁸⁵ Although international co-operation is a distinct principle in international law,⁸⁶ the Articles directly recommend aquifer states create regional institutions and joint management mechanisms to facilitate the exchange of information pertaining to aquifers they share and to effectively govern them.⁸⁷ This shift towards regional agreements helped to create the platform for the Nubian Sandstone Aquifer States to create a working and effective multilateral agreement.

The U.N. General Assembly's 2013 Resolution regarding the future of the TBA Articles indicates the current trend toward a more concrete law regarding transboundary aquifers.⁸⁸ The 2013 Resolution specifically referenced two regional agreements that had incorporated the TBA Articles into their management framework: the Guarani Aquifer Agreement between Argentina, Brazil, Paraguay, and Uruguay, as well as the Model Provision on Transboundary Groundwater adopted by the members of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes.⁸⁹ The 2013 Resolution also "commends to the attention of Governments" that the TBA Articles should be guidance for proper management techniques for future bilateral and regional instruments.⁹⁰

Although international water law regarding non-rechargeable aquifers still has a long journey towards codification, at minimum these various sources created a platform for states to enter into multilateral agreements.⁹¹ Indeed, the ILC's in-depth study on groundwater and other international watercourses facilitated the Nubian Aquifer's SAP. More importantly, the push towards regional agreements in place of a universal framework has allowed Chad, Libya, Sudan, and Egypt to implement a system that is tailored specifically to the unique characteristics of the Nubian Aquifer and the region.

85. Watercourse Convention, *supra* note 53, arts. 8 and 9.

86. U.N. Charter, arts. 1 and 2. *See, e.g.,* Kasikili/Sedudu Island (Bots. v. Namib.), Judgment, 1999 I.C.J. 1045 (Dec. 13).

87. Watercourse Convention, *supra* note 53, arts. 8 and 9.

88. *See generally* G.A. Res. 68/118 (Dec. 16, 2013) [hereinafter 2013 Resolution]; *see also* A. Dan Tarlock, *Toward a More Robust International Water Law of Cooperation to Address Droughts and Ecosystem Conservation*, 28 GEO. ENVTL. L. REV. 261, 271 (2016).

89. G.A. Res. 68/118, *supra* note 88, ¶ 1.

90. *Id.*

91. Tarlock, *supra* note 88, at 271.

This examination of international law shows the need for regional frameworks like SAP.⁹² Although the Nubian Aquifer's SAP has created institutions to utilize and manage the water in the aquifer, these institutions do not fully resolve the conflict between each aquifer state's sovereign right to utilize the Nubian Aquifer and the obligations each state owes to each other.

V. CURRENT STRATEGIC ACTION PROGRAMME BETWEEN THE NUBIAN AQUIFER STATES

On September 18, 2013, SAP was established to address the Nubian Aquifer's main concerns.⁹³ The main driving force behind SAP was information: the member states recognized the importance of and need for a better understanding of the Nubian Aquifer and its potential use to the four Aquifer States.⁹⁴ Utilizing the Nubian Aquifer raises three key transboundary issues: (1) declining water levels related to exploitation; (2) damage to the region's ecosystem and biodiversity; and, (3) pollution.⁹⁵ Although SAP has various important parts, this section will focus on two of the most important institutional mechanisms the agreement created in attempts to address these issues: the administrative body (Joint Authority) and the information center (NARIS). The reason for this focus is to highlight the conflict between state sovereignty and international tensions arising from over-exploitation of shared resources.

A. Joint Authority

One of the most notable mechanisms created to manage the Nubian Aquifer is the Joint Authority, an agreement between Chad, Libya, Sudan, and Egypt to study and develop the Nubian Aquifer. Libya and Egypt first created the Joint Authority in 1989,⁹⁶ with Sudan joining in

92. See Carlson, *supra* note 59, at 1422.

93. Regional Strategic Action Programme for the Nubian Aquifer System, Sept. 18, 2013, <http://iwlearn.net/resources/documents/11743> [hereinafter Regional Strategic Programme].

94. *Id.* at ix. These main concerns were identified and prepared by all four countries and recorded in the Shared Aquifer Diagnostic Analysis. *Id.*

95. *Id.* at x.

96. *Id.* at 16.

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1997,⁹⁷ and Chad in 1999.⁹⁸ Chad's entrance led to a revitalization of the Joint Authority, and acted as a catalyst to create a regional strategy to efficiently manage the Nubian Aquifer.⁹⁹ With all four Aquifer States agreeing to the "Constitution of the Joint Authority for the Study and Development of the Nubian Sandstone Aquifer Waters" (the Constitution), the Joint Authority was able to expand its scope and authority.¹⁰⁰

The Joint Authority is responsible for major advances in regional cooperation between the Aquifer States and their understanding of the importance of the Nubian Aquifer.¹⁰¹ The Joint Authority is a major influence on the Nubian Aquifer because SAP's framework gives the Joint Authority the ability to regulate state sovereignty to a certain extent. Thus, it is important to look at the Joint Authority's Constitution to see how and to what extent the administrative body can exercise its power in relation to the four Aquifer States. The Constitution has four distinct chapters: (1) Establishment, Headquarters, Purpose and Membership; (2) Authority Management; (3) Budget, Accounts and Financial Resources; and (4) General Provisions.¹⁰² Each will be discussed in turn below.

1. Responsibilities of the Joint Authority

Chapter 1 of the Constitution consists of four articles and establishes the Joint Authority's headquarters in Tripoli, Libya, with the option for each of the member states to create additional branches in their own country.¹⁰³ Article 3 lays out the broad powers the Joint Authority may exercise, encompassing a variety of responsibilities, which can be

97. *Id.*

98. *Id.*

99. *Id.*

100. *Id.* at xvi and ix.

101. *Id.* at x.

102. Constitution of the Joint Authority for the Study and Development of the Nubian Sandstone Aquifer Waters 71, Annex 7, Nov. 22, 2004, http://www-naweb.iaea.org/napc/ih/documents/Nubian/Nubian_final_MSP_Sandstone.pdf (English version) [hereinafter Joint Authority Constitution].

103. *Id.* art. 2.

divided into three categories: scientific; dissemination and training; and, management policies.¹⁰⁴

The scientific responsibilities are to initiate studies to collect information on the Aquifer and environmental aspects of the region, including how to control desertification in the four countries.¹⁰⁵ This obligation gives the Joint Authority the ability to gather the data necessary to responsibly utilize the resource without obstruction from any Aquifer State.¹⁰⁶ Moreover, these scientific powers have made the Joint Authority an expert on the Aquifer, ensuring the Aquifer is properly utilized under a cohesive management plan.

The Joint Authority is also responsible for disseminating this information and training the relevant authorities of member states.¹⁰⁷ To accomplish this, the Joint Authority organizes symposiums¹⁰⁸ to facilitate cooperation and train member states when they choose to engage in any domestic activities that will affect the Nubian Aquifer.¹⁰⁹ Specifically, the Joint Authority works with the Research Institute for Groundwater in Egypt; the General Water Authority in Libya; the Non-Nile Waters Directorate in Sudan; and, the Directorate de l'Hudraulique, le Ministère de l'Environnement et de l'Eau in Chad.¹¹⁰ Each of these act as national focal points to implement the Joint Authority's policies.¹¹¹

Arguably the most important power of the Joint Authority is its management responsibility, which empowers it to create common policies intended to utilize, develop, and ration the Nubian Aquifer's water among the member states.¹¹² It is in this context that the Joint

104. See *id.* art. 3; Regional Strategic Programme, *supra* note 93, at 16.

105. Joint Authority Constitution, *supra* note 102, arts. 2 and 3, ¶ 1.

106. *Id.*

107. *Id.* art. 3 ¶ 5.

108. *Id.* art. 3 ¶ 8.

109. *Id.* art. 3 ¶ 5.

110. Formulation of an Action Programme for the Integrated Management of the Shared Nubian Aquifer, UNDP/IAEA, 4-5 (Nov. 22, 2004).

111. *Id.*

112. *Id.* art. 3 ¶ 3; see also Press Release, International Atomic Energy Agency (IAEA), Four African Nations Agree to Water Management Programme, Joint IAEA/UNDP-GEF Press Release 2013/12 (Sept. 18, 2013) [hereinafter 2013 Press Release].

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Authority considers and adopts the scientific information it has gathered as a basis for proper water management for the entire region.¹¹³

2. *Structural Organization of the Joint Authority*

The Joint Authority's management structure allows all four Aquifer States to fully participate in making decisions and fulfilling responsibilities. The Joint Authority is managed by a board of directors, which consists of three directors from each state.¹¹⁴ The relevant ministries in each state appoint three directors at their discretion.¹¹⁵ Every year, each state takes a turn appointing a new chair to the board of directors.¹¹⁶ The chair acts on behalf of the Joint Authority and represents the Joint Authority in its interactions with other states and non-state actors.¹¹⁷ The chair can also invite representatives of international organizations, donor states, and institutions to attend the board meetings as observers.¹¹⁸ A quorum of two thirds of the members is required to be considered a valid board meeting.¹¹⁹ However, if a quorum cannot be reached, the second called board meeting will be "valid if attended by *any* number of members."¹²⁰

The board of directors has jurisdiction and control over the policies, finances, and organizational structure of the Joint Authority;¹²¹ and, the board must approve most of these actions through a majority vote.¹²² However, issues regarding the Joint Authority's budget, relationships with regional and international organizations, and opening of new offices or accepting new members require a two-third majority.¹²³

Finally, the board of directors has two other major tools to implement the board's decisions regarding the use of the Nubian Aquifer. First, the board of directors directly nominates an executive

113. Joint Authority Constitution, *supra* note 102, art. 3 ¶ 4.

114. *Id.* art. 5.

115. *Id.*

116. *Id.* art. 6; *see also* Regional Strategic Programme, *supra* note 93, at 17.

117. Joint Authority Constitution, *supra* note 102, art. 11.

118. *Id.* art. 9.

119. *Id.* art. 8.

120. *Id.*

121. Regional Strategic Programme, *supra* note 93, at 18.

122. Joint Authority Constitution, *supra* note 102, art. 8.

123. *Id.*

general director for a period of three years.¹²⁴ The executive general director has the power to execute the recommendations and resolutions adopted by the board of directors.¹²⁵ Second, the Constitution provides for an administrative body for the Joint Authority to execute the recommendations and resolutions of the board of directors.¹²⁶

3. *Funding of the Joint Authority's Policies*

The Joint Authority is primarily funded through member state contributions based on their share of the Nubian Aquifer.¹²⁷ Although this is the general way the Joint Authority is funded, the Joint Authority also accepts “donations from national and international institutions and organizations and donor countries.”¹²⁸ This gives the Joint Authority the power to receive funds from organizations like UNESCO, the World Bank, and other international and national bodies who want to support sustainable development.

All the funds are transferred to a bank operating in Libya, the Joint Authority's seat country.¹²⁹ The Joint Authority's board of directors creates a budget every fiscal year.¹³⁰ The budget is then submitted to the governments of the member states three months before the beginning of the next fiscal year.¹³¹ Once approved, the Joint Authority is only allowed to pursue expenditures directly approved by the board of directors.¹³² The Joint Authority is also given the ability to enter into financial obligations beyond the annual budget if the value of the obligations will not exceed the total allocated costs.¹³³

124. *Id.* art. 13.

125. *Id.*

126. *Id.* art. 14.

127. *Id.* art. 16.

128. *Id.* art. 21.

129. *Id.* art. 19.

130. *Id.* art. 17.

131. *Id.*

132. *Id.* art. 20.

133. *Id.* arts. 20–22.

4. Other General Provisions

The last chapter of the Constitution officially enacts the by-laws and gives the board of directors the ability to adopt amendments, if necessary, by a two-thirds vote of the board of directors.¹³⁴ The chapter also reinforces the rights of the board of directors to create internal by-laws and administrative and financial regulations “without being bound” by the regulations in current member countries.¹³⁵ Finally, this chapter looks to the Arab States League for initial financial and administrative regulations until the Joint Authority can create a detailed one of its own.¹³⁶

B. Nubian Aquifer Regional Information System (NARIS)

The Joint Authority requires relevant and up to date information to make informed decisions. NARIS was initially hard to implement because of a lack of funding.¹³⁷ However, after the revitalization of the Joint Authority, NARIS is now an integral part of both national and regional cooperation.¹³⁸ NARIS is responsible for researching, gathering, and consolidating data regarding any information related to the Nubian Aquifer.¹³⁹ NARIS works with each state, individually and collectively, to implement SAP and record any other concerns or information on a state’s development.¹⁴⁰

SAP’s success is partially due to NARIS having the necessary information to work with both the Aquifer States and international organizations to implement and develop this strategic framework. However, the task to fully understand the world’s largest fossil aquifer

134. *Id.* art. 24–26.

135. *Id.* art. 24.

136. *Id.* art. 25.

137. Center for Environment and Development for the Arab Region and Europe [CEDARE], *Nubian Sandstone Aquifer System (NSAS) M&E Rapid Assessment Report*, 4 (May 2013), <http://www.cedare.int/namcow/attachments/article/218/Nubian%20Sandstone%20Aquifer%20System%20NSAS%20Monitoring%20and%20Evaluation%20Rapid%20Assess~.pdf> [hereinafter M&E Report].

138. *See* Regional Strategic Programme, *supra* note 93, at 16.

139. *Id.* at x.

140. *Id.*

is difficult; there is still a “lack of area-wide data concerning various “geological structures, hydraulic parameters”, and other information.¹⁴¹

NARIS is dedicated solely to collecting and analyzing data to create a better understanding of the Nubian Aquifer’s specific logistics and its role in the surrounding community.¹⁴² NARIS has helped Aquifer States understand the impact of their actions on the region’s water level and quality. This informational system has also created uniformity and transparent information that is easily accessible to member states and other stakeholders.¹⁴³

Another important function of NARIS is its ability to continuously exchange information between member states. One of the main agreements in SAP is to monitor and exchange information exclusively through NARIS.¹⁴⁴ The agreement also required NARIS to set up the information on a server that is accessible through the Internet.¹⁴⁵ NARIS’s user-friendly interface allows uniform and transparent information to flow continuously between member states.¹⁴⁶

Currently, the Joint Authority has commissioned specialists to enhance the web-based information system.¹⁴⁷ The Joint Authority requires the most current information to create tailored policies maximizing the benefits of the Nubian Aquifer and minimizing the potential harm to each respective state. Thus, NARIS is an essential tool for the Joint Authority to update its current informational system.

C. Potential Threats to the Nubian’s Strategic Action Programme

The Nubian Aquifer is found in four developing states that are plagued with increasing demographic pressures, severe droughts, and political instability.¹⁴⁸ This section will examine the two biggest threats to the future of SAP within the region: each state’s disproportional needs

141. M&E Report, *supra* note 137, at 44.

142. *Id.* at 4.

143. *Id.* at 44.

144. *Id.*

145. *Id.* at 41.

146. *Id.*

147. *Id.* at 42.

148. See Nicholas Maxwell, Note, *The Nubian Sandstone Aquifer System: Thoughts on a Multilateral Treaty in Light of the 2008 UN Resolution on the Law of Transboundary Aquifers*, 46 TEX. INT’L L.J. 379 (2011).

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and the current political instability in the region. These threats are also common among other developing countries that share access to transboundary aquifers.¹⁴⁹

1. Disproportional Use Among the Sharing States

Although the Nubian Aquifer framework has been able to create a strong administrative body based on information and real authority, it does not fully resolve the discrepancy between territorial sovereignty and reasonable utilization of shared resources. One of the main threats to the Nubian Aquifer is over-exploitation because all four states have severely limited access to water.¹⁵⁰ The Nubian Aquifer has been “actively pumped” since the 1960’s to supply Libya with irrigation and other water supplies.¹⁵¹ Recently, over-extraction has already begun to affect certain recharge zones.¹⁵² All four countries disproportionately rely on the Nubian Aquifer for a variety of reasons. Additionally, the region’s drinking and agriculture water demands could double within the next 50-100 years.¹⁵³ Therefore, it is important to create an apportionment system that is fair and sustainable.

Several physical factors are needed to formulate an apportionment system between the four states: “population, percentage of land overlying the aquifer, and percentage of total volume under the land of the aquifer.”¹⁵⁴ The current factors for all four states break down as follows:

- Chad – 12.8 million (population), 11% (land coverage), and 12.8% (aquifer water)¹⁵⁵
- Sudan – 38 million (population), 17% (land coverage), and 9% (aquifer water)¹⁵⁶

149. See QUEVAUVILLER, *supra* note 16, at 13.

150. See IAEA Water Resources Programme, *Transboundary Aquifers and River Basins: Nubian Sandstone Aquifer System* (2011).

151. *Id.*

152. *Id.*

153. *Id.*

154. Ryan Carl Dolezal, *The Nubian Sandstone Aquifer Dispute*, 7 PANGAEA J. 3 (2016), sites.stedwards.edu/pangaea/the-nubian-sandstone-aquifer-dispute/.

155. *Id.*

156. *Id.*

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- Libya – 6.2 million (population), 34% (land coverage), and 36.6% (aquifer water)¹⁵⁷
- Egypt – 82 million (population), 38% (land coverage), and 41.5% (aquifer water)¹⁵⁸

Another important factor to consider when determining apportionment is the need and dependency each of the Aquifer States has on the aquifer. Currently, Libya depends the most on the Nubian Aquifer, relying on groundwater for nearly 95% of Libya's water needs.¹⁵⁹ As a result, Libya created a four-thousand-kilometer subterranean pipeline to directly tap into the Nubian Aquifer.¹⁶⁰ Egypt relies on the Nubian Aquifer the least, relying on only 7% for agricultural needs.¹⁶¹

Sudan has the second highest population of the four Aquifer States and has the economic ability to begin relying on the Nubian Aquifer.¹⁶² Sudan currently relies on the Nile Nubian Aquifer to meet most of Sudan's water demand.¹⁶³ However, if the Sudanese government's access to the Nile is threatened,¹⁶⁴ the government will surely look into tapping into the Nubian Aquifer. Thus, Sudan is in a unique position because Sudan arguably has the most to gain from utilizing the Aquifer.¹⁶⁵

On the other end of the spectrum, Chad is the least likely and able to utilize the Nubian Aquifer. Most of Chad's population is concentrated in the southern half of the country, a region with consistent rainfall and vegetation.¹⁶⁶ The problem is the Nubian Aquifer is located in the

157. *Id.*

158. *Id.*

159. *Id.* at 4.

160. Ngosa Howard Mpamba, *Transboundary Water Management in the Zambezi and Congo River Basins: A Situation Analysis*, in *FREE FLOW: REACHING WATER SECURITY THROUGH COOPERATION* 92 (UNESCO 2013) (also known as the Great Man-made River).

161. Dolezal, *supra* note 154, at 4.

162. *Id.* at 6.

163. *Id.*

164. There is a current dispute over a dam project in Ethiopia that will affect both Egypt and Sudan. For a full article on the dispute see, Sticklor, *supra* note 37.

165. Dolezal, *supra* note 154, at 6.

166. *Id.* at 5

northern part of Chad, and the state is not economically able to build the infrastructure necessary to fully utilize the Nubian Aquifer.¹⁶⁷

All four states currently use the Nubian Aquifer disproportionately; thus, future apportionment should be based on the reasonable needs of each of the Aquifer States. SAP recognizes the importance of the Nubian Aquifer in the region and has created a framework towards maximizing the long-term benefits of this natural resource. SAP has the potential to overcome inequitable uses of the Nubian Aquifer because the Joint Authority has the ability to directly govern each states' access to this vital resource.

2. Political Threats Within the Region

Regional frameworks, including SAP, can only thrive if all member states are active and able to provide funding and support. However, for a state to allocate resources properly, sufficient economic resources and political stability is necessary. Unfortunately, Chad, Sudan, Egypt, and Libya have faced political instability for many generations.¹⁶⁸ Major threats to the political framework include the 2011 Arab Spring protests that “radically reshaped the region’s political and security environment.”¹⁶⁹ Currently, the biggest political threat to the Nubian Aquifer is the unrest in Libya.¹⁷⁰ When the member states reconvened in the spring of 2015 to renew their pledge to the SAP framework, Libya was not present.¹⁷¹ For the purposes of this article, a brief overview of the current political chaos that has threatened Libya’s stability will be helpful.

Libya’s use of the Nubian Aquifer is based on the former President of Libya’s, Muammar Gaddafi, water pipeline, the Great Man-Made River (“GMMR”). This project lasted over thirty years, transports over six million cubic meters of water every day over 600 miles, and costed

167. *Id.*

168. *See generally* Daveed Gartenstein-Ross, et al., *The Crisis in North Africa*, Netherlands Institute of International Relations, Clingendael Report (April 2015), <http://www.clingendael.nl/sites/default/files/The%20crisis%20in%20North%20Africa%20report%202015.pdf>.

169. *Id.*; *see also* M&E Report, *supra* note 137, at 45.

170. *See generally* Sticklor, *supra* note 37.

171. *Id.*

Libya 27 billion dollars.¹⁷² However, in 2011, Gaddafi's reign violently ended, and political unrest began.¹⁷³ Libyan militants, affiliated with the Islamic State, have made large territorial gains across Libya, and now have control of the infrastructure along the GMMR.¹⁷⁴ Control over the GMMR is extremely consequential because it is the only resource that links much of the "endless sparsely populated and little-secured desert terrain."¹⁷⁵

In May 2016, the United States Institute of Peace issued a report on the United States's work in Libya.¹⁷⁶ The report explained the current situation in Libya as a "spiral of deteriorating security, economic crisis, and political deadlock."¹⁷⁷ Libya's commitment to the Nubian Aquifer is directly reliant on the state's ability to maintain social and political stability. Although Libya is currently away from the management table, there are positive signs that Libya will continue its relationship with the other Aquifer States in the future.

Libya's problems particularly affect the Joint Authority because Libya is unable to participate in board meetings, and both the Joint Authority's headquarters and bank are located in Libya. However, the Joint Authority's framework allows for board meetings to continue, even if Libya is unable to attend.¹⁷⁸ Moreover, the other three member states have created national institutions that can both host future board meetings and deposit future finances.¹⁷⁹

VI. POTENTIAL FRAMEWORK FOR OTHER NON-RECHARGEABLE AQUIFERS

An examination of the Nubian Aquifer's SAP framework and other international sources reveal three institutions key to any successful transboundary aquifer framework: (1) a strong administrative body with actual authority over member states; (2) an informational center to

172. Maxwell, *supra* note 148, at 381.

173. *See generally* Sticklor, *supra* note 37.

174. *Id.*

175. *Id.*

176. UNITED STATES INSTITUTE OF PEACE (USIP), USIP'S WORK IN LIBYA (May 2016), http://www.usip.org/sites/default/files/The-Current-Situation-in-Libya_1.pdf.

177. *Id.*

178. Joint Authority Constitution, *supra* note 102, art. 8.

179. *Id.* art. 2.

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strengthen the understanding of the transboundary aquifer; and (3) an apportionment system based on relevant geographic, political, and economic factors. This section will describe the structure and benefits derived from each proposed institution.

A. *Strong Administrative Body*

Any future management framework must include an administrative body similar to the Nubian Aquifer's Joint Authority. Administrative institutions are important because they promote iteration within the community.¹⁸⁰ All member states would be more inclined to look toward the long-term benefits of a successful relationship.¹⁸¹ A strong administrative institution makes it less likely that states will defect from their obligations, and makes states more likely to accept responsibility for violations and less likely to defect from obligations.¹⁸²

Despite the numerous threats to the Nubian Aquifer, the Joint Authority's scope and organizational structure allows for a huge influence on each individual member state and the shared resource in general.¹⁸³ The scope of a transboundary aquifer's administrative body must be strong enough to make more than mere recommendations. Like the Joint Authority's scope, any administrative body should be given a large amount of deference to pursue and implement its decisions. An administrative body should also identify three different responsibilities within its scope: scientific, management policies, and training and dissemination.

This three-pronged approach strengthens the institutions for a variety of reasons. First, the administrative body will have the authority to inspect, gather, and collect all scientific information regarding the aquifer and the aquifer's role in the surrounding environment. Second, the institution will be able to implement knowledge and information to develop sound programs, plans, and policies to most efficiently utilize the aquifer. Third, an administrative body will help train and educate each member state on the importance and vulnerabilities of the aquifer. Thus, the three-pronged approach allows an administrative body to be

180. Aceves, *supra* note 30, at 242.

181. *Id.*

182. *Id.* at 245-46.

183. *See generally* 2013 Press Release, *supra* note 112.

equipped with the tools necessary to manage both sharing states and the shared resource.

The organizational structure of potential administrative bodies should also reflect the Joint Authority's current scheme. There are two essential parts to any proposed administrative body: a board of directors and a chair to the board. First, the board of directors should be equally represented by each member state and have jurisdiction over the administrative body's policies, finances, effective control, and organizational structure. All board decisions should be adopted by at least a majority vote. Special issues like formalizing relationships with regional and international organizations or new member states should require a two-thirds vote. This structure will allow every member state to have an equal say in the decision-making process and encourage cooperation to pass decisions.

Another important position is the chair of the board of director. The chair will oversee the board of directors and act as the main voice of the administrative body. Some of the chair's responsibilities should include: interacting with international organization, states, and other institutions; formally inviting organizations and states to attend board meetings; and representing the administrative body to outside actors. Currently, the Joint Authority appoints a new chair every year, and every year a different state is responsible for filling this role.¹⁸⁴ The chair creates a face for the administrative body, which can act as a strategic focal point to gain funding from international organizations. Moreover, each state is given the responsibility to be in charge of the board. Also, the member states will be more inclined to support the strength of the board's decisions and become intimately involved with the administrative body.

Any future management framework should include an administrative body with the authority to gather information, implement policy, and train member states. The administrative body must also reflect an organizational scheme that creates a neutral environment for each member to voice concerns.

184. Joint Authority's Constitution, *supra* note 102, art. 6; *see also* Regional Strategic Programme, *supra* note 93, at 17.

B. Transparent Informational System

As previously mentioned, an administrative body is only as successful as the information it is able to obtain. “Information is a scarce and valued commodity” in international relations.¹⁸⁵ The international community has recognized that scientific research regarding transboundary aquifers, especially large ones, is extremely difficult to acquire because of the lack of financial resources.¹⁸⁶ The technology to obtain information about transboundary aquifers is available, however, the finances to implement the technology are not. Functional institutions can help reduce costs and mitigate the burden of any single state.

Although a lack of finances is a natural roadblock for most developing countries, it is not a complete hindrance. In fact, many institutions are known to reduce costs to member states in the long run.¹⁸⁷ Without an informational institution, each state would be responsible for obtaining and gathering data regarding the aquifer. However, if each state contributes that money to a long-term informational institution, it will be less expensive than having to create and sustain a system individually. Additionally, a system with up-to-date and uniform information will make co-operation with member states as well as outside actors easier.

The Nubian Aquifer’s informational system, NARIS, has been recognized as a crucial component to the Nubian Aquifer’s future.¹⁸⁸ Similarly, any potential framework will not only have to recognize the importance of continuous information, but also establish a system for the information to be easily accessed and updated. Similar to NARIS and other international treaties, each state will be required to exchange information with the informational institution and other member states. This type of informational institution also allows the administrative body to monitor each state’s use of the aquifer. Additionally, each state would

185. Aceves, *supra* note 30, at 250.

186. See David N. Cassuto & Romulo S.R. Sampaio, *Hard, Soft & Uncertain: The Guarani Aquifer and the Challenges of Transboundary Groundwater*, 24 COLO. J. INT’L EVTL. L. & POL’Y 1 (2013) (discussing the current problems regarding setting up multi-lateral water management framework).

187. Aceves, *supra* note 30, at 244.

188. See 2013 Press Release, *supra* note 112.

be immediately put on notice when there is over-exploitation, pollution, or other threats to the shared resource.¹⁸⁹

At minimum, developing countries can begin to track the current information they do have about the shared resource. An informational system with transparency and authority to gather information will reduce costs for the member states and will be an effective tool to monitor any potential threats to the aquifer.

C. System to Determine Reasonable and Equitable Use

One major threat to all transboundary aquifers is the threat of over-exploitation.¹⁹⁰ Non-rechargeable aquifers are particularly susceptible to over-exploitation because once tapped into, they permanently lower the amount of water in the region.¹⁹¹ With an increase in demand for water around the world, it is apparent these resources will continue to be exploited. However, with a lack of information and universal need for water, rigid rules regarding apportionment of any watercourse can be problematic.

Although the Joint Authority has the ability to implement policy and ration member states' use of the Nubian Aquifer, there is no clear delineation of the water resource among the four member states. Future management frameworks should have factors embedded in the administrative body to determine if each state's use is equitable and reasonable.

The TBA Articles identify several factors to help determine whether a state's utilization of an aquifer is equitable and reasonable.¹⁹² An apportionment system's main focus is to make sure each state's utilization is maximizing the benefits of the aquifer and minimizing any foreseeable harm. However, factors relevant specifically to non-rechargeable aquifers can be further divided into four categories: (1) each state's social, economic, and other needs;¹⁹³ (2) natural characteristics of the aquifer;¹⁹⁴ (3) the aquifer's role in the affected

189. QUEVAUVILLER, *supra* note 16, at 13.

190. *Id.*

191. *Conceptual Models for Transboundary Aquifers*, *supra* note 18, at 685.

192. TBA Articles, *supra* note 24, art. 5.

193. *Id.* art. 5(a)-(b).

194. *Id.* art. 5(c)-(d).

states;¹⁹⁵ and (4) the ability to develop, protect, and conserve the aquifer.¹⁹⁶

An apportionment institution is necessary because the risk of over-exploitation is too great, especially in dry, arid states. An institution that monitors and establishes proper usage of the aquifer will ensure that any threats to the aquifer are traced back to the responsible parties. State discussion of how the several factors are applied to each member state will force states to determine and better understand their respective rights and obligations regarding the shared resource.¹⁹⁷

The first factor is important to consider because the social and economic demographics of each state directly affect the state's use of the aquifer. Developing countries will likely not have economically viable options available to provide water in other ways. Whereas more industrialized countries, with more economic resources, are in a much better position to protect and preserve the aquifer; however, this should not be the only determining factor. The second factor considers the scientific information about the natural characteristics of the aquifer, which includes geographic features, recharge rates, recharge zones, and other related data.

The third and fourth factors consider the aquifer states collectively. The third factor looks at the aquifer's role in the surrounding area because non-rechargeable aquifers have the ability to permanently reduce the water table in an entire region. The fourth factor considers the entire region's ability to develop, protect, and conserve the aquifer. This factor will look different in arid regions that have little to no water access. States in these arid regions will be forced to balance satisfying humans basic rights and preserving the aquifer for a future generations.¹⁹⁸ Thus, an apportionment system that recognizes an aquifer's ability to provide basic human needs has the utmost importance.

195. *Id.* art. 5(i).

196. *See id.* art. 5(f), 5(g), 5(h).

197. *See* Aceves, *supra* note 30, at 247.

198. *See* Russel Frink, Comment, *Preserving Trans-Boundary Aquifers: A Precious Resource for Our Future Generation*, 26 PAC. MCGEORGE GLOBAL BUS. & DEV. L. J. 503, 508-524 (2013); *See e.g.*, Berlin Rules, *supra* note 67, art. 14; TBA Articles, *supra* note 24, art. 5(2); Watercourse Convention, *supra* note 53, art. 10(2).

D. Current Transboundary Aquifers in Danger

Various transboundary aquifers still lack any management framework, and several aquifers are in extreme danger of over-exploitation.¹⁹⁹ This article's proposed framework can be a stepping-stone to successfully managing any aquifer currently in danger. Below is a list of transboundary aquifers that could apply this framework:

- Arabian Aquifer System (Saudi Arabia, Bahrain, Iraq, Jordan, Kuwait, Oman, Qatar, Syria, UAE, Yemen);²⁰⁰
- Indus Basin (India, Pakistan, China, Afghanistan);²⁰¹
- Murzuk-Djado Basin (Libya, Chad, Niger);²⁰²
- Ganges-Brahmaputra Basin (India, China, Nepal, Bangladesh, Bhutan);²⁰³ and
- Northwest Saharan Aquifer System (Algeria, Libya, Tunisia).²⁰⁴

All of these transboundary aquifers do not have any management framework outlining efficient utilization of vital resources. Currently, many Arab states are in negotiations to adopt a "Framework Convention on Shared Water Resources between Arab States" to address many of the threats to aquifers.²⁰⁵ The aquifer states mentioned above can look to the Nubian Aquifer's framework as a hopeful example to implement a proposed management framework. Most aquifer states are developing countries and primarily use the water from these aquifers for agricultural needs.²⁰⁶ An institutional approach, based on the three institutions mentioned above, will allow developing states to start looking at how their actions directly affect the aquifer system and the surrounding states.

Future aquifer frameworks can build on the knowledge already collected by international organizations and use the Nubian Aquifer's

199. *CEO Briefing: Global Depletion of Aquifers*, EARTH SECURITY GROUP [ESG] (2016), <http://earthsecuritygroup.com/wp-content/uploads/2016/06/ESG-Brief-Aquifers.pdf> (the article gives a detailed analysis of the threats to the top ten most vulnerable aquifers in the world).

200. *Id.* at 8.

201. *Id.*

202. *Id.* at 9.

203. *Id.* at 8.

204. *Id.* at 9.

205. *Id.*

206. *Id.* at 8, 9.

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SAP to create tailored institutions that take on many of the principles discussed in this article. At the very least, SAP can be used as a successful example to bring states to the negotiating table to discuss the possibility of proper management institutions collectively or independently.

VII. CONCLUSION

Although our world is facing looming problems that appear unsolvable, human society has thrived due to adaptation and innovation. Similar to the parable of the “last tree” in Easter Island, humans will continue to adapt and look for new solutions to solve the world’s problems. The supply of water will not increase, but society can still create manageable institutional frameworks that will efficiently utilize these vital resources. Institutions will not only solve current exploitation problems, but will create discussions for saving the future of mankind.

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