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Preserving Trans-Boundary Aquifers: A Precious Resource for Our Future Generations

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"Filthy water cannot be washed"—*West African Proverb*[1]

I. INTRODUCTION

Groundwater is rapidly becoming a vital resource for human societies.[2] Though ancient cultures tapped subterranean water reserves, modern pumping technology has allowed groundwater exploitation to increase "exponentially in scale and intensity over recent decades."[3] This rapid increase in groundwater reliance is best illustrated by the fact that wells supply one-fifth of all water users on the globe,[4] providing irrigation for thirty-seven percent of agricultural lands.[5] Though widespread reliance on groundwater has allowed for population expansions and increased agricultural productivity, overuse and contamination has caused shortages, which threaten water supplies for entire regions.[6]

Many nations rely heavily on groundwater to meet their water needs.[7] Because groundwater can be vulnerable to depletion and contamination,[8] these nations must ensure its continued viability to guarantee that future generations will inherit a habitable homeland. This obligation stems from the reality that water is vital to life and that future societies have an inchoate right to life-sustaining natural resources.[9] Unfortunately, because the vast majority of groundwater use is not actively monitored, there is no oversight to prevent overuse or contamination.[10] This lack of oversight has progressed to the extent that at least twenty percent of groundwater consumed globally is pumped from unsustainable sources.[11]

1. *Filthy Water Cannot Be Washed*, GHANA HEALTH AND EDUCATION INITIATIVE (May 18, 2012), *available at* http://gheinews.blogspot.com/2012/05/filthy-water-cannot-be-washed-west.html.

2. Tushaar Shah et al., *Groundwater: A Global Assessment of Scale and Significance*, *in* WATER FOR FOOD, WATER FOR LIFE 395, 398 (David Molden ed., 2007), *available at* http://www.iwmi.cgiar.org/assessment/Water%20for%20Food%20Water%20for%20Life/Chapters/Chapter%2010%20Groundwater.pdf.

3. *Id.* at 395.

4. GROUNDWATER RESOURCES OF THE WORLD AND THEIR USES 21 (Igor S. Zektser & Lorne G. Everett eds., 2004), *available at* http://unesdoc.unesco.org/images/0013/001344/134433e.pdf.

5. S. Siebert et al., *Groundwater Use for Irrigation—A Global Inventory*, 14 HYDROL. EARTH SYST. SCI. 1863, 1864 (2010), *available at* http://www.fao.org/docrep/013/al816e/al816e00.pdf.

6. *See infra* Part I-II.

7. Some countries rely heavily on groundwater, like Germany, and Morrocco, who use it to fill over seventy-five percent of water needs. GROUNDWATER RESOURCES OF THE WORLD AND THEIR USES, *supra* note 4, at 6. There are exceptional places, such as Denmark, Malta, and Saudi Arabia, where groundwater meets all water demands. *Id.*

8. *See infra* Part II.B.

9. *See infra* Part IV (articulating the obligation present societies have to unborn generations).

10. *See infra* Part III.

11. Amanda Mascarelli, *Demand for Water Outstrips Supply*, NATURE (Aug. 8, 2012), http://www.nature.com/news/demand-for-water-outstrips-supply-1.11143.

In July 2012, a massive aquifer[12] named Ohangwena II was discovered in Northern Namibia as a result of a joint effort with Germany to explore Namibia's underground water reserves.[13] The groundwater is located in a sub-surface rock formation comprised of interconnected, porous pockets of rock which straddles the border between Southern Angola and Northern Namibia.[14] This groundwater find is of major importance to Namibia because twenty-three percent of childhood deaths are linked to lack of clean water[15] and demand is set to outpace supply by 2015.[16] Following the discovery, the Namibian government held an investment conference and announced plans to expand investment into water infrastructure.[17] On the other hand, Angola, a nation with ample sources of surface water,[18] has not announced plans to develop the aquifer. This lack of interest is best explained by Southern Angola's sparse population and the country's dire need to repair existing surface water infrastructure.[19] Because Namibia is the only country to announce plans to drill into Ohangwena II, this Comment will focus on Namibia's role in developing this new source of water.

Namibia does not currently have laws in place that would ensure groundwater resources are developed in a sustainable manner.[20] Furthermore, the principles of international law that would apply to govern disputes between neighboring states regarding a groundwater source fail to adequately impose prospective measures to encourage nations to prevent harmful depletion.[21] This legal vacuum perpetuates the lingering threat that either government could allow harmful chemical runoff[22] or unsustainable extractions[23] to damage the aquifer.

12. For a description of aquifers, see *infra* Part I.A.

13. Catherine Sasman, *Huge Water Discovery*, THE NAMIBIAN (July 12, 2012), http://www.namibian.com.na/index.php?id=28&tx_ttnews[tt_news]=99242&no_cache=1; Sébastien Hervieu, *The Story of Namibia's Strategic 'Blue Gold' Reserve*, THE NAMIBIAN (Sept. 19, 2012), http://www.namibian.com.na/index.php?id=28&tx_ttnews[tt_news]=101978&no_cache=1.

14. Sasman, *supra* note 13; Hervieu, *supra* note 13.

15. Jana-Mari Smith, *Red Alert on Sanitation and Safe Drinking Water,* THE NAMIBIAN (July 12, 2011), *available at* http://www.namibian.com.na/news/full-story/archive/2011/july/article/red-alert-on-sanitation-and-safe-drinking-water/.

16. *See* Irene Hoaës, *Namibia: Many Hopes Pinned on Water Investment Indaba*, ALLAFRICA (Sept. 13, 2012), http://allafrica.com/stories/201209131138.html; Alex Duval Smith, *Scientists Urge Sustainable Development of Namibia's Newly Discovered Aquifer*, THE NAMIBIAN (Aug. 8, 2012), http://www.namibian.com.na/index.php?id=28&tx_ttnews[tt_news]=100334&no_cache=1.

17. *Namibia Water Investment Conference, 12-14 September 2012, Windhoek, Namibia*, ORASECOM (Aug. 1, 2012), http://www.orasecom.org/newsevents/news/namibia+water+investment+conference+12-14+september+2012+windhoek+namibia.aspx.

18. Louise Redvers, *Water Everywhere in Angola, but Few Places to Drink*, MAIL & GUARDIAN (Mar. 14, 2011), *available at* http://mg.co.za/article/2011-03-14-water-everywhere-in-angola-but-few-places-to-drink.

19. *Id.*

20. *See infra* Part III.A.

21. *See infra* Part III.B.

22. *See infra* Part I.C.

23. *See infra* Part I.B.

As a result, there is no guarantee that the long unborn children of present-day Namibians will have an abundant source of fresh water beneath their feet.

The severe lack of water in Namibia,[24] the serious threats facing this aquifer,[25] and the absence of laws protecting trans-boundary groundwater[26] all suggest that Namibia and Angola should enter into a bilateral treaty protecting Ohangwena II for future generations. Part I of this Comment explains the physical characteristics of groundwater and describes the numerous threats facing underground freshwater resources. Part II provides the history behind the discovery, an examination of the aquifer's physical attributes, and an illustration of the social and economic importance of the find. Part III delves into the law, both international and domestic, which applies to transboundary aquifer management. Lastly, Part IV will introduce the concept of intergenerational equity and propose a framework for a bilateral treaty aimed at protecting the aquifer from overdraft and contamination. Namibia and Angola should proactively address their potential to deplete Ohangwena II by concluding a treaty, which would protect this valuable resource for future generations to come.

II. THE PHYSICAL CHARACTERISTICS OF GROUNDWATER

Of the 366 million-trillion gallons of water on this earth,[27] the UN estimates that "[thirty] percent . . . [is] stored underground in the form of groundwater . . . constitut[ing] about [ninety-seven] percent of all the freshwater that is potentially available for human use."[28] Usable quantities of groundwater occur in aquifers, areas where a well drilled beneath the water table will yield a productive supply of water.[29] Aquifers occur in a wide variety of geological conditions, and because an aquifer's physical traits define its capacity for use, it is important to distinguish different types of aquifers.[30] There are two major threats to water stored in aquifers: overuse and contamination.[31] Either can potentially render groundwater permanently unusable.[32] The following section will examine the

24. *See* MINISTRY OF AGRICULTURE, WATER & RURAL DEVELOPMENT, NATIONAL WATER POLICY WHITE PAPER: POLICY FRAMEWORK FOR EQUITABLE, EFFICIENT, AND SUSTAINABLE WATER RESOURCES MANAGEMENT AND WATER SERVICES 10 (2000), *available at* http://www.environment-namibia.net/tl_files/pdf_documents/policy/Water%20Policy.pdf [hereinafter NAMIBIA WATER POLICY WHITE PAPER].

25. *See infra* Part I.B-C.

26. *See infra* Part III.

27. Elizabeth Royte, *Strategies for a Changing Planet: Water*, POPULAR SCIENCE (July 12, 2012, 10:04 AM), *available at* http://www.popsci.com/science/article/2012-06/using-softer-approach-water-conservation.

28. *Statistics: Graphs & Maps*, UN-WATER STATISTICS, http://www.unwater.org/statistics_res.html (last visited Oct. 22, 2012).

29. Gabriel Eckstein, *A Hydrological Approach to Transboundary Ground Water Resources and International Law*, 19 AM. U. INT'L L. REV. 201, 210 (2003).

30. *See infra* Part I.A.

31. *See infra* Part I.B-C.

32. *See infra* Part I.B-C.

geological formations which collect usable quantities of groundwater and the unique threats posed to water once it is stored underground.

A. Aquifers

Aquifers are relatively permeable geological formations, which have the storage space and transmissive capacity to provide a useful water supply via wells or springs.[33] The upper limit of an aquifer is known as the water table.[34] All aquifers have an impermeable base layer made of rock or sediment, which creates a natural reservoir by preventing water from seeping down to lower layers.[35] There are two distinct types of aquifers: unconfined aquifers are exposed, while confined aquifers are bounded on the top and bottom by impermeable rock layers.[36] The main difference is that unconfined aquifers are usually recharged over most of their surface area, whereas confined aquifers are refilled only in limited recharge zones, if at all.[37] Depending upon the characteristics of the rock, any one area can have multiple aquifers at differing depths.[38]

Recharge zones are usually areas of loose sediment that allow water to seep into the geological formations where it is stored.[39] Unconfined aquifers have large recharge zones because water can find its way into the formation from areas overlying the aquifer.[40] In confined aquifer systems (like Ohangwena II), water seeps into the ground above the upper confining layer until it pools in the layer of confined sediment.[41] Confined aquifers are preferable for drinking water because they are more protected from overland contamination.[42]

Because groundwater is completely unseen and difficult to observe,[43] those attempting to manage it must use specialized methods to monitor the potential effects of pumping activities.[44] The occurrence of groundwater in a given area depends primarily on geology (the characteristics of the underlying earth),

33. Eckstein, *supra* note 29, at 210.

34. *Id.*

35. *Id.*

36. *Id.* at 210-11.

37. Debbie Sivas, *Groundwater Pollution from Agricultural Activities: Policies for Protection*, 7 STAN. ENVTL. L.J. 117, 119 (1988).

38. Eckstein, *supra* note 29, at 210.

39. *Id.* at 220.

40. *See id.*

41. *Id.*

42. GROUNDWATER RESOURCES OF THE WORLD AND THEIR USES, *supra* note 4, at 19.

43. Albert Tuinhof et al., *Groundwater Monitoring Requirements for Managing Aquifer Response and Quality Threats*, THE WORLD BANK (2006), *available at* http://water.worldbank.org/sites/water. worldbank.org/files/GWMATE_BN09_MonitoringRequirements2006.pdf.

44. *Id.*

geomorphology (the processes which shape landforms), and rainfall.[45] The measurements used to determine the amount of water in an aquifer are transmissivity (the permeability of the rock), effective porosity (the total porosity of the rock formation minus the volume isolated in unconnected pore spaces), saturated thickness (the amount of the formation filled with water), and recharge.[46] Using data that represents these factors, along with average borehole yields, hydrologists can quantify the amount of groundwater available in particular regions.[47] The Namibian government should take these factors, along with other scientific observations of yield,[48] into consideration to determine sustainable development plans for the Ohangwena II aquifer.

B. Over-Exploitation

Twenty-five percent of the world's population relies on groundwater basins, which are being depleted faster than they can be replenished.[49] So much water has been pumped from groundwater sources that it is estimated that a quarter of the rise in global sea-levels can be attributed to this transfer of groundwater into the oceans.[50] Groundwater overdraft is caused when water is pumped out of an aquifer much faster than it can be recharged.[51] Alarmingly, this has led to declining groundwater levels, lower pump yields, deteriorating water quality, and damaged aquatic ecosystems.[52] Because groundwater has become vital to agriculture, some believe that groundwater overdrafts are the single biggest threat to world food production.[53]

Ohangwena II is located in a particularly dry region with a growing demand for water.[54] This creates a significant risk that future users will rely too heavily on this water, leading to overdraft. In regions like South Africa, human populations have grown by three percent each year.[55] This steady rate of population growth, if

45. A. M. MacDonald et al., *Quantitative Maps of Groundwater Resources in Africa*, 7 ENVTL. RES. LETTERS 1, 2 (Apr. 2012).

46. *Id.*

47. *See id.*

48. *See infra* Part IV (discussing other methods used to scientifically determine aquifer capacity and recharge rate).

49. Mascarelli, *supra* note 11.

50. *Rising Sea Levels Attributed to Global Groundwater Extraction*, FACULTY OF GEOSCIENCES: UNIVERSITY OF UTRECHT (Sept. 24, 2010), http://www.uu.nl/EN/Current/Pages/Wereldwijdonttrekkenvangrondwaterleidttotzeespiegelstijging.aspx.

51. Yoshihide Wada et al., *Global Depletion of Groundwater Resources*, 37 ENVTL. RES. LETTERS 1, 1 (Oct. 2012).

52. *See generally Rising Sea Levels Attributed to Global Groundwater Extraction*, *supra* note 50; *see generally* Wada, *supra* note 51.

53. Barton H. Thompson, Jr., *Tragically Difficult: The Obstacles to Governing the Commons*, 30 ENVTL. L. 241, 250 (2000).

54. *See infra* Part III.

55. Salman M. A. Salman, *Legal Regime for Use and Protection of International Watercourses in the*

maintained, will place even greater pressure on water resources.[56] Additionally, Uranium mining interests in the region are in constant need of water,[57] creating the potential approval of high volume extractions. Because Namibia is a region with the future potential for overdraft,[58] officials charged with overseeing groundwater use must take steps to prevent overuse.

The temporary consequences of over-drafting, mentioned above, are just one example of the problems that result when groundwater reserves are used faster than they can be recharged. Water users in basins subject to water table declines can expect increased pumping costs until it is no longer economically feasible to pump.[59] Therefore, over-drafting often prompts affected users to either "find alternative sources of water (which today are typically not available), find a way of proceeding forward without water, or close up shop."[60] Societies that ignore increased pumping costs risk the possibility that their groundwater reserves are lost for future generations through impractical cost of access.

Over-drafting has also led to subsidence, a phenomenon that prompts the compaction of sediment layers overlying aquifers as the result of the water table being lowered.[61] Subsidence occurs when groundwater is drained from underground pockets; this allows gravity to compact the overlying sediment layer into the area otherwise occupied by water.[62] There are major problems associated with subsidence, including the decline in aquifer storage capacity, infrastructure damage, and increased flood hazards.[63] Subsidence is the most significant threat created by overdraft because it is essentially irreversible, even if groundwater is restored to presubsidence levels.[64] The risk of subsidence is a major incentive to regulate groundwater extraction, because otherwise, a productive aquifer can be forever lost.[65]

Over-draft is a preventable problem, which the Namibian government should attempt to avoid when they begin allowing the utilization of this underground reservoir.[66] If the amount of water extracted from an aquifer is consistent with the average recharge rate, then the water table will not be reduced through

Southern African Region: Evolution and Context, 41 NAT. RESOURCES J. 981, 986 (2001).

56. *Id.* at 987.

57. Bridgette Weidlich, *Namibia: Insufficient Water for Uranium Mines in Erongo*, ALLAFRICA (Aug. 24, 2010), http://allafrica.com/stories/201008250642.html.

58. *See infra* Part III.

59. Thompson, *supra* note 53, at 251.

60. *Id.*

61. Herman Bouwer, *Land Subsidence and Cracking Due to Ground-Water Depletion*, 15 GROUNDWATER 358, 358 (1977).

62. *Id.*

63. *Id.*

64. *Id.*

65. *Id.*

66. *Id.*

pumping.[67] Because there have not yet been approved uses for the Ohangwena II aquifer, no individual has yet acquired vested rights to pump beyond recharge rates. This creates a unique opportunity for Namibia to proactively prevent overdraft by refusing approvals for any pumping which will exceed average recharge rates. Therefore, Namibian officials should carefully scrutinize the physical characteristics of this aquifer, including recharge rate, to determine a sustainable extraction total to be applied to future users.

C. Contamination

The Namibian and Angolan governments should take special steps to prevent Ohangwena II from becoming contaminated in any way. Clean water availability has come to be recognized as the most critical of all human security issues facing the world in the next quarter-century.[68] Groundwater is the water resource most threatened by pollution because it slowly accumulates harmful chemicals overtime.[69] Aquifers are essentially sinks for pollutants because unlike rivers, which drain into oceans, pollution flowing into aquifers is trapped like the water itself.[70] Despite this awareness, one to two percent of groundwater has been rendered unusable by pollution,[71] a percentage that is expected to rise.[72] Because contamination can render water unsuitable for a majority of uses, it is one of the most pressing threats facing groundwater.[73] If Ohangwena II is carelessly contaminated, then a vast source of drinkable water could be rendered unusable in a region that is already set to deplete current supplies by 2015.[74]

Groundwater contamination is a preventable phenomenon, which must be avoided in order to ensure that groundwater will be safe for human consumption.[75] The main sources of groundwater contamination are municipal wastes, agricultural run-off, or industrial discharge entering though recharge areas.[76] The recharge area for the Ohangwena II aquifer is not in great jeopardy of run-off pollution because it is located at the foot of a sparsely inhabited mountain range in Southern Angola.[77] However, if Angola does develop the land overlying

67. Bouwer, *supra* note 61, at 358.

68. *See generally* Payal Sampat, *Groundwater Shock: The Polluting of the World's Major Freshwater Stores*, 13 WORLD WATCH MAGAZINE 1 (Jan./Feb. 2000), *available at* http://www.worldwatch.org/node/481.

69. *Id.*

70. *Id.*

71. Sivas, *supra* note 37, at 121.

72. *Id.*

73. *Id.*

74. Smith, *supra* note 16.

75. *See Getting Up To Speed: Groundwater Contamination*, US EPA, C3-C4, http://www.epa.gov/region1/students/pdfs/gwc1.pdf (last visited on Nov. 19, 2012).

76. *See id.* at C3-C4.

77. Ellanie Smit, *Massive Water Source Found*, NAMIBIAN SUN (July 13, 2012), *available at* http://sun.com.na/content/agri/massive-water-source-found-0.

the recharge zone for agriculture or industry, then harmful contaminants could be released into the water.[78] As a result, the Namibian government should coordinate with Angola to ensure that the aquifer recharge zone is not made susceptible to runoff pollution.

Confined aquifers face a unique risk of contamination when located underneath harmful pollutants, like oil or saltwater, that can enter the aquifer if both bodies are breached.[79] Improper drilling, which penetrates both a pollutant source and the aquifer below can create a hydrological shortcut that results in aquifer contamination.[80] Contamination can be avoided if the wells extracting water from an aquifer are drilled to avoid overlying pollutants.[81] The scientists who discovered Ohangwena II also found that it is located underneath a brackish saltwater body that would cause contamination if breached.[82] Any future plans to drill the aquifer must take the risk of contamination into account.

Aquifer contamination is a major threat which must be actively addressed to ensure the continued vitality of groundwater resources for future generations. Groundwater contamination, which renders an aquifer unusable, will deny future generations the right to utilize that natural resource. Such a result would violate the obligation that current generations have to their unborn children to ensure they inherit a world with an adequate supply of life-sustaining natural resources.[83] This means that management strategies for Ohangwena II should be carefully tailored to prevent activities which will result in contamination.

III. AN AQUIFER IN THE DESERT

In late 2006, a team of experts led by German hydrologist Martin Quinger uncovered the first clues of what is now known to be the massive, previously undiscovered aquifer Ohangwena II.[84] The discovery was announced in July 2012 after borehole samples and an electromagnetic image analysis revealed that the sub-strata underlying the Northern Namibian regions of Ohangwena and Oshana are saturated with water.[85] The aquifer lies in between the towns of Eenhana and Okongo, stretches from Okankolo into Southern Angola, and contains an

78. *See Getting Up To Speed: Groundwater Contamination*, *supra* note 75, at C6.

79. *See* J. Jiménez-Martínez et al., *The Role of Leaky Boreholes in the Contamination of a Regional Confined Aquifer. A Case Study: The Campo de Cartagena Region, Spain*, 215 WATER AIR SOIL POLLUTION 311, 311-12 (2011).

80. *See id.*

81. Servaas van den Bosch, *Too Soon to Tap Namibia's Groundwater Find, Experts Say*, SCIDEV.NET (Sept. 27, 2012), http://www.scidev.net/en/agriculture-and-environment/water/news/too-soon-to-tap-namibia-s-groundwater-find-experts-say-1.html.

82. *Id.*

83. *See infra* Part IV (describing the exact nature of the obligation to future generations).

84. Hervieu, *supra* note 13.

85. *Id.*; Sasman, *supra* note 13.

estimated storage capacity of over five-billion cubic meters.[86] The experts believe that the aquifer is recharged during the rainy season by a run-off zone at the foot of mountains 350 kilometers to the north in Angola.[87] These facts have led researchers to conclude that the aquifer could provide 800,000 Namibians (forty percent of the population) with clean drinking water each year.[88] The section below will highlight the importance of the aquifer and discuss the government's current plans for development.

A. "Blue Gold"

New sources of water are particularly welcome in Namibia, a nation that has no permanent rivers in its interior, and where demand for water is set to outpace supply by 2015.[89] Over 500,000 people in Northern Namibia rely on Angolan surface water flowing in a poorly maintained canal that experiences evaporation losses as high as eighty percent.[90] Flooding events during the rainy season cause polluted runoff to infect this water supply, leading to Cholera outbreaks.[91] Providing sanitary drinking water to rural populations has been a major problem in Namibia, where up to twenty-three percent of childhood deaths are linked to lack of clean water.[92] The water contained in this aquifer can be used to target the lack of clean water access; a problem that the UN has determined perpetuates poverty and disease.[93]

This discovery could play a valuable role in economic expansion by providing water for increased food production and industrial expansion. The aquifer is expected to assist agricultural development "since food production has been restricted to areas bordering the two rivers that have historically provided the area with potable water."[94] An increase in food production is a necessity in Northern Namibia, where infant malnutrition rates hit thirty-eight percent in 2011.[95] Though some Namibians have expressed a desire for industrial expansion,[96] commentators fear private investment could deprive impoverished

86. Smit, *supra* note 77.

87. Hervieu, *supra* note 13; Smit, *supra* note 77.

88. Hervieu, *supra* note 13.

89. *See* Hoaës, *supra* note 16; Smith, *supra* note 16.

90. Van Den Bosch, *supra* note 81; Smith, *supra* note 16.

91. Smith, *supra* note 16.

92. Smith, *supra* note 15.

93. *Lack of Access to Safe Water Perpetuates Poverty, Ban Cautions*, UN NEWS CENTRE (Sept. 22, 2010), http://www.un.org/apps/news/story.asp?NewsID=36050&Cr=water&Cr1#.UOYupm_LSvs.

94. Sarah Marshall, *Ohangwena II Aquifer, Namibia's Jackpot?*, THE MUSLIM NEWS (Aug. 24, 2012), *available at* http://www.muslimnews.co.uk/paper/index.php?article=5959.

95. Smith, *supra* note 16.

96. Curious, Comment to *Where is the Ohangwena Aquifer?*, THE NAMIBIAN ECONOMIST (last accessed 1/11/2013) http://www.economist.com.na/2011-12-07-11-05-31/speak-your-mind/2159-where-is-the-ohangwena-aquifer.

local inhabitants of a life-giving necessity.[97] Because water has such great value in Namibia, this discovery has the potential to improve the quality of life for Namibians.

B. Development Plans

Just three months after Ohangwena II was discovered, the Namibian government held a water investment conference that was designed to channel investment into new water infrastructure.[98] The International Water Investment Conference was a meeting of experts, stakeholders, and policymakers seeking to address water access in rural areas.[99] Following the conference, the Namibian government announced plans to invest USD $383 million into water infrastructure in coming years.[100] These developments clearly show that Namibia has the economic potential and incentive to facilitate utilization of Ohangwena II.

Currently, the main obstacle preventing Namibians from harnessing this vast reserve is the danger posed by drilling through the overlying salt-water layer.[101] Scientists associated with the find have cautioned against excessive optimism because it is still unclear how the aquifer can be drilled without piercing the overlying saltwater layer.[102] These experts have planned additional studies in order to determine the age of the aquifer and the areas where it may be safe to drill.[103] Assuming these studies produce favorable results, there are no other major impediments to the future utilization of Ohangwena II.

IV. LEGAL PRINCIPLES AFFECTING GROUNDWATER

Despite the intense reliance that human societies have developed around the use of groundwater, the law specifically relating to transboundary groundwater management does not adequately protect this resource from depletion.[104] For the most part, policymakers continue to treat usage and ownership of groundwater differently than surface waters, causing it to be governed differently or not at

97. Marshall, *supra* note 94. In places such as Bolivia, private investment into water infrastructure has turned "the necessities of life into commodities . . . at the expense of the poor." *Id*.

98. *Namibia Water Investment Conference, 12-14 September 2012, Windhoek, Namibia*, *supra* note 17.

99. *Id.*; Hoaës, *supra* note 16.

100. Randall Hackley, *Namibia's State Water Provider Plans $383 Million in Investments*, BLOOMBERG NEWS (Sept. 20, 2012), *available at* http://www.businessweek.com/news/2012-09-20/namibia-s-state-water-provider-plans-383-million-in-investments; Hoaës, *supra* note 16.

101. *See generally* Van den Bosch, *supra* note 81.

102. *Id.*

103. *Id.* The aquifer's age is indicative of average the recharge rate. Once the recharge rate is determined, scientists can accurately measure how much water can be removed from the aquifer without risking overdraft. *Id.*

104. Nora R. Pincus, *Groundwater and International Law: The Need for Specific Regulation*, 11 U. DENV. WATER L. REV. 313, 314 (2008).

all.[105] As a result, the existing law does not proactively address the risk of groundwater depletion because nations must independently implement measures to prevent unsustainable extractions within their specific region.[106] The failure to implement aquifer-specific laws has caused many societies to damage vital aquifers irreversibly.[107] At present, legal disputes affecting uses of Ohangwena II would be resolved by hydrologically inapposite laws which would not prevent potentially harmful extractions.[108]

A. National Laws and Regional Agreements

The scarcity of surface water sources in Namibia has forced an extensive reliance on groundwater despite the lack of national laws which ensure sustainable use.[109] Namibia is sub-Saharan Africa's driest country with around ninety percent of its total area consisting of desert, arid, and sub-arid land.[110] Rainfall varies "from virtually zero along the coast to a maximum of 700 mm (27.6 in.) in the extreme north-east."[111] All of the perennial rivers which deliver surface water to Namibia flow along international borders and have their sources in other nations.[112] The scarcity of surface water, and the lack of rainfall, create significant socioeconomic consequences and make it difficult for groundwater sources to be recharged.[113] Accelerating concerns is the realization that Namibia's water supply is particularly vulnerable to climate change.[114] Given these features, and the remnants of an Apartheid water regime, "[w]ater resource management in the Namibian context is, above all, an exercise in risk management."[115]

Namibia achieved independence in 1990, and "necessity required that the country retain many of the laws that had been in effect under the previous regime."[116] The Constitution mandates that "the people of Namibia . . . . shall exercise their sovereignty through the democratic institutions of the State,"[117] but

105. *See* Gabriel Eckstein, *Application of International Water Law to Transboundary Groundwater Resources, and the Slovak-Hungarian Dispute over Gabcikovo-Nagymaros*, 19 SUFFOLK TRANSNAT'L L. REV. 67, 70-71 (1995).

106. *See infra* Part III.C.

107. *See infra* Part III.C; Pincus, *supra* note 104.

108. *See infra* Part IV.A.

109. STANFORD LAW SCH., MILLS INT'L HUMAN RIGHTS & ENVIRONMENTAL LAW CLINICS, NOT COMING UP DRY: REGULATING THE USE OF NAMIBIA'S SCARCE WATER RESOURCES BY MINING OPERATIONS 1-2 (2009).

110. NAMIBIA WATER POLICY WHITE PAPER, s*upra* note 24, at 10.

111. *Id.*

112. STANFORD LAW SCH., *supra* note 109, at 1.

113. *Id.* at 2.

114. *Id.* at 3.

115. NAMIBIA WATER POLICY WHITE PAPER, *supra* note 24, at 15.

116. STANFORD LAW SCH., *supra* note 109, at 7.

117. THE CONSTITUTION OF THE REPUBLIC OF NAMIBIA, art. 1(2).

existing remnants of the Apartheid water regulations stand in contrast to this guarantee.[118] The Water Act, No. 54 of 1956 became a means of controlling access to water in what was then South West Africa, and "though it has been repeatedly amended, it has remained the governing law of Namibia to the present day."[119] This law allows overlying owners to pump water underneath their land without any permit,[120] but because the water is "public water,"[121] there are minor criminal punishments for wasteful or non-approved uses.[122] As a result, Namibia is still governed by a legal regime with laws that are not designed to address the most pressing threats associated with groundwater reliance.[123]

Though attempts have been made to reform inherited water policies, the permit process granting extraction rights does not explicitly prohibit large-scale extractions.[124] The most recent National Development Plan was designed to address the issue of inequality in both the laws and the way that water is distributed.[125] The Plan's goal was to utilize water resources in an equitable and efficient manner to benefit all water users in Namibia.[126] However, "until a new framework is formally put in place . . . . the outdated Water Act" will determine the permit process when a company seeks to extract "a significant amount of [groundwater]".[127] Government water agencies have been repeatedly redesigned to reform the water sector, but implementation has been met with slow

118. STANFORD LAW SCH., *supra* note 109, at 7.

119. *Id.* at 14.

120. Regulation in Respect of Subterranean Water Control Areas: South-West Africa, R. 1278 (July 23, 1971) (Namib.).

121. STANFORD LAW SCH., *supra* note 109, at 15.

122. *Id.* at 18. The maximum penalty for a first offense ranges from a fine of N$100 to N$2000 and/or prison time of three to six months imprisonment. Water Act, No. 54, § 170 (1956) (S. Afr.). After a first conviction, a repeat or continuing offense results in fine not exceeding N$25 to N$100 per day, depending on the offense. Thus, so long as over abstraction brought an enterprise more than N$200 in profits per day, breaking the law would be economically preferable to following it. *Id.*

123. Piet Heyns, *Water Institutional Reforms in Namibia*, 7 WATER POL'Y 89, 105 (2005), *available at* http://www.environmental-expert.com/Files%5C5302%5Carticles%5C9972%5CWaterinstitutionalreformsin Namibia.pdf.

124. *See id.*; STANFORD LAW SCH., *supra* note 109, at 18.

125. Republic Of Namibia, Third National Development Plan 126, 2007/2008-2011/12 46 (rev. Sept. 6, 2008). "[T]he coverage of water provision to rural households increased from 75 percent in 2001 to 90.7 percent by 2006 (against the NDP2 target of 80 percent) while the coverage of urban households was maintained at 98.4 percent during the period." *Id.*

126. *Id.* There are five proposed strategies: (1) Promote Integrated Water Resources Management (IWRM); (2) Harmonize policies, legislation, and regulations regarding water resources management; (3) Approve laws that will enable the government to subsidize water to the needy; (4) Make more water available for the satisfaction of basic needs and for the development of the country through finding new water sources (especially groundwater), securing additional allocations of water from the perennial rivers, reusing more water (after adequate treatment) and desalination of sea water; and (5) Follow the principles of integrated water resources planning and development of water resources when allocating water for different uses. *Id.* at 127.

127. STANFORD LAW SCH., *supra* note 109, at 15. The existing permit process has been demonstrated to favor international business interests. *Id.*

progress.[128] Therefore, the existing domestic legal regime leaves open the possibility that a non-sustainable, high-volume commercial groundwater extraction will be approved.

International cooperation over water has proliferated in Southern Africa in response to shortages of surface water. Namibia is a member of the South African Development Community ("SADC"), an inter-governmental economic development agency whose mission is to improve the region through sustainable economic growth and development.[129] The SADC region has two key characteristics that have helped prompt the development of a regional body of watercourse laws: a multitude of transboundary rivers and the proclivity towards water shortages.[130] The SADC made a monumental step in cooperative watercourse management when it concluded the Protocol on Shared Watercourse Systems in 1995.[131] This agreement was updated by the Revised Protocol on Shared Watercourse Systems to take "into account developments in the field of international water law as reflected in the UN Convention, as well as to address the limitations of the Protocol."[132] The Revised Protocol comports with other international law because it is largely based on the 1997 UN Watercourses Convention, embodying a number of similar concepts.[133]

Though Namibia has formed agreements with its neighbors over shared surface water reserves, existing laws do not create specific measures to prevent harm to trans-boundary groundwater. The Protocol on Shared Watercourses, and its more recent revised edition, includes the principle of equitable utilization,[134]

128. Heyns *supra* note 123 (discussing the inadequacies of administrative reform absent the enactment of new legislation to address problems in water policy).

> It was also accepted that the overall sustainability of this sector will depend on its ability to become self-sufficient by at least recovering running and maintenance costs, . . . but the resulting water sector performance, as far as cost recovery is concerned, is not acceptable. . . . It is, therefore, difficult to differentiate between . . . successful organizational reforms and the degree of success with the cost recovery process. . . . As a result, very little progress has thus far been made to address the real needs of the water sector.

Id. at 103, 105.

129. *See* Treaty of the Southern African Development Community, Apr. 1, 1980, 32 I.L.M. 120; *About SADC*, THE SOUTH AFRICAN DEVELOPMENT COMMUNITY, http://www.sadc.int/english/about-sadc/ (last visited Oct. 22, 2012). Currently SADC has a membership of fifteen Member States, namely; Angola, Botswana, Democratic Republic of Congo (DRC), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia, and Zimbabwe. *Id.*

130. Salman, *supra* note 55, at 994.

131. *Id.* at 996; Protocol on Shared Watercourse Systems in the Southern African Development Community (SADC) Region (Aug. 28, 1995), *available at* http://www.fao.org/docrep/ W7414B/w7414b0n.htm [hereinafter Protocol].

132. Salman, *supra* note 55, 1004; Revised Protocol on Shared Watercourse Systems in the Southern African Development Community, art. 5, Aug. 7, 2000, LEX-FAOC015902, *available at* http://www.sadc.int/files/2913/5292/8368/Revised_Protocol_Shared_Watercourses.pdf [hereinafter Revised Protocol].

133. Salman, *supra* note 55, 1006.

134. Protocol, *supra* note 131, at art. 2 cl.2; Revised Protocol, *supra* note 132, at art. 2, cl. 1.

and the duty to consult.[135] However, disputes concerning the exact terms of these obligations are "settled in one of three ways: by the agreement of the parties . . . by submission to a 3rd party determination; [or] by the use of force."[136] In practice, the most effective way that nations have achieved equitable utilization is to consult and negotiate regarding "the utilization in question."[137] Therefore, although the existing regional agreements provide either nation a duty to consult, it is up to either nation to agree on the specific affirmative protections that will apply to prevent shared aquifer depletion.[138]

B. Shared International Aquifers

Though groundwater law has a relatively short history, there are a number of agreements which have attempted to address the need for international cooperation in utilizing shared aquifers. The 1966 Helsinki Rules, created by the ILA, made the first attempt at codifying international groundwater law by including "underground waters" in the definition of "international drainage basin."[139] Intergovernmental agencies have since followed suit. Most notably, the United Nation's International Law Commission ("ILC") produced the Draft Articles on the Non-Navigable Uses of International Watercourses and the Draft Articles on Trans-boundary Aquifers to assist nations in crafting treaties and settling disputes absent preexisting agreements.[140] Another notable non-treaty document is the Bellagio Draft, produced in 1991 by a group of experts in response to a dispute between the United States and Mexico over the Colorado River.[141] The principles contained in these documents have been used to inspire other subsequent bilateral groundwater agreements.

The following principles, derived from customary international law, constitute potentially binding authority for international groundwater disputes. There are five principles of customary international law which have been applied to trans-boundary groundwater: (1) the principle of territorial sovereignty; (2) the obligation not to cause appreciable harm; (3) the principle of reasonable and equitable utilization; (4) the principle of the community of interest; and (5) the principle of prior notice.[142] The first two principles mentioned above are "precepts" which have long been understood as a fundamental basis for

135. Protocol, *supra* note 131, at art. 2 cl.4-6; Revised Protocol, *supra* note 132, at art. 3, cl. 5-7.

136. TRILOCHAN UPRETI, INTERNATIONAL WATERCOURSES LAW AND ITS APPLICATION IN SOUTH-EAST ASIA, 118 (2006).

137. *Id.* at 117.

138. *Id.*; Protocol, *supra* note 131, at art. 2 cl.4-6; Revised Protocol, *supra* note 132, at art. 3, cl. 5-7.

139. Pincus, *supra* note 104, at 318.

140. Eckstein, *supra* note 105, at 93.

141. Pincus, supra note 104, at 318; Eckstein, *supra* note 105, at 96.

142. Eckstein, *supra* note 105, at 72.

international relations.[143] However, it should be noted that the principle of territorial sovereignty has been widely criticized by both scholars and states.[144] The last three principles mentioned developed out of a need for "new conceptions to deal with modern issues of transboundary resources."[145] Customary international law has been applied by the International Court of Justice in disputes concerning international watercourses.[146]

The UN has also made significant contributions to groundwater regulation by facilitating treaties which can be applied to resolve trans-boundary water disputes. The process to govern shared water sources began with the Rio Declaration,[147] and continued with the Convention on the Law of the Non-Navigational Uses of International Watercourses.[148] The most recent development in this area of law is the ILC's newly proposed Draft Articles on trans-boundary aquifers.[149] The Draft Articles incorporate hydrological understandings from competent scientific organizations into the framework forming the basis of the Watercourses Convention.[150] The international agreements, decisions of the International Court, and multilateral treaties mentioned above represent the legal authority pertinent to resolving disputes over trans-boundary aquifers.

C. Shortcomings in International Law

The international agreements and treaties mentioned above are an inadequate source of protection for trans-boundary aquifers. The 2008 Draft Articles sought to incorporate modern scientific understandings within the framework for existing treaties.[151] Though the Articles succeed in that regard, they fail to include

143. *Id.*

144. *Id.* at 73.

145. *Id.* at 72.

146. *See, e.g.*, Gabcikovo-Nagymaros Project (Hungary-Slovakia), Judgment, I.C.J. Reports 1997, p. 7; For a discussion of the application of Customary International Law, see Ben Chigara, *The International Tribunal for the Law of the Sea and Customary International Law*, 22 LOY. L.A. INT'L & COMP. L. REV. 433, 439 (2000).

147. United Nations Conference on Environment and Development, Rio de Janeiro, Braz., June 3-14, 1992, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/26/Rev.1 (Vol. I), Annex I (Aug. 12, 1992) [hereinafter Rio Declaration]. This multi-national agreement was approved by 178 nations and addressed the need for cooperation in managing shared resources. Jeffrey S. Dornbos, *All (Water) Politics Is Local: A Proposal for Resolving Transboundary Water Disputes*, 22 FORDHAM ENVTL. L. REV. 1, 4-5 (2010).

148. Dornbos, *supra* note 147, at 4-5; *see generally* Convention on the Law of the Non-navigational Uses of International Watercourses, May 21, 1997, 36 I.L.M. 700 (1997); Nicholas Maxwell, *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, 388 (2011) (though the treaty has not entered into force, it still represents an important progression in international water law).

149. Stephen C. McCaffrey, *The International Law Commission Adopts Draft Articles on Transboundary Aquifers*, 103 AM. J. INT'L L. 272, 273-74 (2009).

150. *Id.* at 274.

151. *Id.* at 272.

realistic legal remedies to proactively address competitive pumping practices.[152] For example, equitable utilization would not provide a useful guideline for nations with differing resource management paradigms because each nation is not entitled to an equal share of the aquifer, "rather this principle concerns a states right to a reasonable use of the benefits of the watercourse, and its protection from infringement by other states."[153] In that sense, the existing agreements indicate signatories' willingness to cooperate, but fall short of implementing substantive provisions that would limit potentially harmful uses of the aquifer before they actually occur.[154]

Though the 2008 Draft Articles were drafted to apply the principle of equitable utilization, the duty to share information, and the duty to do no harm to other aquifer states, they still fail to provide an adequate protection for transboundary groundwater. For example, a major flaw in the Draft Articles is that they fail to clearly define groundwater as a separate entity from the geological structures in which the water is contained.[155] This ambiguity creates inconsistencies when the principle of equitable utilization is combined with the concept of "sovereignty of aquifer states"[156] because the geological structures are unmoving, always located in one country or another, while the water within is subject to flow.[157] Without explicitly distinguishing geological formations which trap water from the water itself, the term "aquifer" encompasses both the rock formation and the water, subjecting both to claims of national sovereignty.[158] Equitable utilization becomes overshadowed when nations reserve the right to national sovereignty over water because sovereignty allows nations to administer their own resources as they see fit.[159] Absent explicit cooperative agreements regarding uses, nations have resorted to competitive pumping in attempts to realize the maximum benefit from aquifers before they are depleted.[160] Therefore, because of the realities of competitive pumping, the principle of equitable utilization does not adequately protect shared aquifers from overdraft unless each nation can agree to proactively limit consumption.[161]

152. *Id.*

153. *See* Christine Traversi, *The Inadequacies of the 1997 Convention on International Water Courses and 2008 Draft Articles on the Law of Transboundary Aquifers*, 33 HOUS. J. INT'L L. 453, 474-5 (2011).

154. *Id.*

155. Draft Articles on the Law of Transboundary Aquifers art. II, in Rep. of the Int'l Law Comm'n, 60th sess, May 5-June 6, July 7-Aug. 8, 2008, U.N. Doc. A/63/10 [hereinafter 2008 Draft Articles]; McCaffrey, *supra* note 149, at 282.

156. McCaffrey, *supra* note 149, at 285. The concept of sovereignty of aquifer states grants nations sovereignty over underlying aquifers and in effect the waters contained therein. *Id.*

157. *Id.* at 282.

158. *Id.*

159. *See id.* at 291-92.

160. *See Deep Waters, Slowly Drying Up*, THE ECONOMIST (Oct. 7th, 2010), *available at* http://www.economist.com/node/17199914.

161. *See, e.g.*, Traversi, *supra* note 153, at 487-88.

Though the Draft Articles can serve to inform future agreements affecting transboundary aquifers, they are unlikely to be adopted as binding international law. The Draft Articles are inconsistent with prior international law because sovereignty has not been applied "to shared freshwater resources in any way that resembles its application" in land disputes.[162] Furthermore, the Draft Articles also contain a significant overlap with the UN Watercourses Convention because both govern groundwater hydrologically connected to that surface water.[163] If the Draft Articles are adapted in treaty form, then it is highly foreseeable that signatory states would be conflicted over whether to apply the concept of sovereignty or equitable apportionment to groundwater with a hydrological connection to surface water.[164] The problems, inconsistencies, and omissions in the current Draft Articles may prevent them from being accepted by the UN, leaving status quo in effect.[165]

V. SUSTAINABILITY THROUGH AN INTERGENERATIONAL FOCUS

The delicate physical characteristics of Ohangwena II, combined with the dire need for water in Namibia, create significant hurdles to ensuring sustainable utilization.[166] The law currently applicable to groundwater fails to accurately address the specific threats posed to transboundary aquifers because it lacks specific, affirmative measures to prevent overdraft and contamination.[167] Under the status quo, commercial uses which threaten the continued viability of an indisputably vital resource are being approved.[168] Therefore, it is necessary for Namibia and Angola to cooperate in helping to ensure that this water will be used to sustainably benefit growing populations.

This Comment will propose a framework for a bilateral treaty through which Namibia and Angola can ensure the equitable and sustainable use of their shared subterranean water for the benefit of future generations.[169] The treaty will incorporate "intergenerational equity," a decision-making calculus that incorporates an obligation to future generations into actions affecting natural resources.[170] Section A, below, will explicate the concept of intergenerational equity and its role in sustainable development. The following section will

162. McCaffrey, *supra* note 149, at 288.

163. U.N. Watercourses Convention, May 21, 1997, 36 I.L.M. 700, 704; 2008 Draft Articles, *supra* note 155, at art. II; McCaffrey, *supra* note 149, at 288.

164. McCaffrey, *supra* note 149, at 288.

165. *See infra* Part IV.C.

166. *See supra* Part I-II.

167. *See supra* Part III.C.

168. Heyns, *supra* note 123, at 100.

169. *See infra* Part IV.C.

170. Jeffrey M. Gaba, *Environmental Ethics and Our Moral Relationship to Future Generations: Future Rights and Present Virtue*, 24 COLUM. J. ENVTL. L. 249, 280-81 (1999).

examine the international agreements which have already incorporated provisions inspired by intergenerational equity. The Comment will culminate with a proposed framework to manage Ohangwena II through a bilateral treaty between Namibia and Angola that recognizes a shared obligation to preserve the resource for future generations.

A. Intergenerational Equity and Sustainable Development

Intergenerational equity espouses an obligation to future generations which is justified in part by the instinctive adherence to generational roles which has fundamentally shaped the human experience.[171] Intergenerational equity provides justification for the practice of sustainable development,[172] an obligation which has slowly permeated international environmental treaties.[173] The exact nature of this obligation is easily disputed because terms like "intergenerational" and "generation" are nebulous and in need of greater refinement.[174] This section will attempt to cultivate a clear and precise understanding of a particular interpretation of intergenerational equity that can be translated into real-world application.

Concern for future generations is not a demand handed across time, it is a recognition of the dignity of life, an expression of humanity's highest virtue.[175] This recognition is most easily relatable to the natural resources that serve as essential fuel to develop human societies.[176] The obligation to future generations is not grounded in a clear corresponding right because there are "no determinate people to whom the right attaches."[177] However, the vast majority of parents want to ensure that their children have the same opportunities which were available to them, and this is the most basic instantiation of this concept.[178] Therefore, the premise behind intergenerational equity is that societies should create institutions to help realize the instinctive desire to ensure the success of their offspring.[179]

Wide-reaching adaptations of intergenerational equity become intricate compared to basic expressions of the concept because such extrapolations target large-scale social harms to prevent the lives of future generations from being

171. *See id.* at 252.

172. Alhaji B.M. Marong, *From Rio to Johannesburg: Reflections on the Role of International Legal Norms in Sustainable Development*, 16 GEO. INT'L ENVTL. L. REV. 21, 30 (2003).

173. *Id.* at 21-22.

174. Lawrence B. Solum, *To Our Children's Children's Children: The Problems of Intergenerational Ethics*, 35 LOY. L.A. L. REV. 163, 169-171 (2001).

175. *See* Trevor R. Updegraff, *Morals on Stilts: Assessing the Value of Intergenerational Environmental Ethics*, 20 COLO. J. INT'L ENVTL. L. & POL'Y 367, 382-83 (2009).

176. *See* Edith Brown Weiss, *Our Rights and Obligations to Future Generations for the Environment*, 84 AM. J. INT'L L. 198, 199 (1990).

177. *Id.* at 204.

178. *See* Solum, *supra* note 174, at 165-67.

179. *See* Weiss, *supra* note 176, at 199-200.

impaired.[180] The term "generation" has a clear meaning when it is associated with a particular genealogical line,[181] but when perspective is abstracted beyond the familial context, the meaning of this term becomes ambiguous.[182] There are two distinct ways to abstract the term; one method is to group people according to demographic cohort generations,[183] while another simply defines future generations as those born after the last currently living person is dead.[184] Both frames of reference can be used to prevent future harms because they provide a framework to relate the effects of present actions to the interests of a distinct group of future individuals.[185] However, to avoid confusion in the present context, the term "future generations" will be used to refer to all future unborn humans within a particular geographic area.

The term "equity" connotes justice, a concept intrinsically related to individual morality.[186] But because the term will be used in the legal context, it must be carefully defined to avoid inconsistent interpretations.[187] Consider the present dilemma: when the rights of unborn future generations conflict with the economic or social needs of present day societies, what degree of sacrifice is acceptable?[188] There are two distinct concepts that can be employed to determine the equitable answer to this question; corrective justice and distributive justice.[189]

Corrective justice mandates that present-day societies make attempts to rectify permanent damage wrought to natural resources.[190] Corrective justice would require present societies to create a trust fund to compensate future generations for environmental harms resulting from present day actions.[191] Distributive justice is best illustrated by a system such as social security, in which generations share the benefits and burdens of ensuring the needs of the

180. Solum, *supra* note 174, at 167-69.

181. *Id.* at 170.

182. *Id.*

183. *Id*. at 169. The Baby Boomer generation, or Generation X'ers, are examples of demographic cohorts which derive from cultural influences or major events (i.e., World War II). *Id.* These demographic units have served as shortcuts for the discussion of public policy questions that involve issues of intergenerational justice. *Id.*

184. Solum, *supra* note 174, at 170.

185. *See* Gaba, *supra* note 170, at 253-55 (discussing the difficulties in relating present actions to a distinct group of future individuals).

186. *See generally* Allan Beever, *Aristotle on Equity, Law, and Justice*, 10 LEGAL THEORY 33 (2004) (discussing the interrelationship between justice and equity).

187. *See generally* Julian Lamont, *Distributive Justice*, STAN. ENCYCLOPEDIA OF PHIL. (Sept. 22, 1996), *available at* http://plato.stanford.edu/entries/justice-distributive/ (explaining the widely divergent interpretations of justice).

188. *See generally* Smith, *supra* note 16 (finding UNICEF reported 958 cases of cholera caused by faeces mixed with water in 2008); *see also* Marshall, *supra* note 94.

189. *See* Solum, *supra* note 174, at 174.

190. *See id.*

191. *Id.* at 175.

elderly are met.[192] Distributive justice would apply in determining to what extent environmental burdens created by one generation (i.e., increased pumping costs) should be shared by multiple generations.[193] Corrective justice will be used as the conceptual basis for equity in the present application because it can be applied to redress specific harms[194] whereas distributive justice tends to be more applicable in addressing the shared burden for widespread social problems.[195]

The notion of equity, as it applies to the intergenerational sharing of natural resources, is essentially interchangeable with the growing awareness of the need for sustainable development. Intergenerational equity is an approach to building societies that recognizes mankind's ability to profoundly alter his environment.[196] Consider the elegant statement of these principles contained in the preamble to the Stockholm Declaration, which provides that:

> Man is both creature and molder of his environment . . . [and] through the rapid acceleration of science and technology, man has acquired the power to transform his environment in . . . an unprecedented scale. Both aspects of man's environment, the natural and the man-made, are essential to his well-being and to the enjoyment of basic human rights the right to life itself.[197]

Many present day societies have taken costly steps to reduce the environmental destruction caused by infrastructure development and resource acquisition.[198] The environmental protections which have become more common in recent years are arguably motivated in part by the widespread recognition for the understanding of sustainable development which is stated above.[199]

B. Legal Recognition for Future Generations

In certain places, the need to formally accept responsibility to future generations for the negative consequences of present-day human activities has acquired the force of law.[200] Recognitions of intergenerational equity have

192. *Id.*

193. *See generally* Alice Kaswan, *Distributive Justice and the Environment*, 81 N.C. L. REV. 1031 (2003).

194. *See* Solum, *supra* note 174, at 174-75.

195. *See id.*

196. Updegraff, *supra* note 175, at 375.

197. U.N. Conference on the Human Environment, June 5-16, 1972, *Stockholm Declaration*, U.N. Doc. A/CONF.48/14, at pmbl. (June 16, 1972) [hereinafter Stockholm Declaration]; Updegraff, *supra* note 175, at 375.

198. *See generally The Rise of Green Building*, THE ECONOMIST (Dec. 2, 2004), *available at* http://www.economist.com/node/3422965.

199. *Supra* Part IV.A.

200. *See infra*.

abounded both in international treaties and through application in the courts.[201] Furthermore, independent nations have taken steps to ensure that present day actions resulting in environmental harm are offset by financial investments benefiting future generations.[202] The following section will examine and compare the various legal instantiations of intergenerational equity and sustainable development, the conceptual counterpart.

Intergenerational equity is emerging as "an important and rapidly developing principle," which has been repeatedly confirmed by international law.[203] The Stockholm Declaration made an early articulation of the principle of sustainable development by "integrat[ing] environmental concerns in development decision-making."[204] The Declaration provides that the "natural resources of the earth, including . . . water . . . [be] safeguarded for the benefit of present and future generations through careful planning and management."[205] The concern for protecting the environment for future generations was also incorporated into three treaties which were drafted at the same time as the Declaration.[206] The signatories have reaffirmed the validity of the Declaration and urged "all Governments and peoples of the world to . . . collectively . . . ensure that our small planet is passed over to future generations in a condition which guarantees a life in human dignity for all."[207] The principles contained in these treaties should have a guiding force in shaping the proposed bilateral treaty described below.

Scientific understanding is a prerequisite for quantifying the effects that human beings will have on the environment, but because many scientific conclusions are uncertain, treaties have created a framework for action in absence of scientific certainty.[208] It is a human tendency to base environmental law on the presumption that measures to protect the environment are only justifiable when harms can be conclusively demonstrated.[209] In contrast to this position, many

201. EDITH BROWN WEISS, *Intergenerational Equity: A Global Framework for Environmental Change*, *in* ENVIRONMENTAL CHANGE AND INTERNATIONAL LAW: NEW CHALLENGES AND DIMENSIONS, 4 (Edith Brown Weiss ed., 1992); *see infra* (discussing examples of intergenerational equity in international law).

202. *See infra* notes 219-25.

203. Edith Brown Weiss, *A Reply to Barresi's "Beyond Fairness To Future Generations"*, 11 TUL. ENVTL. L.J. 89, 94 (Winter 1997).

204. Marong, *supra* note 172, at 26.

205. Stockholm Declaration, *supra* note 197, at princ. 2.

206. Weiss, *supra* note 203 (finding the 1972 London Ocean Dumping Convention, the 1973 Convention on International Trade in Endangered Species, and the 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage all explicitly incorporated the notion of protecting the environment for future generations).

207. U.N.E.P. Report of the Governing Council, *The Nairobi Declaration*, ¶ 10, U.N. Doc. A/37/25, (May 18, 1982).

208. Jorge E. Vinuales, Legal Techniques for Dealing with Scientific Uncertainty in Environmental Law, 43 VAND. J. TRANSNAT'L L. 437, 447 (2010).

209. Marong, *supra* note 172, at 64.

declarations have recognized the precautionary principle,[210] expressing the need to act to stop threats to the environment despite a lack of scientific evidence that irreversible harm will result.[211] The most prominent formulation of this principle is contained in the Rio Declaration,[212] which provides that: "where there are threats of . . . irreversible damage, lack of full scientific certainty shall not be used . . . [to] postpon[e] cost-effective measures to prevent environmental degradation."[213] Therefore, the lack of complete scientific certainty as to the full extent of the potential effects, which can result from a harmful activity, is not alone a sufficient justification to continue such harm.

Influential tribunals have also recognized intergenerational equity as an emerging principle of law applicable in resolving disputes affecting natural resources. A class-action suit brought on behalf of current and future generations in the Philippines Supreme Court proceeded on the basis that timber licenses issued by the government were causing extensive environmental harm to the rights of future generations.[214] The Court invalidated harmful logging permits because they interfered with the rights of future generations to a healthy environment.[215] Judge Weeramantry of the International Court of Justice has also discussed the implications of intergenerational equity on two separate occasions; first in an opinion on maritime boundaries,[216] and then in a dissenting opinion on nuclear testing.[217] Although the principle was not decisive in these two cases, the inclusion of intergenerational equity in international case law signals that it may be directly addressed in future natural resources disputes.[218]

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210. Rio Declaration, *supra* note 147, at princ. 15.

211. Weiss, *supra* note 203.

> The Group of 7 Ministerial Declaration in July 1990 stated . . . that "in the face of threats of irreversible environmental damage, lack of full scientific certainty is no excuse to post-pose actions which are justified in their own right." The UN Economic Commission for Europe ministerial meeting in Bergen in May 1990 declared: "Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation."

Id.

212. Marong, *supra* note 172, at 66.

213. Rio Declaration, *supra* note 147, at princ. 15.

214. Minors Oposa v. Secretary of the Department of Environment and Natural Resources, 33 I.L.M. 173 (S.C., July 30, 1993) (Phil.); Marong, *supra* note 172, at 62.

215. Minors Oposa, 33 I.L.M. 173.

216. Maritime Delineation in the Area between Greenland and Jan Mayen (Den. v. Nor.), 1993 I.C.J. 41 (June 14) (separate opinion of Judge Weeramantry).

217. Request for an Examination of the Situation in Accordance with Paragraph 63 of the Court's Judgment of 20 December 1974 in the Nuclear Tests (N.Z. v. Fran.), 1995 I.C.J. 288 (Sept. 22) (dissenting opinion of Judge Weeramantry). In his dissenting opinion in Nuclear Tests 1995, Judge Weeramantry stated that: "the principle of intergenerational equity [is] an important and rapidly developing principle of contemporary environmental law." Owen J. Lynch, *Human Rights, Environment, and Economic Development: Existing and Emerging Standards in International Law and Global Society*, THE CENTER FOR INTERNATIONAL ENVIRONMENTAL LAW (Nov. 15, 1997), http://www.ciel.org/Publications/olp3iv.html.

218. Lynch, *supra* note 217.

Two African nations, Nigeria and Angola, have created sovereign wealth funds[219] which can serve as inspiration for the intergenerational component of the bilateral treaty proposed below. Sovereign wealth funds allow resource rich nations to divert earnings from resource extraction into funds which provide for intergenerational savings and future investment in infrastructure.[220] In Nigeria, a sovereign wealth fund was created to allow intergenerational savings and to create an infrastructure fund.[221] In Angola, a fund was also created with the intention of using its investment for the development of infrastructure.[222] Many in both nations look forward to the promise of an increased quality of life from long overdue investments in much needed infrastructure that will become possible once the funds reach maturity.[223] Both funds mentioned above were funded by oil revenues,[224] but the Namibian government could still potentially follow suit by setting aside profits from commercial water extractions from Ohangwena II to create their own fund.[225]

C. Bilateral Treaty Framework

The severe lack of water, the serious threats facing aquifers, and the absence of laws protecting transboundary groundwater all suggest that Namibia and Angola should enter into a bilateral treaty in order to protect Ohangwena II for future generations. At present, no uses have been approved,[226] but the proposal advocated by this Comment is aimed to preemptively address problems associated with groundwater use before individuals acquire rights to pump unsustainably.[227] The main threat facing this aquifer is contamination,[228] but overdraft could also become an issue,[229] and any potential treaty should address ways to avoid these problems. Another problem being addressed is the lack of specific provisions dictating nations' respective rights should a dispute arise over

219. Candido Mendes & Colin McClelland, *Angola Starts Sovereign Wealth Fund With $5 Billion*, BLOOMBERG (Oct. 17, 2012), *available at* http://www.bloomberg.com/news/2012-10-17/angola-starts-sovereign-wealth-fund-with-5-billion.html; Emma Ujah, *Nigerian Economy: How the Sovereign Wealth Fund Will Make a Difference*, VANGUARD (Dec. 25, 2012), *available at* http://www.vanguardngr.com/2012/12/nigerian-economy-how-sovereign-wealth-fund-will-make-a-difference/.

220. *See* Madhavi Acharya-Tom Yew, *The Case for Sovereign Wealth Funds in Canada,* THE STAR (Jan. 8, 2013), *available at* http://www.thestar.com/business/article/1312119—the-case-for-sovereign-wealth-funds-in-canada.

221. Ujah, *supra* note 219.

222. Mendes & McClelland, *supra* note 219.

223. *Id.*; Ujah, *supra* note 219.

224. Mendes & McClelland, *supra* note 219; Ujah, *supra* note 219.

225. *See infra* Part IV.C.3.

226. *See supra* Part I.B.

227. *See supra* Part I.B (listing the harms associated with over pumping).

228. *See supra* Part II.C.

229. *See supra* Part I.B.

extraction rates.[230] Lastly, the treaty should rely on intergenerational equity as a foundational principle by creating provisions to ensure that future generations are compensated for any permanent damage to the aquifer.

The following section contains a description of the proposed bilateral treaty which will highlight provisions designed to prevent the potential issues mentioned above. Subsection 1 will discuss measures designed to avoid the physical harms facing the aquifer from misuse or over-allocation. The following subsection will propose a coherent legal framework which is tailored to fit Ohangwena II by augmenting the shortcomings in existing treaties. The final subsection will advocate for a process by which future generations can be incorporated as a stakeholder group in decisions affecting the aquifer. This Comment does not contain model provisions; instead, it relies on a narrative description of essential considerations which should be addressed by those who would be responsible for drafting the proposed treaty.

1. Overdraft and Contamination

The physical threats facing Ohangwena II have the potential of rendering the water inside unusable,[231] but through careful management and strict avoidance of contamination, the water will be safe for future uses.[232] Scientific monitoring provides the basis for learning about the size and location of aquifers because groundwater cannot be subject to conventional observation.[233] It is important that any treaty designed to protect an unseen resource have accurate means of predicting the available reserves and potential concerns associated with the aquifer and its location.[234] In recognition of the importance of scientific understanding, the bilateral treaty between Namibia and Angola should create a permanent commission with an obligation to monitor key data points and predict the effects of proposed uses. If an accurate monitoring can be achieved, then this treaty would allow scientific understandings about potential threats to become part of the decision-making framework for permitting uses.

Assuming that an effective program is established to monitor the groundwater source, this data can be used to ensure permitted uses do not threaten the aquifer's continued viability. Accurate monitoring data can allow scientists to map the recharge zone, the overlying saltwater body, and observe the continued effects of pumping.[235] Having access to this data could allow the

230. *See supra* Part III C.

231. *See supra* Part II.C.

232. The expert responsible for the find opines that the water in the aquifer is likely safe for drinking, at present. Hervieu, *supra* note 13.

233. *See supra* Part I.A.

234. *See supra* Part III.C.

235. *See supra* Part I.A (describing the methods that used to measure and determine the physical characteristics of aquifers).

proposed commission to create a map of safe drilling sites, an estimate of safe extraction totals, and will provide a baseline for comparison should evidence of harms emerge.[236] Maps of the recharge zone can help to ensure that either nation will be aware of the regions that must be protected from development that might contaminate water entering the aquifer.[237] It is important that these figures be consistently monitored and applied because, unlike surface water, the effects of groundwater depletion or contamination are difficult to observe.[238]

2. Changes to International Law

Under current international law transboundary aquifers are not adequately protected.[239] The proposed treaty could avoid these problems by incorporating provisions that are informed by the scientific realities affecting specific groundwater sources. The ILC's Draft Articles on Transboundary Groundwater are not a viable solution to the lack of groundwater specific law because they fail to carefully define both aquifers and groundwater in general, a problem that breeds confusion.[240] Furthermore, unless disputing nations agree to submit to an international court judgment, the Draft Articles and applicable surface water treaties require each nation to independently consult regarding the way that trans-boundary watercourses are shared.[241] The present treaty will overcome these shortcomings by employing terminology consistent with the hydrological realities associated with aquifers and addressing specific considerations unique to this particular aquifer.[242]

The main shortcoming in the international law affecting aquifers that should be addressed in the proposed treaty is the lack of detailed provisions that would curb competitive pumping by requiring aquifer states to agree on sustainable extraction limits.[243] At present, nations can exercise sovereign control over groundwater vis-à-vis the mineral rights to the subsurface rock layer.[244] Nations exercising sovereign control over groundwater have no duty to equitably utilize the resource because reservations of national sovereignty operate to undermine any shared conservation efforts.[245] Those who draft this proposed treaty should

236. *See supra* Part I.B (explaining the variable required to engage in groundwater mapping projects).

237. *See supra* Part I.C (describing the process through which aquifers are contaminated).

238. Tuinhof et al., *supra* note 43.

239. *See supra* Part III.C.

240. *Supra* Part III.C.

241. *See* McCaffrey, *supra* note 149, at 274-75; Convention on the Law of the Non-navigational Uses of International Watercourses, *supra* note 148; 2008 Draft Articles, *supra* note 155, at art. II; Protocol, *supra* note 131, at art. 1, cl.1; Revised Protocol, *supra* note 132, art. 1, cl. 1; UPRETI, *supra* note 136, at 118.

242. McCaffrey, *supra* note 149, at 273.

243. *See, e.g.*, Traversi, supra note 153, at 474-5, 487-88.

244. *See supra* Part III.C.

245. *See supra* Part III.C.

take careful steps to overcome present inadequacies in the law, otherwise nations will not have remedies to address potentially harmful uses.[246]

3. Intergenerational Justice

The concept of intergenerational equity must be introduced in the treaty in order to prevent uses of the aquifer, or the overlying lands, in ways that would threaten the long-term viability of the resource. The preamble of this treaty should be similar to the introductory comments made in both the Stockholm Declaration[247] and Rio Declaration[248] because these documents recognize that current generations have an obligation to protect vital resources for future generations. As additional protection, Namibia should establish a sovereign wealth fund that can be used both to invest in infrastructure and to counteract any potential harm wrought on the aquifer.[249] If the proposed treaty is created to be consistent with these suggestions, then present generations will have a legal obligation to ensure intergenerational justice.

The preamble of the proposed bilateral treaty should contain principles of intergenerational equity because those who would use the aquifer consistent with the treaty's mandate will be forced to consider the effects of their action on the resources available to future generations. The component of the Stockholm Declaration that will be crucial to adopt is the recognition that current human actions have the potential to forever despoil natural resources that are integral for future societies.[250] Additionally, the drafters should include the portion of the Rio Declaration contending that harmful actions should not be allowed to continue solely because of scientific uncertainty as to their permanent effects.[251] Clearly expressing the need for intergenerational equity at the outset of the treaty can serve to provide a long-term focus on management that can be used to proscribe unsustainable uses.[252]

In recognition that treaty language alone may not serve as complete protection for this resource, the treaty should also include language encouraging the creation of a sovereign wealth fund that can be used by future generations to offset harmful misuses.[253] Though other sovereign wealth funds are typically funded by oil revenues,[254] a percentage of the proceeds from using the aquifer could be channeled into a fund with more limited investment purposes. The

246. *See generally* McCaffrey, *supra* note 149 (discussing the inadequacies of the draft articles).

247. Stockholm Declaration, *supra* note 197, at pmbl.

248. Rio Declaration, *supra* note 147, at princ. 3.

249. *See supra* Part IV B.

250. Stockholm Declaration, *supra* note 197, at pmbl.

251. Rio Declaration, *supra* note 147, at princ. 7.

252. *See, e.g.*, *id.* at princ. 8; Stockholm Declaration, *supra* note 197, at pmbl.

253. *See supra* Part IV.B.

254. *See supra* Part IV.B.

money in the fund could be reserved to counteract any damages wrought by accidental misuse, and excesses earned from interest could be used to bring water infrastructure to rural areas that are currently in desperate need of clean water.[255] Therefore, the proposed treaty should include a provision that requires approved uses of Ohangwena II with economic value to divert a small portion of their proceeds to establish a sovereign wealth fund to be used to correct potential environmental harms and eventually provide much needed infrastructure to rural areas.

VI. CONCLUSION

Groundwater is an abundant natural resource that is both vital to future societies and at great risk of being lost to use by present-day mismanagement. The great many risks posed to aquifers from overuse and irresponsible drilling have caused some basins to be rendered permanently unusable.[256] More concerning is that many aquifers lack legal protection because there are no principles of international law that institute the rigid extraction limits necessary to prevent competitive pumping.[257] One method of inspiring nations to adequately protect their groundwater resources is to frame the issue in terms of the obligation to provide future generations with the resources necessary to live.[258] The instinctive human desire to ensure the success of one's offspring may be enough to inspire action on behalf of groundwater-reliant societies who often ignore threats to the viability of valuable aquifers.[259]

This Comment demonstrates that Namibia and Angola have inherited a valuable groundwater resource that must be actively protected in order to ensure that present uses do not jeopardize future availability. Attendant in acknowledging the need to protect this aquifer is the recognition that future generations have an inchoate right to inherit a world replete with natural resources.[260] Because no one has yet exercised a legal claim to the water in Ohangwena II, the Namibian and Angolan governments have a unique opportunity to proactively create legal protection for this aquifer before anyone gains unrestricted rights to use the water. Therefore, Namibia and Angola should seize the present opportunity to establish a legal framework protecting Ohangwena II for future generations to come.

255. *See supra* Part II.A.
256. *See supra* Part I.A-B.
257. *See supra* Part III.C.
258. *See supra* Part IV.
259. *See supra* Part I.B-C.
260. *See supra* Part IV.A.