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International Law and Efforts to Mitigate Freshwater Scarcity

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ABSTRACT

Water scarcity—shortage in the availability of water—is an impending global crisis. Climate change continues to reduce precipitation rates, which leads to a lower amount of water in rivers. An increase in global population further aggravates the crisis by reducing the overall per capita availability of water and putting increased pressure on available freshwater resources. In particular, groundwater tables are decreasing in many regions of the world, especially in Pakistan, India, and California. In addition, factories are dumping untreated industrial waste directly into fresh watercourses, which further reduces the availability of clean drinking water. This situation calls for the international community to take strong measures to ensure sustainable drinking water for everyone. This Article will include an overview of the existing situation regarding freshwater scarcity around the world. Furthermore, this Article will provide an overview of the recommended steps to mitigate water scarcity–related threats. Lastly, this Article will discuss the suggestions provided by international conventions to mitigate the problem of water scarcity.

INTRODUCTION

According to the World Economic Forum, water scarcity is one of the gravest threats humanity faces today.[1] The term "water

1 *See* WORLD ECON. F., THE GLOBAL RISKS REPORT 2019, at 12 (14th ed. 2019), http://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf [https://perma.cc/XV6H-DJHD].

scarcity" literally means a shortage of freshwater.[2] Unfortunately, today, we face an acute shortage of freshwater.[3] A number of factors contribute to the growing scarcity of freshwater.[4] For instance, global warming and the resulting climate change may severely and negatively affect freshwater availability in many regions.[5] Specifically, lower precipitation rates in subtropical and midlatitude regions lead to water shortages.[6] In addition, the rapid growth in population increases the demand for freshwater[7] and places additional stress on existing freshwater resources.[8] Consequently, the per capita availability of freshwater continues to decline in many regions, especially in South Asia.[9]

Unfortunately, many regions poorly execute proper water management schemes, if at all. Poor water management intensifies the scarcity of freshwater in these regions.[10] Poor water management also has a harmful impact on agricultural production.[11] This harm on agricultural production has a significant, negative, economic impact on countries in those agrarian regions.[12] Additionally, a lack of clean water causes the spread of diseases, such as diarrhea, because people have to rely on unclean drinking water.[13]

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2 *See* U.N. Water, *Factsheet on Water Scarcity* (Sep. 2018), https://www.unwater.org/water-facts/scarcity/ [https://perma.cc/XZP3-BSM3] (scroll down to "Related Links" and click "Factsheet on Water Scarcity").

3 *See id.*

4 *Id.*

5 *See* Gabriel Eckstein, *Water Scarcity, Conflict, and Security in a Climate Change World: Challenges and Opportunities for International Law and Policy*, 27 WIS. INT'L. L.J. 409, 410–11 (2010).

6 *Id.* at 411.

7 *See* Cornelius Okello et al., *Impact of Population Growth and Climate Change on the Freshwater Resources of Lamu Island, Kenya*, 7 WATER 1264, 1264 (2015).

8 Alberto Boretti & Lorenzo Rosa, *Reassessing the Projections of the World Water Development Report*, NATURE PARTNER J. CLEAN WATER, July 31, 2019, at 1.

9 *See* Michael N. Fienen & Muhammad Arshad, *The International Scale of the Groundwater Issue*, *in* INTEGRATED GROUNDWATER MANAGEMENT: CONCEPTS, APPROACHES AND CHALLENGES 21, 28 (Anthony J. Jakeman et al. eds., 2016).

10 International Conference on Water and Environment, *The Dublin Statement and Report of the Conference*, at 5, 71-ICWE92-9739 (Jan. 31, 1992) [hereinafter *The Dublin Statement*].

11 *See* Eckstein, *supra* note 5, at 419–20.

12 *See id.* at 411, 419.

13 *See* CAROL TURKINGTON & BONNIE LEE ASHBY, THE ENCYCLOPEDIA OF INFECTIOUS DISEASES 339 (3d ed. 2007).

Existing freshwater resources are finite, but they are essential for the survival of life on Earth.[14] Therefore, freshwater resources must be protected.[15] States must implement strategies to sustainably manage and develop freshwater resources.[16] Integrated water management schemes can help achieve this purpose.[17] Furthermore, safeguarding existing freshwater resources from depletion and pollution is essential.[18] To achieve this purpose, states should penalize or prevent factories and entities from dumping industrial waste directly into open fresh watercourses.[19] Similarly, states should implement policies and procedures to ensure the quality of freshwater remains clean enough to drink.[20]

International law provides support and guidance to states to sustainably manage and preserve freshwater resources.[21] The United Nations Economic Commission on Europe (UNECE) Convention (1992), the Berlin Rules on Water Resources (2004), Agenda 21, the United Nations Watercourses Convention (1997), and the Dublin Statement (1992) are some of the notable international conventions. These conventions offer guidance to states to sustainably manage and preserve their freshwater resources and prevent growing water scarcity.[22] This Article highlights the important recommendations of those conventions and agendas that states should act on. Notably, this Article maintains that climate change, an increase in global population, pollution, and the mismanagement of freshwater resources are the main causes of water scarcity. Furthermore, this Article puts forward that states can mitigate water scarcity by controlling pollution,

14 *The Dublin Statement*, *supra* note 10, at 4.

15 *Id.*

16 *Id.*

17 *Id.* at 6.

18 *See id.* at 4.

19 *See id.* at 5.

20 *See* Int'l L. Ass'n, *The Berlin Rules on Water Resources*, art. 28 (2004), https://www.unece.org/fileadmin/DAM/env/water/meetings/legal_board/2010/annexes_groundwater_paper/Annex_IV_Berlin_Rules_on_Water_Resources_ILA.pdf [https://perma.cc/4K3D-HF72].

21 *See, e.g.*, Virpi Stucki et al., *Water and Security in Central Asia—Solving a Rubik's Cube*, 28 INT'L J. OF WATER RES. DEV. 395, 395 (2012); Ryan B. Stoa, *Climate Change Mitigation and Adaptation: The Role of International Ocean and Freshwater Agreements*, *in* SUSTAINABILITY OF INTEGRATED WATER RESOURCES MANAGEMENT: WATER GOVERNANCE, CLIMATE AND ECOHYDROLOGY 445, 451–52 (Shimelis Gebriye Setegn & Maria Concepcion Donoso eds., 2015).

22 *See* Stoa, *supra* note 21, at 451–52.

implementing sustainable water management schemes, and following the recommendations provided by the international conventions.

Part I of this Article explores the main causes of water scarcity. For instance, it highlights that climate change and the resulting decrease in precipitation have caused water scarcity. Additionally, it states that the rise in pollution and ever-growing human population caused a decline in per capita availability of water, which has also led to freshwater scarcity.

Thereafter, Part II discusses potential strategies to reduce the growing scarcity of water. It suggests that states can mitigate water scarcity by implementing sustainable and integrated water management schemes. Moreover, it advocates for protecting freshwater resources from pollution and extending cooperation among riparian states by resolving their bilateral conflicts related to distributing their transboundary watercourses.

Part III discusses international legal conventions and agreements that provide guidance to states to sustainably manage and safeguard their freshwater resources. For instance, it discusses the UNECE Convention (1992), the Berlin Rules on Water Resources, Agenda 21 from the 1992 Earth Summit Conference in Brazil, the U.N. Watercourses Convention (1997), and the Dublin Statement (1992). All of these conventions and agreements highlight the need to cooperate among the riparian states, adopt sustainable water management schemes, and develop freshwater resources by using integrated water management schemes to mitigate scarcity. Finally, the last Part discusses takeaways to draw from this Article.

I
THE CURRENT SITUATION OF WATER SCARCITY

Freshwater resources include water in river basins, streams, canals, ponds, and groundwater.[23] Unfortunately, due to climate change, an increase in population, and lack of managing freshwater resources, the scarcity of freshwater resources is increasing at an alarming rate.[24] More than one billion people on Earth live in regions of water scarcity,[25] and many of them face a shortage of clean and good-quality

23 FIRE PROT. ASS'N, FIRE SAFETY AND RISK MANAGEMENT FOR THE NEBOSH NATIONAL CERTIFICATE IN FIRE SAFETY AND RISK MANAGEMENT 504 (2015).

24 *See* Boretti & Rosa, *supra* note 8, at 1.

25 *See* U.N. Water, *supra* note 2.

freshwater. And, almost two-thirds of the world population experiences water scarcity for at least one month every year.[26] The majority—more than 70%—of that population is in Asia,[27] and members of the U.N. fear that around 1.8 billion people will be living in water-scarce regions by the year 2025.[28]

A. Causes of Water Scarcity

The main causes of water scarcity include, but are not limited to, climate change, an increase in population, pollution, and the mismanagement and wastage of freshwater resources.[29] This section of the Article will include a brief description of these four issues.

1. Climate Change and Water Scarcity

Today, global warming is a serious concern and has caused grave changes to the climate of the earth. Those changes consist of rising average temperatures, fluctuating precipitation levels, rising sea levels, and increasing the pace of glacial melt.[30] Human activities are exacerbating those changes. For example, experts regard the burning of fossil fuels as the leading cause of global warming.[31] Factories and vehicles require burning fossil fuels to operate.[32] This burning of fossil fuels in large quantities worldwide gives rise to the spread of greenhouse gases such as carbon dioxide, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons.[33] Those gases stay in the atmosphere for a long time and trap the heat waves from the sun in the earth's atmosphere.[34] This trapping causes an increase in the overall temperature of the earth.[35]

Global warming is causing dire changes to the earth's climate, and it will continue to do so if stringent measures are not taken to prevent

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26 *Id.*

27 *Id.*

28 *Id.*

29 *See* Boretti & Rosa, *supra* note 8, at 1; U.N. Water, *supra* note 2.

30 Intergovernmental Panel on Climate Change [IPCC], *Climate Change 2007: Impacts, Adaptation and Vulnerability*, at 187 (2007) [hereinafter IPCC].

31 G. TYLER MILLER, JR. & SCOTT SPOOLMAN, LIVING IN THE ENVIRONMENT: PRINCIPLES, CONNECTIONS, AND SOLUTIONS 33 (16th ed. 2008).

32 *Id.*

33 *See Overview of Greenhouse Gases*, U.S. ENV'T. PROT. AGENCY (2017), https://www.epa.gov/ghgemissions/overview-greenhouse-gases [https://perma.cc/REV3-FDVV].

34 *Id.*

35 *Id.*

it.[36] According to the Intergovernmental Panel on Climate Change (IPCC), global warming and climate change have the potential to adversely affect the availability and flow of freshwater resources on Earth.[37] In some locations, e.g., in North America and northern Europe, global warming and climate change may cause an increase in precipitation rates and water flow in rivers, which may lead to floods.[38] However, in other regions, such as in Central America, Africa, Australia, southern Europe, and South Asia, climate change can significantly lower the availability of water in watercourses.[39] In particular, subtropical and midlatitude regions can experience severe water scarcity due to ongoing global warming and climate change.[40] Those regions also face a 10 to 30% decline in the availability of water, which is primarily caused by decreased precipitation levels reducing the average flow of water into rivers.[41]

Scientists have made gloomy predictions about the intensity and magnitude in the change of precipitation levels due to climate change.[42] For instance, the Mediterranean region, southern Africa, and the western coasts of Africa and Europe may experience at least a 20% reduction in rainfalls, causing stronger heat waves and droughts.[43] Furthermore, in some rivers, the average annual water flow may decline by half of its current level.[44] Some of the most prominent transboundary rivers such as the Danube, the Rio Grande, the Euphrates, the Syr Darya, and the Indus will face a substantial decrease in water flow in their basins.[45] A decline in the average annual water flow and a decrease in rainfall will reduce the availability of water to irrigate crops.[46] This reduction will greatly harm the agrarian economies of the world.[47] An agrarian economy is one that depends on

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36 *See* IPCC, *supra* note 30, at 187.

37 Eckstein, *supra* note 5, at 410.

38 *See id.*

39 *Id.* at 410–11.

40 *Id.*

41 *Id.* at 416.

42 *Id.* at 411.

43 *Id.*

44 *Id.* at 416. For instance, scientists fear the flow of water in the Orange River will decrease by 50% within the next few years. *Id.*

45 *Id.* at 416, 418 n. 37.

46 *Id.* at 411.

47 *See* Muhammad Qasim, *Determinants of Farm Income and Agricultural Risk Management Strategies: The Case of Rain-Fed Farm Households in Pakistan's Punjab*,

agricultural production as the largest contributor to its GDP.[48] For instance, Pakistan is an agrarian economy; its agricultural production accounts for around 22% of its Gross Domestic Product (GDP).[49]

In short, climate change can significantly reduce precipitation rates in many regions.[50] Lower precipitation rates can reduce the average annual flow of water in rivers, which can cause a shortage of the availability of freshwater.[51] Consequently, climate change can, and will, intensify the ongoing scarcity of water. Notably, Australia and South America already have famines, and experts fear such conditions will be worse in the future.[52]

2. Increase in Population

The population of the world is growing at a rapid rate.[53] The increase in population has reduced the availability of water due to an increase in demand.[54] For instance, in South Asia and, in particular, in the regions surrounding the Indus Basin in Pakistan, the per capita availability of water has declined substantially.[55] Notably, in 1961, the per capita availability of water in the Indus Basin was around 4,000 cubic meters.[56] This number fell to 1,078 cubic meters in 2001,[57] and experts fear this number will fall below 860 cubic meters by the end of 2020 and below 500 cubic meters by 2040.[58] The increase in population and a decline in the average annual flow of water in the rivers are the prime reasons behind the Indus Basin's decrease in per capita availability of water.[59] The population in Pakistan in 1961 was

3 INT'L RURAL DEV. 1, 69 (Béatrice Knerr ed., 2012). For instance, in Pakistan, sufficient availability of water is required by an agrarian economy for GDP growth. *Id.*

48 *See* L.P. Singh, *Cooperative Marketing in India*, in RURAL MARKETING 243, 243 (Sawalia Bihari Verma et al. eds., 2014).

49 Qasim, *supra* note 47, at 69.

50 Eckstein, *supra* note 5, at 410.

51 *Id.* at 416.

52 *See id.* at 412.

53 Boretti & Rosa, *supra* note 8, at 1.

54 *Id.*; *see also* Okello et al., *supra* note 7, at 1264.

55 *See* Bashir Ahmed, *Water Management: A Solution to Water Scarcity in Pakistan*, 9 J. Indep. Stud. & Rsch. 111, 114 (2011).

56 *Id.*

57 *Id.*

58 *Per Capita Water Availability May Fall to 860 Cubic Metres*, EXPRESS TRIB. (June 28, 2019), https://tribune.com.pk/story/2002420/per-capita-water-availability-may-fall-860-cubic-metres.

59 *Id.*; *see also* Boretti & Rosa, *supra* note 8, at 1.

46 million.[60] The population increased to more than four times that—220 million in 2020.[61] Pakistan's population growth rate mirrors the population growth rates of other regions of the world, including China, India, and Africa. The population increases in these regions result in a significant decline of the per capita availability of freshwater.[62] In particular, experts fear that the groundwater tables in Asia and Africa are facing an acute shortage of water.[63]

3. Water Pollution

Pollution in freshwater resources also prevents people from consuming these water resources for drinking. In many countries, factories dump industrial waste into fresh watercourses without carrying out proper treatment procedures, which makes these resources unsuitable for drinking.[64] For instance, in Bangladesh, factories dump industrial waste directly into fresh watercourses.[65] Unfortunately, a lack of awareness, regulations, and law enforcement mechanisms all contribute to allowing factories to emit industrial waste into open fresh watercourses.[66] In many developing regions, harmful chemicals, including arsenic and lead, contaminate the groundwater.[67] Those chemicals are immensely detrimental to human health and can cause life-threatening diseases such as cancer.[68] Consequently, such water is not suitable to drink, which causes a shortage of available freshwater in these regions.[69]

4. Mismanagement and the Wasting of Freshwater Resources

In many developing parts of the world, freshwater resources are not sustainably managed.[70] Furthermore, a large amount of the existing

60 Ahmed, *supra* note 55, at 114.

61 *Pakistan Population*, WORLDOMETER, https://www.worldometers.info/world-population/pakistan-population/ (last visited Nov. 28, 2020).

62 Thomas Bilaliib Udimal et al., *China's Water Situation: The Supply of Water and the Pattern of Its Usage*, 6 INT'L J. SUSTAINABLE BUILT ENV'T 491, 492 (2017).

63 *Id.*

64 *See* IMF, *Unlocking the Potential*, Bangladesh: Poverty Reduction Strategy Paper, at 183 (2005) [hereinafter *Unlocking the Potential*].

65 *Id.*

66 *See id.*

67 *See* DAVID B. RESNIK, ENVIRONMENTAL HEALTH ETHICS 141–42 (2012).

68 *Id.* at 142–43.

69 *Id.* at 143.

70 *See The Dublin Statement*, *supra* note 10, at 5.

freshwater is wasted directly into the sea.[71] This happens due to a lack of existing water-storage facilities in many countries.[72] For instance, in Pakistan, a significant amount of the Indus River water drains into the Arabian Sea.[73] In 2017, the Indus River System Authority (IRSA) estimated that the amount of water wasted annually is worth around $21 billion.[74] The maximum amount of water that should be released from the Indus River into the Arabian Sea is 8.6 million acre feet (MAF) per year,[75] but the actual amount of water released is around 28 MAF per year.[76] This indicates that a high amount of water goes to waste by flowing into the sea.[77]

Similarly, due to the inefficiency of the irrigation system, a huge amount of Indus Basin water is wasted along its course to reach crop plants.[78] According to the official estimates provided in the State Bank's Annual Report, Pakistan's irrigation system has huge conveyance losses.[79] For instance, over one-fifth of canal water destined for irrigating crops is lost on its way to farms, and an additional one-fourth of the water is lost on its way to crop plants.[80] Hence, the inefficient irrigation system wastes almost half the total amount of Indus Basin water for crops before it ever reaches them.[81] Pakistan uses those unsustainable methods despite the scarcity of water in the Indus Basin.[82] Therefore, preventing the excessive wastage of freshwater is a dire need. Countries may address this need by implementing modern, efficient irrigation schemes and installing new

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71 *See, e.g.*, Michael Zakaras, *Why Does California Let Billions of Gallons of Fresh Water Flow Straight into the Ocean?*, FORBES (Apr. 15, 2015, 12:00 AM), https://www.forbes.com/sites/ashoka/2015/04/15/why-does-california-let-billions-of-gallons-of-fresh-water-flow-straight-into-the-ocean/#14bc7e36517c [https://perma.cc/8FUU-QDVU]. This freshwater wasting behavior even exists in regions facing acute water scarcity. For example, California does not prevent billions of gallons of freshwater from wasting into the sea. *Id.*

72 *See* GERALD O. BARNEY, ENTERING THE 21ST CENTURY: THE TECHNICAL REPORT 158 (2013).

73 *See* Nadir Guramani, *Pakistan Dumps $21bn Worth of Water in the Sea Each Year: IRSA*, DAWN (Nov. 2, 2017), https://www.dawn.com/news/1367885 [https://perma.cc/CG7R-E5UK].

74 *Id.*

75 *See* STATE BANK OF PAK., ANNUAL REPORT 2016-17, at 96 (2017).

76 *Id.*

77 *See id.*

78 *See id.* at 100.

79 *Id.*

80 *Id.*

81 *See id.*

82 *See id.* at 95.

water-storage facilities, especially in the regions facing water scarcity and high per capita demand for freshwater.[83]

In sum, certain factors such as the decrease in precipitation rates due to climate change, the increase in population and resulting decline in per capita availability of freshwater, the rise in pollution, and the mismanagement and excessive wastage of existing freshwater resources contribute to the growing scarcity of freshwater resources. As a result, threats including a lack of good-quality drinking water, a lack of freshwater for irrigating crops, and threatened food security loom over humanity. To counter these grave threats, states must implement effective policies and plans mitigating the aforementioned causes of scarcity in such a way that the policies and plans lead to sustainably managing, developing, and preserving existing freshwater resources. The next section of this Article will describe some potential ways to mitigate the problem of growing water scarcity.

II
POTENTIAL WAYS TO MITIGATE WATER SCARCITY

The scarcity of water can result in dire consequences for the agricultural sector, the economy, and people's health and livelihoods.[84] Therefore, it is essential to undertake effective measures to mitigate the ongoing scarcity of freshwater resources. These measures should include the sustainable management of freshwater resources, including developing, allocating, regulating, preserving, and controlling freshwater resources.[85]

A. Sustainability

It is essential that countries develop, preserve, and use all freshwater resources in a sustainable manner.[86] Sustainability means extracting water from freshwater resources must not harm the availability of an adequate amount of water for future generations.[87] Sustainably

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83 *See* U.N. Conference on Environment and Development, *Rio Declaration on Environment and Development*, ¶ 18.2, U.N. Doc. A/CONF.151/26 (Vol. II), (Aug. 12, 1992), https://www.un.org/esa/documents/ga/conf151/aconf15126-2.htm [https://perma.cc/G4BP-3BDV].

84 Eckstein, *supra* note 5, at 411, 419.

85 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 3(14).

86 *See id.*

87 *Id.* at art. 3(19) (defining sustainable use).

managing and developing freshwater resources can slow the increase in water scarcity.[88]

B. Protecting Existing Freshwater Resources

Protecting freshwater resources requires that states prevent pollution from entering freshwater resources.[89] Preventing pollution specifically includes prohibiting factories from throwing their industrial waste directly into freshwater resources.[90] States could implement the "polluter pays" principle to punish factories that dump industrial waste directly into freshwater resources.[91] This principle involves the polluter entity receiving a heavy financial penalty.[92] Hence, deterring factories from polluting existing scarce freshwater resources will lead to preserving those resources.

Protecting water resources also involves states causing no harm to the water-storage facilities and natural aquifers in the event of armed conflicts.[93] Similarly, protecting freshwater also means that no water-storage project of one riparian state should cause any harm to the quality and quantity of freshwater resources in another riparian state.[94] In addition, it also means states should protect water resources from the potential adverse effects of climate change.[95] However, climate change is a global phenomenon;[96] therefore, its potential adverse effects on water resources should be tackled by mutual cooperation among states.[97] Mutual cooperation among states could result in sustainably managing, developing, and preserving freshwater sources. Protecting freshwater resources is necessary to mitigate the threats caused by water scarcity.[98]

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88 *See* R. Warren Flint, *The Sustainable Development of Water Resources*, 127 J. CONTEMP. WATER RSCH. AND EDUC. 41, 43 (2004).

89 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 26.

90 *See id.* at arts. 26, 27.

91 *The Dublin Statement*, *supra* note 10, at 5.

92 *See* BARRY TURNER, THE STATESMAN'S YEARBOOK 2008: THE POLITICS, CULTURES AND ECONOMIES OF THE WORLD 30 (2007).

93 *The Berlin Rules on Water Resources*, *supra* note 20, at arts. 50–55.

94 *See* G.A. Res. 51/229, annex, Convention on the Law of Non-Navigational Uses of International Watercourses, at art. 7 (May 21, 1997); *The Berlin Rules on Water Resources*, *supra* note 20, at art. 12.

95 *See The Berlin Rules on Water Resources*, *supra* note 20, at arts. 22–28.

96 *See* Rajib Shaw et al., *Climate Change: Global Perspectives*, *in* CLIMATE CHANGE ADAPTATION ACTIONS IN BANGLADESH 3, 3 (Rajib Shaw et al. eds., 2013).

97 *See* Eckstein, *supra* note 5, at 436.

98 *See The Dublin Statement*, *supra* note 10, at 7–8 (stressing the importance of preserving water resources for future generations).

Moreover, it is essential that local government agencies raise awareness among the general public regarding how to properly use and protect the available freshwater resources in their territories.[99] Government agencies must implement effective policies and steps to protect freshwater resources and prevent intensifying the world's water scarcity.[100]

It is also necessary to regularly evaluate the quality of freshwater resources,[101] which helps identify potential water pollution.[102] All states must implement stringent measures to reduce pollution in watercourses.[103] In addition, states must also regularly conduct forecasts to predict the potential impacts of climate change on the quality and quantity of water.[104] Consequently, they should take countermeasures to mitigate the projected adverse effects of climate change on their freshwater resources.[105] Collaborative measures to mitigate and counter the harmful effects of climate change on transboundary freshwater resources could be beneficial and prevent the adverse impacts of climate change on international watercourses.[106]

C. Mitigating Conflict over the Distribution of Transboundary Water Resources

It is also essential that riparian states sharing one or more transboundary water resources cooperate to sustainably use their shared freshwater resources.[107] This mutually beneficial cooperation would ensure that when one riparian state extracts water from a transboundary shared water resource, it does not prevent the people of another riparian state from accessing and using water to fulfill their basic life necessities.[108] Moreover, in the event of any conflict or disagreement among riparian states over accessing a shared transboundary water resource, the states should resolve the conflict or disagreement through

99 *Id.* at 4.

100 *See id.*

101 *Id.* at 7.

102 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 28.

103 *See The Dublin Statement*, *supra* note 10, at 3.

104 *See The Berlin Rules on Water Resources*, *supra* note 20, at arts. 34, 35.

105 *See id.*

106 *See id.*

107 *See id.* at art. 11.

108 *See id.* at arts. 3, 14. It is essential that the freshwater be first allocated for fulfilling basic life necessities. *Id.*

bilateral talks.[109] The bilateral talks can also involve signing and implementing bilateral or multilateral agreements that outline the rules regarding distributing and managing the transboundary shared water resources.[110] The agreements should bind riparian states to ensure mutual cooperation and sustainably manage their shared transboundary freshwater resources to mitigate water scarcity.[111] For instance, the Indus Waters Treaty imposed binding regulations on India and Pakistan regarding the Indus Basin. These two states are arch rivals that are upper riparian and lower riparian states, respectively,[112] and they share the water resources of the Indus Basin. The Indus Waters Treaty is a regulatory agreement between Pakistan and India stipulating the rules for utilizing water from the Indus River Basin.[113] Pertinently, the Indus Waters Treaty has stood for the last six decades,[114] despite recurrent skirmishes and hostile relations between the two states. Hence, such agreements can be useful to resolve bilateral conflicts and disagreements among riparian states that share transboundary freshwater resources.

D. Implementing Integrated Water Management Schemes

Integrated water management schemes provide opportunities to sustainably manage and preserve freshwater resources.[115] Those schemes manage land and water resources in an environmentally sustainable way.[116] The World Bank defines integrated water management as a "process through which water and land resources are managed and developed within a coordinated framework in order to

109 *See* Mohammad Badrul Alam, *Nuclear India and Pakistan and Quest for Peaceful Dialogue*, *in* GOVERNANCE, DEVELOPMENT AND CONFLICT 281, 297 (Manas Chatterji et al. eds., 2011). For example, the Permanent Indus Water Commission holds regular dialogue sessions between the upper riparian state, India, and the lower riparian state, Pakistan, regarding any issues that may appear in their utilization of their shared Indus Basin River Waters. *Id.*

110 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 2 (suggesting that the signing of such agreements among the riparian states helps resolve bilateral conflicts over the use of their shared land).

111 *See* ROBERT G. WIRSING ET AL., INTERNATIONAL CONFLICT OVER WATER RESOURCES IN HIMALAYAN ASIA 46 (2013).

112 *See* Rashmi Prakash, *Inter-State River Water Disputes in India: Problems and Solutions*, *in* WATER RESOURCES MANAGEMENT 46, 51 (R.B. Mandal ed., 2006).

113 *Id.*

114 *See id.*

115 *The Dublin Statement*, *supra* note 10, at 6.

116 THE MINISTRY OF WATER RES. AND IRRIGATION & WORLD BANK, ARAB REPUBLIC OF EGYPT: INTEGRATED WATER RESOURCES MANAGEMENT PLAN 6 (June 2005).

maximize economic and social welfare and ensure equity and sustainability of environmental systems."[117]

Many international conventions on sustainably developing and protecting freshwater resources suggest that all states implement integrated water management schemes.[118] However, implementing such schemes requires trained experts to preserve and manage all water resources with no administrative mismanagement.[119] In addition, adopting integrated water management schemes requires substantial financial resources,[120] which may be a reason why many states do not implement such schemes. Once funding becomes available, implementing integrated water management schemes can produce many benefits to preserve and sustainably develop freshwater resources.[121]

The integrated management of water resources can mitigate water scarcity by preserving and sustainably managing freshwater resources.[122] Similarly, it is also essential for riparian states sharing one or more transboundary freshwater resources to cooperate.[123] Riparian states can cooperate, whether by treaty or joint body, to improve how they manage and protect international water resources[124] by eliminating pollution and reducing water scarcity.[125]

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117 *Id.*

118 *See, e.g.*, *The Berlin Rules on Water Resources*, *supra* note 20; U.N. Econ. Comm'n for Eur., The 1992 UNECE Convention on the Prot. & Use of Transboundary Watercourses & Int'l Lakes, https://www.unece.org/fileadmin/DAM//env/water/documents/brochure_water_convention.pdf [https://perma.cc/XNG4-NUDS]; G.A. Res. 51/229, *supra* note 94; *The Dublin Statement*, *supra* note 10 (recommending the adoption of integrated water management schemes); *see* Stoa, *supra* note 21.

119 *See The Dublin Statement*, *supra* note 10, at 7.

120 *See id.*

121 *See id.* at 6.

122 *See id.*

123 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 11.

124 *See, e.g.*, U.N. ECON. COMM'N FOR EUR. (UNECE), RIVER BASIN COMMISSIONS AND OTHER INSTITUTIONS FOR TRANSBOUNDARY WATER COOPERATION: CAPACITY FOR WATER COOPERATION IN EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA, at 8, U.N. Doc. ECE/MP.WAT/32, U.N. Sales No. 09.II.E.16 (2009) [hereinafter RIVER BASIN COMMISSIONS].

125 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 26.

III
INTERNATIONAL LAW AND WATER SCARCITY

International law directs states in utilizing and managing freshwater resources.[126] Notably, this section of the Article discusses the relevant clauses of the Berlin Rules on Water Resources (2004), the UNECE Convention (1992), Agenda 21 from the 1992 Earth Summit Conference in Brazil (1992), the U.N. Watercourses Convention (1997), and the Dublin Statement (1992). These conventions highlight the importance of managing, preserving, and developing freshwater resources to mitigate water scarcity by setting principles, rules, and recommendations.[127] Therein, this section of the Article will elaborate on how the aforementioned conventions of international law endorse those suggestions—managing sustainably, reducing pollution, protecting water resources, mitigating conflict, and implementing integrated water management schemes.

A. Sustainability

Sustainability is an essential requirement for managing and utilizing freshwater resources. The relevant clauses of the international law conventions on water resources that endorse sustainability are elaborated below.

1. The UNECE Convention (1992)

In 1992, the leadership of the United Nations Economic Commission for Europe (UNECE) held the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, also known as the UNECE Convention.[128] The UNECE Convention recommends that states sustainably manage and use their freshwater resources.[129] In particular, the Convention recommends

126 *See* Stucki et al., *supra* note 21, at 395.

127 *See* Stoa, *supra* note 21, at 451–52.

128 *See* Iulia Trombitcaia & Sonja Koeppel, *From a Regional Towards a Global Instrument – The 2003 Amendment to the UNECE Water Convention*, *in* THE UNECE CONVENTION ON THE PROTECTION AND USE OF TRANSBOUNDARY WATERCOURSES AND INTERNATIONAL LAKES: ITS CONTRIBUTION TO INTERNATIONAL WATER COOPERATION 15, 15 (Attila Tanzi et al. eds., 2015).

129 Convention on the Protection and the Use of Transboundary Watercourses and International Lakes pmbl., Sep. 18, 1992, 1936 U.N.T.S. 269 [hereinafter UNECE Convention].

states cooperate when using and managing their shared resources[130] by recommending states sign bilateral or multilateral agreements focusing on implementing cooperative measures.[131] The UNECE Convention recommends riparian states create joint bodies that monitor and facilitate measures for sustainably managing and using their transboundary shared water resources.[132] Further, the Convention mandates that those joint bodies ensure the timely exchange of data regarding the quality and quantity of the water flow in their shared transboundary watercourses.[133]

Sustainably managing freshwater resources, which riparian states can carry out through joint measures by riparian states, can effectively mitigate water scarcity and improve the level of water security for all the concerned riparian states.[134] Therefore, the UNECE Convention (1992) emphasizes that every measure riparian states take should ensure that the freshwater resources are sustainable.[135]

2. The Berlin Rules on Water Resources (2004)

The International Law Association (ILA) presented the Berlin Rules in 2004.[136] The Berlin Rules provide valuable guidance for managing freshwater resources.[137] In particular, the Berlin Rules recommend that states manage and consume their freshwater resources in a sustainable manner.[138] For clarity, the Berlin Rules define "sustainability" in Article 3: "'[s]ustainable use' means the integrated management of resources to assure efficient use of and equitable access to water for the benefit of current and future generations while preserving renewable resources and maintaining non-renewable resources to the maximum

130 *See* CHRISTINA LEB, COOPERATION IN THE LAW OF TRANSBOUNDARY WATER RESOURCES 64 (2013).

131 *See* RIVER BASIN COMMISSIONS, *supra* note 124, at 8.

132 UNECE Convention, *supra* note 129, at 276.

133 *Id.* Article 9 of the UNECE Convention makes it an obligation for the riparian states to establish joint bodies. *Id.*

134 *See* Anatole Boute, *The Water-Energy-Climate Nexus Under International Law: A Central Asian Perspective*, 5 MICH. J. ENV'T & ADMIN. L. 371, 408 (2016).

135 *See* UNECE Convention, *supra* note 129, at 270–71.

136 SLAVKO BOGDANOVIĆ, THE INTERNATIONAL LAW ASSOCIATION HELSINKI RULES: CONTRIBUTION TO INTERNATIONAL WATER LAW 77 (2019).

137 *See* Jens Newig & Edward Challies, *Water, Rivers, and Wetlands*, *in* ROUTLEDGE HANDBOOK OF GLOBAL ENVIRONMENTAL POLITICS 439, 446 (Paul G. Harris ed., 2013).

138 OWEN MCINTYRE, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW 247 (2016).

extent reasonably possible."[139] In addition, in Article 3(14) the Berlin Rules define measures to sustainably manage freshwater resources, including the "development, use, protection, allocation, regulation, and control of waters."[140] The six measures mentioned in Article 3(14) denote special endeavors states should implement in a sustainable manner.[141]

a. Development of Freshwater Resources

The first measure—the "development" of freshwater resources in a sustainable manner—implies states manage their resources to ensure minimal wastage of water and improve the future availability of water.[142] To carry out the integrated management and sustainable development of freshwater resources, Article 64 of the Berlin Rules recommends that states establish joint bodies to plan and execute the integrated management of freshwater resources.[143] Article 64 also recommends that the joint bodies review the arrangements and procedures of basin-wide joint management of freshwater resources[144] to ensure the arrangements are sustainable and beneficial to mitigate water scarcity in the future.[145]

b. Sustainable Use of Freshwater Resources

The second measure—the "use" of freshwater resources in a sustainable manner—implies that states should optimally extract water from freshwater resources.[146] States should not harm the quality or quantity of water in the reserve.[147] For instance, if a state extracts the water from a river basin, then the state should not harm the natural flow of the river.[148] Similarly, if a state extracts water from a groundwater reserve, the state should not significantly lower the groundwater table.[149] Furthermore, the Berlin Rules recommend that states should first allocate enough water to meet peoples' basic needs to drink and to

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139 *The Berlin Rules on Water Resources*, *supra* note 20, at art. 3(19).

140 *Id.* at art. 3(14); *see id.* at art. 1 (commentary under text).

141 *See id.* at art. 3(14).

142 *See* Flint, *supra* note 88, at 43 (defining sustainable development of water).

143 *The Berlin Rules on Water Resources*, *supra* note 20, at art. 64.

144 *Id.*

145 *See id.*

146 *See* Flint, *supra* note 88, at 43.

147 *See id.* (reflecting on the meaning of sustainability).

148 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 24 (commentary under text).

149 *Id.* at art. 40 (commentary under text).

use for domestic and agricultural purposes.[150] Once states allocate water for the basic life necessities, states may use their transboundary water resource to carry out other endeavors, such as using their transboundary water resources for industrial use.[151] In Article 3(20) of the Berlin Rules, "'[v]ital human needs' means waters used for immediate human survival, including drinking, cooking, and sanitary needs, as well as water needed for the immediate sustenance of a household."[152] After defining vital human needs, Articles 3 and 14 of the Berlin Rules instruct all states, whether riparian or not, to first allocate water to fulfill vital human needs;[153] only then can states equitably and sustainably use freshwater resources.[154] Articles 3 and 14 instruct, "In determining an equitable and reasonable use, states shall first allocate waters to satisfy vital human needs."[155]

c. Allocation of Freshwater Resources

The third measure—the "allocation" of freshwater resources in a sustainable manner—implies that states must equitably allocate freshwater resources to all parties that depend on it.[156] The measure specifically refers to transboundary freshwater resources shared by two or more states.[157] Equitably utilizing freshwater resources means that no riparian state can deprive another of its due share of water from a resource.[158] Article 12 also recommends that "[b]asin States shall in their respective territories manage the waters of an international drainage basin in an equitable and reasonable manner having due regard for the obligation not to cause significant harm to other basin States."[159] In order to manage a transboundary freshwater resource in a sustainable manner, Article 11 of the Berlin Rules recommends that riparian states cooperate: "[b]asin States shall cooperate in good faith in the management of waters of an international drainage basin for the mutual benefit of the participating States."[160]

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150 *See id.* at art. 14.

151 *See id.*

152 *Id.* at art. 3(20).

153 *Id.* at arts. 3, 14.

154 *See id.*

155 *Id.* at arts. 3, 14.

156 *Id.* at art. 7 (commentary under text).

157 *See id.*; *see also id.* at art. 12.

158 *See id.* at art. 12.

159 *Id.*

160 *Id.* at art. 11.

Riparian states can cooperate by establishing joint agencies or committees to oversee the integrated management, development, protection, and utilization of freshwater resources.[161]

Similarly, riparian states can cooperate by timely exchanging qualitative and quantitative data regarding the flow of water in a shared transboundary resource.[162] States can also exchange data related to the flow of rivers, precipitation rates, or water levels in dams.[163] Exchanging data can help states prevent the hostile impacts of climate change on watercourses and can help states sustainably manage and protect their transboundary watercourses.[164]

B. Protecting Freshwater Resources

Protecting freshwater resources is an important recommendation that states need to actively pursue to mitigate water scarcity. The relevant clauses of several notable international law conventions, which highlight the need to protect freshwater resources, are discussed below.

1. The Berlin Rules on Water Resources (2004)

During armed conflicts, protecting freshwater resources involves two aspects: protecting the aquatic environment and protecting freshwater resources.[165] Protecting the aquatic environment means protecting the natural ecological flow of water,[166] protecting watercourses from hazardous chemicals,[167] and protecting freshwater resources from pollution.[168] Chapter V of the Berlin Rules suggests that state parties act to reduce pollution and prevent any entity from polluting freshwater resources.[169] If pollution occurs in any freshwater resource, the Berlin Rules advise state parties take immediate action to remove the pollution and eliminate its potential cause.[170] In addition,

161 *See id.* at art. 64.

162 *See id.* at art. 42.

163 *See id.* at art. 34 (commentary under text).

164 *See id.*

165 *See id.* at arts. 22–28 (discussing protecting the aquatic environment); *see also id.* at arts. 50–55 (discussing protecting freshwater resources).

166 *See id.* at art. 24.

167 *See id.* at art. 26.

168 *See id.* at art. 27.

169 *See id.*

170 *Id.* at art. 27; *see also id.* at art. 33.

the Berlin Rules advise state parties to create water quality standards to evaluate the quality of drinking water.[171]

a. Protection from Climate-Related Threats

Climate change poses the most damaging threat to freshwater resources because it creates unusual droughts, which cause the partial or complete drying out of freshwater resources.[172] States must mitigate this threat to protect freshwater resources.[173] The Berlin Rules suggest that state parties cooperate to prevent drought-related threats from occurring.[174] Articles 34 and 35 specifically recommend that state parties take cooperative, preventative action to protect freshwater resources from drought-related situations.[175] Both articles suggest that state parties regularly exchange data related to the quality and quantity of water and implement coordinated measures to sustainably maintain the quantity of water.[176] Such measures, if implemented to sustainably manage freshwater resources, can mitigate the potential impacts of climate change and reduce the scarcity of freshwater resources.[177]

b. Protection of Groundwater Aquifers

The Berlin Rules address protecting groundwater resources.[178] The stress on groundwater resources continues to increase considerably due to an increase in population. In many regions—for instance, in California, India, and Pakistan—the groundwater table has fallen

171 *Id.* at art. 28(1).

172 *See* PAVEL KABAT & HENK VAN SCHAIK, CLIMATE CHANGES THE WATER RULES: HOW WATER MANAGERS CAN COPE WITH TODAY'S CLIMATE VARIABILITY AND TOMORROW'S CLIMATE CHANGE 22 (2003).

173 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 35.

174 *See id.* at arts. 34, 35.

175 *Id.*, at arts. 34, 35; Ha Le Phan & Inga T. Winkler, *Water Security*, *in* RESEARCH HANDBOOK ON DISASTERS AND INTERNATIONAL LAW 295, 309 (Susan C. Breau & Katja L.H. Samuel eds., 2016).

176 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 34 (explaining the mitigation of threats of floods); *see also id.* at art. 35 (explaining the mitigation of threats of droughts).

177 *See* Flint, *supra* note 88, at 43.

178 *See The Berlin Rules on Water Resources*, *supra* note 20, at arts. 36–42; *see also* Joseph W. Dellapenna, *The Law of Transboundary Groundwater*, *in* THE EARTH CHARTER, ECOLOGICAL INTEGRITY AND SOCIAL MOVEMENTS 77, 84 (Laura Westra & Mirian Vilela eds., 2014).

significantly,[179] which may cause water scarcity.[180] To protect groundwater resources, the Berlin Rules advise state parties to implement measures that could sustainably use groundwater resources.[181] Chapter VIII provides more recommendations on protecting groundwater.[182] For instance, Chapter VIII, Article 41, suggests that states take measures to prevent salinity in groundwater resources because salinity can make groundwater resources unsafe for drinking.[183] Similarly, Article 41 advises state parties ensure that groundwater resources remain protected from pollution.[184]

c. Protection of Water Resources During Armed Conflicts

To protect freshwater resources during armed conflicts, the Berlin Rules mandate that all state parties ensure no harm is done to water resource facilities when a state is involved in armed conflicts.[185] Chapter X of the Berlin Rules, which mandates that combatants cannot harm water resources if the harm would cause disproportionate suffering to civilians, illustrates this rule.[186] Thus, implementing the Berlin Rules can protect both freshwater resources and prevent water scarcity during armed conflicts.

2. Agenda 21

Agenda 21 is a set of recommendations endorsed by the United Nations during the 1992 Earth Summit Conference in Brazil.[187] Although Agenda 21 primarily focuses on sustainable development and environmental preservation, Chapter 18 addresses the availability of freshwater resources.[188] To protect freshwater resources from pollution, Chapter 18 advises state parties take measures to prevent pollution in existing freshwater resources.[189] Protecting freshwater

179 Fienen & Arshad, *supra* note 9, at 27.

180 Jason M. Buenkar & Robert A. Robinson, *A History of Tunneling in Los Angeles*, *in* NORTH AMERICAN TUNNELING: 2014 PROCEEDINGS 1111, 1112 (Davidson Gregg et al. eds., 2014).

181 *The Berlin Rules on Water Resources*, *supra* note 20, at art. 40.

182 *See id.* at arts. 36–42.

183 *See id.* at art. 41(2)(c).

184 *Id.* at art. 41.

185 *See id.* at arts. 50–55.

186 *Id.* at art. 51(1).

187 *See generally Rio Declaration on Environment and Development*, *supra* note 83.

188 *Id.* at ch. 18.

189 *Id.* ¶ 18.2.

resources from pollution and managing freshwater resources can reduce water scarcity.[190]

3. The Convention on the Law of the Non-Navigational Uses of International Watercourses (1997)

In 1997, the United Nations General Assembly adopted the Convention on the Law of the Non-Navigational Uses of International Watercourses, also known as the U.N. Watercourses Convention.[191] The U.N. Watercourses Convention recommends that state parties implement adequate measures to preserve and manage freshwater resources.[192] In particular, the U.N. Watercourses Convention focuses on transboundary watercourses shared by two or more riparian states.[193] The U.N. Watercourses Convention obligates all state parties to ensure that they protect and sustainably develop transboundary water resources.[194] Article 5 expresses this obligation as follows: "Watercourse [s]tates shall participate in the use, development and protection of an international watercourse in an equitable and reasonable manner."[195]

In addition, Articles 8 and 9 of the U.N. Watercourses Convention recommend other methods not only to ensure continued cooperation among riparian states after allocating water but also to ensure continued cooperation among riparian states in mitigating scarcity.[196] For instance, Article 9 advises riparian states to continually share data about the flow of water in their shared transboundary watercourse.[197] This data must include information about the quality and quantity of water.[198] Article 9 states, "Pursuant to Article 8, watercourse states shall on a regular basis exchange readily available data and information on the condition of the watercourse, in particular that of a hydrological,

190 *See id.* ¶ 18.6.

191 ALISTAIR RIEU-CLARKE, INTERNATIONAL LAW AND SUSTAINABLE DEVELOPMENT: LESSONS FROM THE LAW OF INTERNATIONAL WATERCOURSES 24 (2005).

192 G.A. Res. 51/229, *supra* note 94, at art. 1.

193 *Id.* at arts. 1, 2 (defining an international watercourse as "a watercourse, parts of which are situated in different States").

194 *See* Christina Leb, *The Significance of the Duty to Cooperate for Transboundary Water Resource Management Under International Water Law*, *in* ROUTLEDGE HANDBOOK OF WATER LAW AND POLICY 247, 252 (Alistair Rieu-Clarke et al. eds., 2017).

195 G.A. Res. 51/229, *supra* note 94, at art. 5.

196 *See id.* at arts. 8, 9.

197 *Id.* at art. 9.

198 *See id.* at art. 9(1).

meteorological, hydrogeological and ecological nature and related to the water quality as well as related forecasts."[199] Subsequently, states should implement initiatives to eliminate pollution in their shared watercourses, particularly if the data informs the states about the presence of pollution in the water.[200]

In addition, the U.N. Watercourses Convention recommends states cooperate and exchange their watercourse data to assess and mitigate the threats of climate change and natural disasters on their watercourses.[201] Article 27 of the U.N. Watercourses Convention identifies those threats as "resulting from natural causes or human conduct, such as flood or ice conditions, water-borne diseases, siltation, erosion, salt-water intrusion, drought or desertification."[202] To mitigate those threats, the U.N. Watercourses Convention suggests that riparian states implement joint measures to protect their shared transboundary watercourses.[203] By cooperating, riparian states can take emergency measures to counter the adverse effects of floods and droughts.[204] A well-coordinated emergency response will improve the effectiveness of such measures in mitigating climate change threats on water resources.[205]

In addition, Article 5 of the U.N. Watercourses Convention suggests that riparian states cooperate to equitably use and manage their shared freshwater resources.[206] Article 11 of the U.N. Watercourses Convention advises riparian states share data about their planned and ongoing water-storage projects and other projects related to shared transboundary watercourses.[207] Sharing data will allow states to assess whether water-storage projects, or related projects that other riparian states plan or pursue, have potentially harmful effects on each state's water resources.[208] The Indus Waters Treaty (1960), which India and Pakistan signed regarding the allocation of the Indus Basin, is an

199 *Id.*

200 *See* Leb, *supra* note 194, at 252.

201 *See* G.A. Res. 51/229, *supra* note 94, at art. 28(1).

202 *Id.* at art. 27.

203 *Id.*

204 *Id.* at art. 28.

205 *See id.* at art. 28(3).

206 *Id.* at art. 5.

207 *See id.* at art. 11.

208 *See id.* at art. 12.

example of two riparian states cooperating to manage their shared freshwater resources.[209]

Article 27 states, "Watercourse states shall, individually and, where appropriate, jointly, take all appropriate measures to prevent or mitigate conditions related to an international watercourse that may be harmful to other watercourse states."[210] For instance, if an upper riparian state's water-storage work is harmful, then the lower riparian state can share its concerns and ask the upper riparian state to modify the design or storage capacity of its water-storage work.[211] In addition, the U.N. Watercourses Convention recommends timelines (e.g., six months) for exchanging information and notifying the other party about any planned water-storage works that a state may want to construct on shared transboundary water resources.[212] Timelines ensure that no riparian state's water-storage work will result in a lack of water for the other state.[213] Thus, sharing data among states can prevent water scarcity from any man-made water management endeavors.

To ensure justice in allocating water between riparian states, the U.N. Watercourses Convention advises states to equitably distribute and use the transboundary water resource while also respecting the interests of co-riparian states.[214] Specifically, Article 5 of the U.N. Watercourses Convention illustrates this advice: "Watercourse states shall in their respective territories utilize an international watercourse in an equitable and reasonable manner."[215] Hence, the U.N. Watercourses Convention advises riparian states to cooperate and implement jointly coordinated endeavors that will serve as emergency responses to protect their shared, transboundary freshwater resources.[216] Thus, the U.N. Watercourses Convention regards cooperation among riparian states as a fundamental step to effectively mitigate water-related threats.[217]

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209 WIRSING ET AL., *supra* note 111, at 46; *see also* Prakash, *supra* note 112, at 51.

210 G.A. Res. 51/229, *supra* note 94, at art. 27.

211 *See id.* at art. 12.

212 *Id.* at arts. 12–18.

213 *See id.*

214 *Id.* at art. 5(1).

215 *Id.*

216 *Id.* at art. 28.

217 *See id.* at art. 27.

C. Mitigating Conflict

Mitigating conflict among the riparian states over distributing their shared, transboundary freshwater resources is an essential recommendation for managing water scarcity. Therefore, certain international law conventions, such as the Berlin Rules on Water Resources (2004), suggest some principles for mitigating conflicts among the riparian states.[218] In addition, some bilateral treaties have provided guidance to riparian states in preventing conflicts and equitably and peacefully sharing their watercourses.[219]

A noteworthy measure suggested in Article 3(14) of the Berlin Rules on Water Resources—"regulation"—implies enacting new laws and agreements can enforce the equitable utilization of water among riparian states.[220] The Indus Waters Treaty is an example of such regulation among upper and lower riparian states.[221] The Indus Waters Treaty divided the water resources of the Indus Basin between India and Pakistan in an equitable manner by allocating the three eastern rivers of the Indus Basin to India and the three western rivers to Pakistan.[222] Furthermore, the Indus Waters Treaty also provides rules and restrictions on the consumptive use of water resources, which means using the water of a river in such quantity as to cause a change in its natural flow.[223] Restricting the consumptive use of water resources prevents India from using the western rivers of the Indus Basin for consumptive purposes but allows India to use the Basin's eastern rivers for consumptive purposes.[224] Similarly, the Indus Waters Treaty prevents Pakistan from consumptive use of the eastern rivers but allows Pakistan to extract water from the western rivers.[225] Thus, in a way, the Indus Waters Treaty prevents both riparian states, to the extent practicable, from changing the natural flow of water in the rivers

218 *E.g.*, *The Berlin Rules on Water Resources*, *supra* note 20, at art. 10.

219 *See* Patricia Wouters, *Universal and Regional Approaches to Resolving International Water Disputes: What Lessons Learned from State Practice?*, *in* RESOLUTION OF INTERNATIONAL WATER DISPUTES: PAPERS EMANATING FROM THE SIXTH PCA INTERNATIONAL LAW SEMINAR, NOVEMBER 8, 2002, 138–46 (Kluwer Law International ed., 2003).

220 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 3(14).

221 WIRSING ET AL., *supra* note 111, at 46.

222 FEREIDOUN GHASSEMI & IAN WHITE, INTER-BASIN WATER TRANSFER: CASE STUDIES FROM AUSTRALIA, UNITED STATES, CANADA, CHINA AND INDIA 42 (2007).

223 *See* The Indus Waters Treaty, India-Pak., art. IV, Sep. 19, 1960, 419 U.N.T.S. 125.

224 *See id.* at 130–40.

225 *See id.*

allocated to the other riparian states.[226] Hence, the Indus Waters Treaty not only ensures both states equitably use the eastern and western rivers but it also ensures the sustainable use of their waters.[227] Preventing consumptive use averts the drying out of the rivers, which prevents the acute scarcity of water in the rivers.[228]

The term "regulation" can also imply that states create and enforce rules that can prevent the spread of pollution in freshwater resources.[229] For instance, such regulatory rules can restrict factories from throwing their industrial chemical waste into freshwater resources, or penalize them for doing so.[230] Such restrictions can protect the freshwater resources and could reduce the ongoing water scarcity.

D. Implementing Efficient Water Management Schemes

Implementing efficient water management schemes, such as the integrated water management scheme, is the most essential requirement to extend more control over freshwater resources. Having more control can enhance efficiency in managing the watercourses and, consequently, in mitigating the scarcity of water.

1. Berlin Rules on Water Resources Regarding "Control of Water"

The "control of water," as mentioned in the Berlin Rules on Water Resources, implies implementing such endeavors to provide states with additional control over managing freshwater resources.[231] The "control of water" could also mean the integrated management of freshwater resources.[232] In addition, the text of Article 27 of the Berlin Rules requires states to take measures to control water pollution.[233] In any case, any endeavor to gain control over the freshwater must lead to

226 *See id.*

227 *See* Prakash, *supra* note 112, at 51.

228 *See* The Indus Waters Treaty, *supra* note 223, 419 U.N.T.S. at 136. Consumptive use of water implies unrestricted use, which may have the tendency to affect the natural flow of water in the river. *Id.*

229 *See The Berlin Rules on Water Resources*, *supra* note 20, at arts. 5, 8 (endorsing the application of Supplemental Rules on Pollution).

230 TURNER, *supra* note 92, at 30 (penalizing factories for polluting the watercourses applies the "polluter pays" principle).

231 *The Berlin Rules on Water Resources*, *supra* note 20, at art. 3(14).

232 *Id.* at arts. 3(14), 6. According to Article 3 of the Berlin Rules, the management and integrated management of water resources includes gaining control of the water. *Id.* at art. 3. Article 6 of the Berlin Rules stresses implementing integrated management. *Id.* at art. 6.

233 *Id.* at art. 27.

sustainably managing freshwater resources.[234] Article 7 of the Berlin Rules reiterates this recommendation in unequivocal words: "States shall take all appropriate measures to manage waters sustainably."[235]

In a nutshell, the Berlin Rules push state parties toward sustainably managing and using their freshwater resources in order to mitigate water scarcity and ensure adequate water security for every human being.[236] Therein, the Berlin Rules suggest carrying out sustainable development by implementing integrated management schemes for freshwater resources and enforcing rules and regulations for preventing pollution and the unsustainable use of freshwater resources.[237]

2. Agenda 21

Chapter 18 of Agenda 21 endorses that the adequate availability of freshwater resources is essential for life.[238] Chapter 18 also endorses the fundamental right to an adequate amount of good quality water.[239] Therefore, all state parties should take measures to ensure that every human being has this right.[240] Agenda 21 further endorses the Mar del Plata Action Plan, which the U.N. Watercourses Conference approved.[241] The Mar del Plata Action Plan accepts this right to water by stating, "All peoples, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantities and of a quality equal to their basic needs."[242]

Considering the right to water, Agenda 21 sets several goals for all state parties to implement measures guaranteeing the availability of an adequate amount of good-quality freshwater for drinking and sanitizing purposes.[243] However, Agenda 21 also accepts the fact that water scarcity is currently mounting in many regions of the world.[244] Thus, in order to ensure that an adequate amount of good-quality water is available for all human beings, Agenda 21 advises state parties adopt

234 *Id.* at art. 7.

235 *Id.*

236 *See id.*

237 *See id.* at arts. 3(14), 6.

238 *Rio Declaration on Environment and Development*, *supra* note 83, ¶ 18.2.

239 *Id.* ¶ 18.47.

240 *Id.*

241 *Id.*

242 *Id.; see also* U.N. Water Conference, *Mar del Plata Action Plan*, U.N. Doc. E/Conf. 70/29 (Mar. 1977).

243 *Rio Declaration on Environment and Development*, *supra* note 83, ¶ 6.3.

244 *Id.* ¶¶ 18.3, 18.6.

modern technology to create improved strategies for managing scarce water resources.[245] To achieve this purpose, Agenda 21 also suggests implementing integrated water management schemes for managing and utilizing scarce freshwater resources.[246]

Proper management of freshwater resources results in allocating the required amount of water to all the sectors that need it.[247] For instance, states can allocate water to the agricultural and industrial sectors after states make available an adequate amount of water for basic life necessities.[248] Therefore, considering the basic needs of the communities that depend on those water resources, Agenda 21 sets an objective for state parties to implement integrated water management schemes that will ensure preserving and sustainably managing freshwater resources.[249]

Chapter 18 of Agenda 21 also includes recommendations for managing transboundary freshwater resources in a way that could benefit all the riparian states equitably.[250] For this purpose, Agenda 21's first and foremost recommendation involves building mutually beneficial cooperation among riparian states.[251] States can cooperate by mutually exchanging data regarding the flow of their shared transboundary watercourses and by signing contracts that manage the transboundary freshwater resources.[252]

E. The Dublin Statement (1992) and Its Principles for Mitigating Water Scarcity

In 1992, the Dublin Statement on Water and Sustainable Development (Dublin Statement) was ratified at the International Conference on Water and the Environment (ICWE), which was held in Dublin, Ireland.[253] The Dublin Statement addresses the concerns related to the emergence of water scarcity.[254] The Dublin Statement

245 *Id.* ¶ 18.2.

246 *Id.* ¶ 18.3.

247 *See id.*

248 *See id.* ¶ 18.8.

249 *Id.* ¶ 18.9(b).

250 *See id.* ¶¶ 18.4, 18.10.

251 *Id.* ¶ 18.4.

252 *See id.* ¶ 18.27.

253 RICHARD E. SAUNIER & RICHARD A. MEGANCK, DICTIONARY AND INTRODUCTION TO GLOBAL ENVIRONMENTAL GOVERNANCE 109 (2007).

254 *The Dublin Statement*, *supra* note 10, at 3.

recommends a number of steps and policies for states to take in order to mitigate the threats related to water scarcity.[255] In addition, the Dublin Statement discusses the concerns related to improper management and misappropriation of freshwater resources.[256]

The Dublin Statement also highlights pollution as one of the main concerns causing water management and water safety problems, thus threatening the earth's ecology.[257] The Dublin Statement also invites all state parties to implement adequate measures to reduce pollution in freshwater resources.[258] Moreover, the Dublin Statement demands state parties ensure better management of their freshwater resources, which will lead to better preservation and development of the freshwater resources.[259] Like the U.N. Watercourses Convention, the Dublin Statement also recommends that state parties cooperate and take joint measures to manage and develop freshwater resources.[260]

In particular, the Dublin Statement introduces four principles that guide state parties to mitigate water scarcity and pave the way for sustainable development.[261] The first principle accepts the finite nature of freshwater on Earth and stresses the need to implement sustainable development measures to preserve existing freshwater resources.[262] The text of the first principle unequivocally states, "Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment."[263]

The second principle recommends policy-makers and planners participate in developing and managing existing freshwater resources.[264] The text of the second article asserts that "water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels."[265]

The third principle recognizes the significance of the role of women in sustainably managing and preserving water resources.[266]

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255 *Id.* at 3, 5–7.

256 *Id.*

257 *Id.* at 12; *see id.* at 3.

258 *Id.* at 3.

259 *See id.*

260 *See id.*; *see also id.* at 5–7.

261 *Id.* at 4.

262 *Id.*

263 *Id.*

264 *Id.*

265 *Id.*

266 *Id.*

Specifically, the third principle accepts the fact that, in many regions, women preserve sufficient quantities of water for their children and families for drinking and other household purposes.[267] The third principle states that "women play a central part in the provision, management and safeguarding of water."[268]

The fourth principle assigns economic value to freshwater.[269] It regards freshwater as an important and valuable resource on Earth; therefore, the fourth principle considers water an "economic good."[270] This is stated in the text of the fourth principle: "Water has an economic value in all its competing uses and should be recognized as an economic good."[271]

To realize the goals set by these four principles, the Dublin Report at the ICWE provides a separate Action Agenda,[272] which highlights some of the concerns that can directly or indirectly affect the provision of freshwater.[273] For instance, the Action Agenda considers poverty as one of the reasons for poor sanitation and a lack of freshwater management facilities.[274] Hence, the Action Agenda recommends that states manage freshwater resources in such a manner that ensures people have proper sanitation facilities because having proper sanitation facilities will help to create a disease-free environment.[275]

In addition, the Action Agenda considers poor natural disaster preparedness to be one of the factors intensifying the harmful effects of climate change on water resources.[276] Furthermore, the Action Agenda expresses regret that developing countries, in particular, have not exerted sufficient efforts protecting and mitigating the impact of climate change on freshwater resources.[277] The Action Agenda also warns that climate change and rising sea levels can have disastrous effects on existing freshwater resources.[278] Therefore, it concludes that states must adopt the recommendations of the Dublin Report to prevent

267 *Id.*
268 *Id.*
269 *Id.*
270 *Id.*
271 *Id.*
272 *Id.* at 5–7.
273 *Id.*
274 *See id.* at 5.
275 *See id.*
276 *See id.*
277 *Id.*
278 *See id.*

the severe projected effects of climate change on freshwater resources.[279]

The Action Agenda of the Dublin Statement also highlights the unfortunate fact that current water management schemes result in excessive wasting of freshwater.[280] In particular, the agricultural sector causes a significant amount of freshwater waste in the course of irrigating crops.[281] The Action Agenda further highlights that agriculture consumes around 80% of the total freshwater used on Earth; however, around 60% of freshwater is wasted on its path to crop plants.[282] Primarily, this waste is due to many regions of the world adopting inefficient irrigation schemes.[283] Thus, the Action Agenda calls for adopting efficient irrigation schemes to save the amount of freshwater currently lost during irrigation.[284]

In addition, the Action Agenda recommends state parties penalize those spreading pollution in watercourses.[285] Specifically, it suggests the "polluter pays" principle,[286] which means that state parties should charge freshwater polluters a financial penalty that correlates to the amount or nature of the polluting chemicals that the polluters throw into the watercourses.[287] Such penalties will hold the polluting factories accountable and make them pay for the damage they commit to fresh watercourses.[288] As a result, watercourses will remain cleaner and become available for the general public to drink and to use for other domestic purposes.

The Action Agenda also highlights the impact of increasing urbanization on the availability of freshwater in urban regions.[289] Specifically, the Action Agenda recognizes the additional stress on water resources due to growing urban populations.[290] Urbanization has also reduced the amount of water available to drink and to use for other

279 *Id.*

280 *See id.*

281 *Id.*

282 *Id.*

283 *Id.*

284 *See id.*

285 *Id.*

286 *Id.*

287 TURNER, *supra* note 92, at 30.

288 FREDERICK BOADU, AGRICULTURAL LAW AND ECONOMICS IN SUB-SAHARAN AFRICA 507 (2016).

289 *The Dublin Statement*, *supra* note 10, at 6.

290 *Id.*

domestic purposes in urban areas.[291] In addition, the Action Agenda regards previous inefficient management and excessive water wasting as major reasons for reducing the freshwater resources in urban regions.[292] The increasing scarcity of freshwater resources in urban regions is getting worse in the world's most populous cities where residents are now facing an acute shortage of water.[293] For instance, the groundwater tables in California, Pakistan, and India have greatly declined, making these regions water scarce.[294]

The Action Agenda particularly recommends adopting integrated water management schemes to preserve fresh watercourses.[295] It further asserts that state parties should sign international agreements that will guide the integrated management of their freshwater resources.[296] In addition, the Action Agenda stresses resolving bilateral or multilateral conflicts among riparian states over distributing, allocating, and utilizing their shared transboundary freshwater resources.[297] It suggests that state parties record the quality and quantity of water every season in order to assess the rise or fall of watercourse flow and any changes in water quality.[298] Experts that analyze water quality and quantity data can assess the potential effects of climate change on the watercourse.[299] Additionally, the Action Agenda requires all state parties to gather data related to the quality and quantity of water flow in their regions.[300]

Importantly, the Dublin Conference accepts that implementing the Action Agenda's recommendations without administrative error will require the services of highly trained and experienced individuals to create, plan, and implement these policies.[301] If a state does not have personnel with experience in implementing integrated water management works, then the state should provide integrated water management training to its water management personnel.[302] In addition, the Action Agenda stresses the need to spread awareness to

291 *Id.*
292 *See id.*
293 *See* Fienen & Arshad, *supra* note 9, at 27.
294 *See id.*
295 *The Dublin Statement*, *supra* note 10, at 6.
296 *See id.*
297 *See id.*
298 *See id.* at 7.
299 *See id.*
300 *Id.*
301 *Id.*
302 *Id.*

the general public regarding the importance of managing and preserving freshwater.[303] Thus, governments should also offer training and awareness programs to the public to guide them about preserving and preventing water waste.[304]

Overall, international law has provided some relevant guidance and recommendations to states to sustainably manage, develop, and preserve their freshwater resources.[305] In particular, the international conventions discussed above recommend that states take seven steps: (1) prevent pollution in their freshwater resources; (2) implement integrated water management schemes; (3) cooperate to sustainably develop and manage their transboundary shared freshwater resources; (4) share and exchange data regarding the quality and quantity of water flow; (5) analyze data on the flow of water to estimate the probable effects of climate change on the existing water resources; (6) prevent excessive wastage of freshwater; and (7) spread awareness to the public about safeguarding freshwater resources.[306]

CONCLUSION

Water scarcity is the shortage of available water.[307] Today, water scarcity is growing at an alarming pace.[308] Many regions in the world face significant decline in available freshwater,[309] and climate change is the most significant contributor.[310] It has altered precipitation rates in many regions and has caused a significant decline in rainfall in midlatitude and Mediterranean regions.[311] In turn, the shortage of freshwater in these regions has led to a decline in agricultural production because less water is available for irrigating crops.[312] Consequently, water shortage threatens the food security of people who depend on crop production for their livelihoods.[313]

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303 *See id.*

304 *See id.*

305 *See* Stoa, *supra* note 21, at 451–52.

306 *See supra* Section III.

307 *See* Fluence News Team, *What Is Water Scarcity?*, FLUENCE (Oct. 6, 2017), https://www.fluencecorp.com/what-is-water-scarcity/ [https://perma.cc/KN2X-LRAM].

308 *See The Dublin Statement*, *supra* note 10, at 3.

309 *See* Fienen & Arshad, *supra* note 9, at 28.

310 *See The Dublin Statement*, *supra* note 10, at 5.

311 *See* Eckstein, *supra* note 5, at 411.

312 *See id.*

313 *Id.* at 419.

The rapid growth of the human population, which has now reached 7.7 billion people,[314] has also contributed to freshwater scarcity.[315] This growth in population has increased the per capita demand for freshwater,[316] which has reduced the available per capita amount of water in many regions.[317] Because the earth's existing freshwater resources are finite, increased stress on existing freshwater resources has caused a shortage of freshwater available per person.[318]

In addition to population increase, pollution in freshwater resources reduces the amount of good-quality drinking water.[319] In some regions, such as Bangladesh, factories dump chemicals and industrial waste into open freshwater channels without conducting proper treatment procedures.[320] This dumping pollutes fresh watercourses and makes them unsuitable for drinking.[321] The lack of sustainably managing and developing existing freshwater resources and the excessive freshwater waste when irrigating crops further aggravate the water scarcity around the world.[322] Therefore, there is an urgent, global need to preserve and sustainably manage freshwater resources before freshwater becomes immensely scarce.[323]

Implementing integrated water management schemes can be effective in mitigating water scarcity crises.[324] Integrated water management schemes that sustainably manage and develop freshwater resources can minimize freshwater waste.[325] Furthermore, it is essential that states coordinate at the international level to implement mutually

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314 Current World Population Clock, WORLD DATA LAB, https://population.io/?utm_source=google&utm_medium=search&utm_campaign=population&campaignid=1695828135&adgroupid=64502612525&adid=329422103477&gclid=EAIaIQobChMI2viRnKLY5wIVk0DTCh2IvAsPEAAYASAAEgJ1IPD_BwE (last visited Nov. 28, 2020).

315 Prakriti Sharma & Priyanka Pandey, *Population Explosion and Water Scarcity*, CLARO: HOW RISE IN POPULATION IS LEADING TO WATER SCARCITY, https://claroenergy.in/population-explosion-water-scarcity/ [https://perma.cc/7PLE-DCSE] (last visited Nov. 28, 2020).

316 *See* Boretti & Rosa, *supra* note 8, at 1.

317 *See id.;* Okello et al., *supra* note 7, at 1264.

318 *See* Boretti & Rosa, *supra* note 8, at 1.

319 *Id.*

320 *Unlocking the Potential*, *supra* note 64, at 183.

321 *Id.* at 183–84.

322 *See The Dublin Statement*, *supra* note 10, at 5.

323 *See id.* at 4.

324 *See id.* at 6; *The Berlin Rules on Water Resources*, *supra* note 20, at art. 6.

325 *See The Dublin Statement*, *supra* note 10, at 6.

beneficial integrated water management schemes.[326] If upper and lower riparian states cooperate, their cooperation can mitigate conflicts between them related to distributing and allocating their shared transboundary water resources.[327]

Moreover, it is essential that states manage, preserve, and develop freshwater resources sustainably.[328] Sustainability is an essential requirement that all states must consider prior to implementing their endeavors to manage and preserve their freshwater resources.[329] Sustainability means managing, developing, utilizing, and preserving freshwater resources in such a way to ensure the availability of an adequate amount of freshwater for future generations.[330] States can achieve sustainability by reducing wastage of existing water resources, preventing pollution, and safeguarding water resources from all kinds of mismanagement and other threats such as climate change.[331] A number of international law conferences and conventions—the UNECE Convention (1992), the U.N. Watercourses Convention (1997), Agenda 21 from the 1992 Earth Summit Conference in Brazil, the Berlin Rules on Water Resources (2004), and the Dublin Statement (1992)—provide adequate guidance and recommendations for states to sustainably manage and preserve their freshwater resources.[332] States can mitigate threats of water scarcity by implementing the recommendations provided in these conventions.

To eliminate the problem of water scarcity for current and future generations, states can also mutually cooperate at the national and international level to implement concerted programs to sustainably manage and preserve freshwater resources.[333] In addition to collaborating on implementing integrated water management schemes,[334] states should also collaborate to gather accurate data regarding the quantity and quality of the flow of water in their watercourses.[335] This data can be an effective tool to implement

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326 *See id.*; *Rio Declaration on Environment and Development*, *supra* note 83, ¶ 18.9(b); *The Berlin Rules on Water Resources*, *supra* note 20, at art. 64.

327 *See The Dublin Statement*, *supra* note 10, at 6.

328 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 7.

329 *See id.*

330 *See id.* at art. 3(19).

331 *See id.*

332 *See* Stoa, *supra* note 21, at 451–52.

333 *See The Dublin Statement*, *supra* note 10, at 6.

334 *See id.*

335 UNECE Convention, *supra* note 129, 1936 U.N.T.S. at 276.

measures to mitigate the potential harmful effects of climate change on freshwater resources.[336] Furthermore, since preventing pollution is essential to mitigate water scarcity, all states should focus on preventing pollution. Specifically, states should safeguard existing freshwater resources from pollution because pollution will make the water unsuitable for drinking.[337]

Finally, states can also adopt modern data analysis tools to estimate the potential effects of climate change on their freshwater resources.[338] Consequently, based on this data, states can plan and implement measures to safeguard their freshwater resources for the future. In turn, implementing data-driven measures will lead to sustainably developing freshwater resources because their implementation will ensure that states have freshwater available for future generations.[339]

336 *See The Berlin Rules on Water Resources*, *supra* note 20, at arts. 34–35.

337 *See The Dublin Statement*, *supra* note 10, at 6.

338 *See Rio Declaration on Environment and Development*, *supra* note 83, ¶ 18.2.

339 *See The Berlin Rules on Water Resources*, *supra* note 20, at art. 3(19).