Water Security in South Asia: The Case of Indus River Basin

by Arslan M. Sheikh

ITSS Verona Magazine, Vol. 2, n. 1

Spring/Summer 2023

Water Security in South Asia: The Case of Indus River Basin

Arslan M. Sheikh

To cite this article: Arslan M. Sheikh, *Water Security in South Asia: The Case of Indus River Basin*, ITSS Verona Magazine, Vol. 2, no. 1, Spring/Summer 2023.

Keywords: Water Security, Indus River Basin, Indus Water Treaty, India, Pakistan.

ITSS Verona website: https://www.itssverona.it/itss-magazine

LinkedIn: https://www.linkedin.com/company/itss-verona/

Instagram: https://instagram.com/itss_verona?igshid=YmMyMTA2M2Y=

Published online: July 4th, 2023

Abstract: This essay will try to analyse the water security of South Asia's Indus River Basin (IRB) through the human security approach. This essay will use a critical analytical framework in assessing the water security and water governance of IRB. In doing so, it will critically analyse the vulnerabilities in the water security and governance with regards to growing population and urbanisation, decreased and irregular surface flows, quality and quantity of groundwater, and the effects of climate change on IRB. The essay will further critically analyse the water-scarcity-security nexus of IRB and the prevailing governing mechanisms of IRB. It will use Multimedia and Textual Analysis as research methods and will follow qualitative methodology in answering the research questions. This essay will argue that the negative impacts of climate change coupled with unequipped governing mechanisms has made the IRB highly vulnerable to water scarcity and has put its water security at risk.

Climate change is going to disrupt the hydrological cycle of water bodies, water supply systems, and aggravate the requirement of water in different territories because of variability and extreme events. For example, by the year 2050, the population exposed to the threat of floods is projected to rise from the current figure of 1.2 billion to 1.6 billion indivuduals.[1] In recent times, more than 20% of the world's basins have undergone significant changes either witnessing rapid expansions in their surface water area, suggesting occurrences of flooding, the construction of reservoirs, and the submergence of previously dry land, or experiencing swift reductions in the surface water area, indicating the depletion of lakes, reservoirs, wetlands, floodplains, and seasonal water bodies.[2] Climate change is surmounting a big challenge in achieving water security while also raising the intricacy and expenses of safeguarding it.[3] The impacts of climate change will go ahead in lowering water availability in the countries facing water scarcity and increase in the variability of delivery water.[4] Water security, despite being an ' 'unconventional security'' issue, is intricate and crucial for other security issues such as food, energy, and human security.

This essay will try to analyse the water security of South Asia's Indus River Basin (IRB) through the human security conceptual paradigm. This essay will use a critical analytical framework in assessing the water security and water governance of IRB. The first part of this essay will define the concept of water security and the relationship between climate change and water security. Then, it will explain the hydrological environment and the importance of IRB. In doing so, it will critically analyse the vulnerabilities in the water security and governance with regards to pollution, growing population and urbanisation,

---

[1] 1. rep., *United In Science 2022: A Multi-Organization High-Level Compilation of the Most Recent Science Related to Climate Change, Impacts and Responses* (World Meteorological Organization, 2022), https://public.wmo.int/en/resources/united_in_science.

[2] *Summary Progress Update 2021 – SDG 6 – Water and Sanitation for All* (UN Water, 2021).

[3] World Bank, "High and Dry: Climate Change, Water, and the Economy." 2016

[4] Rafik Hirji and Hans Olav Ibrekk, "Environmental and Water Resources Management," *Environment Strategy Papers No. 2*, October 2001, http://web.worldbank.org/archive/website00662/WEB/PDF/ESP2WATE.PDF.

decreased and irregular surface flows, quality and quantity of groundwater, and the effects of climate change on IRB. The essay will further critically analyse the water-scarcity-security nexus of IRB highlighting some limitations of measuring water security through the lens of water scarcity and per capita water availability. It will also critically analyse the prevailing governing mechanisms of IRB with a focus on the Indus Water Treaty (IWT) of 1960 signed between India and Pakistan in terms of water access, availability and adaptability. The essay will use Multimedia and Textual Analysis as research methods and will follow qualitative methodology in answering the research questions. This essay will argue that the negative impacts of climate change coupled with unequipped governing mechanisms has made the IRB highly vulnerable to water scarcity and has put its water security at risk.

Water Security in Perspective

Water security can be defined as 'the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems, and production, coupled with an acceptable level of water-related risks to people, environments, and economies.'[5] Unlike food and energy, water has both productive as well as destructive characteristics which means that attaining and sustaining water security doesn't necessarily mean the 'availability and access' to water resources.

Water Security and Climate Change

The relationship between water security and climate change is complex. The impact of climate change has been primarily observed on water bodies through the variations in occurrence and intensity of extreme weather incidents.[6] These impacts can be grouped into three categories – first, too little water due to droughts and water shortages; second, excessive

[5] David Grey and Claudia W. Sadoff, "Sink or Swim? Water Security for Growth and Development," *Water Policy* 9, no. 6 (January 2007): pp. 545-571, https://doi.org/10.2166/wp.2007.021, 548.

[6] Mukand S. Babel et al., "Measuring Water Security: A Vital Step for Climate Change Adaptation," *Environmental Research* 185 (2020): p. 109400, https://doi.org/10.1016/j.envres.2020.109400, 1.

quantities of water due to floods; third, too dirty water due to pollution.[7] Most of the cities are facing these impacts of climate change in water-dependent sectors such as agriculture and hydropower, among others.[8]

Thus, climate change is surmounting a big challenge in achieving water security while also raising the intricacy and expenses of safeguarding it. The impacts of climate change will go ahead in lowering water availability in countries facing water scarcity and increase in the variability of delivery of water.[9] Therefore, the consequences of variability and extreme events are two core challenges in ensuring water security, especially in poorer countries which are struggling with inadequate institutional capabilities in managing water resources.

Moreover, water security is primarily determined by three factors. First, the hydrologic environment – which comprises the availability of water resources, its annual inconsistency, and spatial distribution. Second, the socio-economic environment – which includes 'the structure of the economy and the behaviour of its actors. And third, changes in the future environment – which clearly establishes its linkage with the evident impacts of climate change.[10] The following section will provide an overview of the hydrological environment of IRB.

Hydrological Environment of IRB

The IRB rises in southwestern Tibet Autonomous Region of China and flows northwest. It continues north-westward through the disputed Indian and Pakistani-administered areas of Kashmir and then turns south into Pakistan.[11] The basin has

---

[7] Ibid.

[8] See Shibao Lu et al., "Impacts of Climate Change on Water Resources and Grain Production," *Technological Forecasting and Social Change* 143 (2019): pp. 76-84, https://doi.org/10.1016/j.techfore.2019.01.015 for impact of climate change on agriculture, and Pengcheng Qin et al., "Climate Change Impacts on Three Gorges Reservoir Impoundment and Hydropower Generation," *Journal of Hydrology* 580 (2020): p. 123922, https://doi.org/10.1016/j.jhydrol.2019.123922 on hydropower.

[9] Hirji and Ibrekk, "Environmental and Water Resources Management,"

[10] Gray and Sadoff, ''Sink or Swim?''

[11] "Indus River," Encyclopædia Britannica (Encyclopædia Britannica, inc.), accessed August 18, 2022, https://www.britannica.com/place/Indus-River.

six main tributaries – one of them Sutlej, like Indus itself rises in China's Tibetan Plateau while another tributary Kabul rises in Afghanistan, and the remaining Ravi, Beas, Jhelum, and Chenab rises in India.[12] *Table 1.1* shows the country areas of IRB and *Map 1* shows the Indus River and the flow of its tributaries through India, Pakistan, China, and Afghanistan.

Basin	Area		Countries included	Area of country in basin (km^2)	As % of total area of the basin	As % of total area of the country
	km^2	% of Southeast Asia				
Indus	1 120 000	5.4	Pakistan	520 000	47	65
			India	440 000	39	14
			China	88 000	8	1
			Afghanistan	72 000	6	11

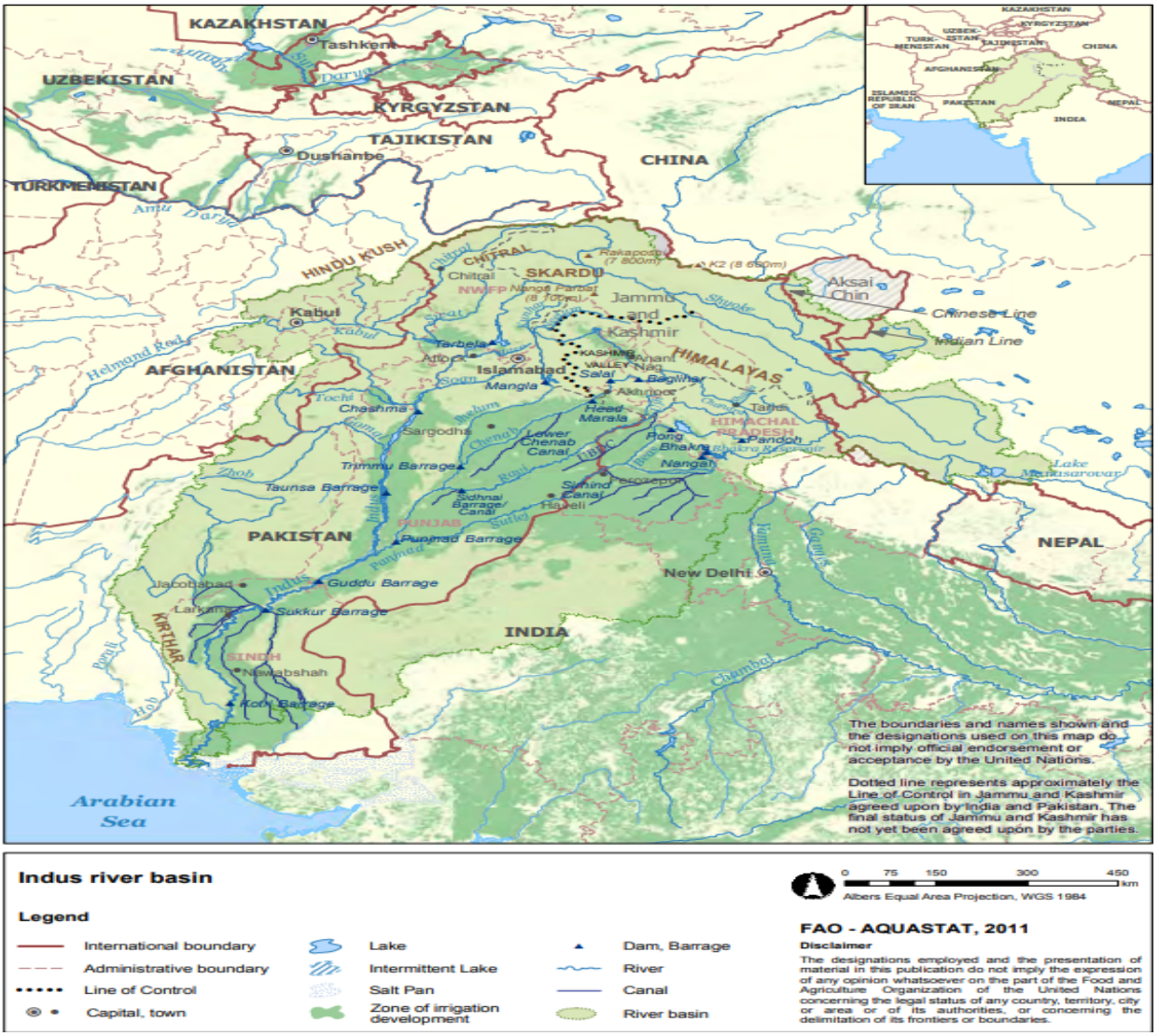
Table 1.1 Country areas in the IRB (Source: FAO AQUASTAT[13], 2011)

The IRB waters which flow through the Kashmir region come from rain, snow, runoff, and glaciers shaping its various springs, lakes, rivers, and their tributaries. The flow of waters coming from snow and glaciers are the main source which keep rivers of Kashmir region perennial although the precipitation provides the bulk of water to the basins which are primarily used for irrigation and hydropower generation.[14]

[12] Zafar Adeel and Robert G. Wirsing, eds., *Imagining Industan Overcoming Water Insecurity in the Indus Basin* (Springer International Publishing, 2016),6.

[13] FAO AQUASTAT, "Transboundary River Basin Overview - Indus" (Food and Agriculture Organization of the United Nations, 2011), https://www.fao.org/3/ca2136en/CA2136EN.pdf.

[14] "State Action Plan on Climate Change Jammu & Kashmir ," State Action Plan on Climate Change Jammu & Kashmir §, accessed October 13, 2022, https://www.fao.org/faolex/results/details/en/c/LEX-FAOC194030/, 138.



Map 1 Indus River Basin and its Tributaries (Source: FAO AQUASTAT, 2011)

India and Pakistan share the IRB waters through a World Bank-mediated agreement known as the Indus Water Treaty (IWT) of 1960. The IWT of 1960 secured and defined the rights and commitments of both countries pertaining to the use of the waters from the IRB. According to the IWT, India was allocated exclusive rights of the three eastern tributaries (Ravi, Beas, and Sutlej) while Pakistan was allocated the rights of three western tributaries (Chenab, Jhelum, and Indus) except for specified domestic, non-consumptive, and agricultural use permitted to India.[15]

[15] "Mea: Statements : Bilateral/Multilateral Documents," Ministry of External Affairs, Government of India, accessed September 19, 2022, https://mea.gov.in/bilateral-documents.htm?dtl%2F6439%2FIndus.

Indus is the backbone of people living throughout the basin. It provides water for agriculture, industries, hydroelectric power, recharging aquifers, maintenance of wetlands, transportation, fisheries, and domestic consumption. India draws thirty-six percent of water used in the basin while Pakistan draws sixty-three percent.[16] *Figure 1.1* shows the available renewable water resources of India and Pakistan and their withdrawal levels from IRB explaining that both countries withdraw almost the same amount of water available to them from the basin available each year. The total catchment area (see *Table 1.2*) of IRB is 1,128,508 km^2 and irrigated agriculture in the IRB is widespread with the construction of link canals, barrages, and dams to deliver the water.[17] Pakistan is critically dependent on the basin because its other rivers are only seasonal, having a total flow of less than two percent of the mean annual inflow into Pakistan. As for India, the basin provides about seven percent of the yearly exploitable surface water accessible to the country.[18]

Country	India	Pakistan	Total
Average long-term available renewable water supplies in the IRB	97 km^3/year	190 km^3/year	287 km^3/year
Estimated renewable surface water supplies in the IRB	73 km^3/year	160-175 km^3/ year	239-258 km^3/year
Estimated renewable groundwater supplies in the IRB	27 km^3/year	63 km^3/year	90 km^3/year
Estimated total water withdrawals in the IRB	98 km^3/year	180-184 km^3/ year	257-299 km^3/year
Estimated total surface water withdrawals in the IRB	39 km^3/year	128 km^3/year	
Estimated total groundwater withdrawals in the IRB	55 km^3/year	52-62 km^3/year	

Figure 1.1 Renewable Water Resources and Withdrawal Levels in the IRB (Source: Stimson, 2013)

[16] Indus Basin Working Group, "Connecting the Drops: An Indus Basin Roadmap for Cross-Border Water Research, Data Sharing, and Policy Coordination" (Stimson, Sustainable Development Policy Institute, Observe Research Foundation, 2013), https://www.stimson.org/2013/connecting-drops-indus-basin-roadmap-cross-border-water-research-and-policy-coordination-1/ 13.

[17] Judy Estham et al., "Water-Use Accounts in CPWF Basins: Simple Water-Use Accounting of the Indus Basin," 2010, https://cgspace.cgiar.org/handle/10568/4696, 7.

[18] ''Connecting the Drops'', Indus Basin Working Group. 14.

The total amount of water withdrawn from the IRB for agriculture is around ninety-three percent while the remaining withdrawn water is used for industrial and domestic demands. Yearly, Pakistan extracts seventy-five percent of the river's flow into canal systems for irrigated agriculture and the basin provides for ninety-five percent of the country's total irrigation. For India, the IRB contributes to approximately twenty-five percent of its total grain production, providing considerable surpluses which help in reducing deficits in other regions.[19] In short, the IRB provides food, water, energy, and economic security to the hundreds of millions of people surrounding the basin across the borders. Thus, IRB is the key factor in ensuring human security to people dependent on it.

Catchment	Area, km^2
Tarbela	188,378
Nowshera	87,614
Kalabagh	25,085
Gomal	98,395
Marala	30,461
Mandi Plain	19,522
Sutlej	64,972
Ravi	32,701
Mangla	32,345
Jhelum Chenab	41,717
Panjnad	88,607
Rajasthan	120,453
Sukkur	98,497
Kotri	186,779
Estuary	12,981
Total	1,128,508

Table 1.2 Catchment Area of IRB (Source: CPWF Working Paper, 2010)

Vulnerabilities of IRB

[19] ''Connecting the Drops'', Indus Basin Working Group, 14-15.

The IRB has a multifaceted hydrology and is wrenched with dangerous hydro-political affairs amongst riparian countries.[20] The factors which threaten the water security of this basin include – being an international transboundary river and major global challenges such as pollution, increased population growth and urbanisation, decreasing surface water flows, deteriorating quantity and quality of groundwater, and climate change.[21] The following subsections will explain in detail how global challenges such as pollution, growing population and urbanisation, decreased or irregular surface flows, quality and worsening quantity of groundwater, and climate change are aggravating the vulnerabilities and extreme events – the two most challenging threats to the water security of this basin. These subsections will critically analyse these factors by using Multimedia and Textual Analysis methods and qualitative methodology.

Pollution

Water pollution in the Indus river stems from various origins. One of the sources is the agricultural runoff, which introduces sodium nitrates, phosphates, and pesticides into the river. Furthermore, untreated or inadequately treated sewage from cities situated along the Indus, industrial waste, and inorganic pollutants are discharged directly into the river.[22] These pollutants not only affect the water quality but also endangers the marine life of the Indus river. Thus, pollution is the basic threat which undermines the water security of IRB.

Growing Population, Urbanization and Decreased or Irregular Surface Flows

There are around three-hundred million people inhabiting the IRB across the political boundaries of their respective countries with about sixty-one percent of them living in

---

[20] "Water Conflict and Cooperation between India and Pakistan." Climate Diplomacy.

[21] Bjørn-Oliver Magsig, "Introducing an Analytical Framework for Water Security: a Platform for the Refinement of International Water Law," *Journal of Water Law*, no. 20 (2009): pp. 61-69, 62.

[22] Gregory Pappas, "Pakistan and Water: New Pressures on Global Security and Human Health." *Am J Public Health* 101, no. 5 (May 2011): 786–88. https://doi.org/10.2105/AJPH.2010.300009.

Pakistan and thirty-five percent in India.[23] The current population is projected to increase to three hundred and nineteen million in the year 2025 and three hundred and eighty-three million by 2050.[24] This expanded population growth rate would negatively impact the 'economic growth, trade balance, and poverty reduction measures.'[25] By 2050, the IRB will be capable of supplying food to twenty-six million less people than it does today, which is nonetheless predicted to expand further.[26]

Pakistan's absolute yearly water withdrawals from IRB has soared from 153.4 km^3 in 1975 to 183.5 km^3 in 2008, while the overall per capita water availability declined from 3,385 m^3 in 1977 to 1,396 m^3 in 2011.[27] On the other hand, absolute yearly water withdrawals of India from the basin increased from 380 km^3 in 1975 to 761 km^3 in 2010, while the overall per capita water availability declined from 2,930 m^3 in 1977 to 1,539 m^3 in 2011. The rate of population growth and urbanisation will decrease the per capita water availability of the region and bring fundamental shifts in the water use. This would increase the complexity in ensuring water security as climate change is projected to wield extra prolonged pressure on water resources by possibly altering the seasonal timing or lumbering the geographical distribution of water availability.[28] This rapid growth coupled with associated settlements are putting an increasing pressure on IRB whose most of the waters are used for irrigation ensuring food security for millions of people.

The median yearly flows of main rivers of IRB have indicated diminishing trends for both east- and west-flowing rivers (see *Table 1.3*). *Table 1.3* shows that median yearly flow of

---

[23] Sadiq I. Khan and Thomas E. Adams, eds., *Indus River Basin: Water Security and Sustainability* (Elsevier , 2019), https://ebookcentral.proquest.com/lib/kcl/detail.action?docID=5633144, 190.

[24] A. N. Laghari, D. Vanham, and W. Rauch, "The Indus Basin in the Framework of Current and Future Water Resources Management," *Hydrology and Earth System Sciences* 16, no. 4 (February 2012): pp. 1063-1083, https://doi.org/10.5194/hess-16-1063-2012.

[25] Khan et. al, *Indus River Basin*, 190.

[26] Walter W. Immerzeel, Ludovicus P. van Beek, and Marc F. Bierkens, "Climate Change Will Affect the Asian Water Towers," *Science* 328, no. 5984 (November 2010): pp. 1382-1385, https://doi.org/10.1126/science.1183188.

[27] Indus Basin Working Group, *Connecting the Drops*, 14.

[28] Indus Basin Working Group, *Connecting the Drops*, Preface.

eastern rivers into Pakistan has decreased by seventy-five percent and ninety-two percent between the years 1985-2002 and 2007-2010, respectively. Another study has shown about seventeen percent decline in the median yearly flow of western rivers as well.[29]

	River	Rim Station	Average Annual Flow (1922–61) (km^3)	Average Annual Flow (1985–2002) (km^3)	Average Annual Flow (2007–10) (km^3)
West flowing rivers	Indus	Kalabagh	114.4	94.1	101.9
	Jhelum	Mangla	28.3	23.7	19.3
	Chenab	Marala	31.9	24.5	23.9
East flowing rivers	Ravi	Below Madhopur	8.6	4.0	1.1
	Sutlej	Below Ferozepur	17.2	2.2	0.8
	Total		200.4	148.5	147.0

Table 1.3 Average Flows of Major Rivers of IRB (Source: Indus River Basin, 2019[30])

The variation in the flow of rivers impacts the overall surface water supplies of the areas under irrigation. As nearly all the irrigated agricultural land in IRB is completely dependent on these flows, any variation in water's availability can impact the food security in the basin, thus, putting the human security of Kashmir and the other regions dependent on this basin under extreme threat.

Quantity and Quality of Ground Water

The variation in the flow of surface water and its escalating demand have led to a huge demand of extracting the groundwater. The overall groundwater potential in the IRB is estimated at 85 km^3 while about 68 km^3 of groundwater is being extracted each year, the amount which is also increasing because of the rising demand.[31] This massive extraction has resulted in the reduction of groundwater of IRB at a rate of 31 km^3 causing a serious

[29] M.J.M. Cheema, W.W. Immerzeel, and W.G.M. Bastiaanssen, "Spatial Quantification of Groundwater Abstraction in the Irrigated Indus Basin," *Groundwater* 52, no. 1 (2013): pp. 25-36, https://doi.org/10.1111/gwat.12027.

[30] Khan et. al, *Indus River Basin*, 190.

[31] M.J.M Cheema (VSSD, Delft, the Netherlands, 2012), https://repository.tudelft.nl/islandora/object/uuid%3A7b569411-9934-4b23-b631-36a58f60363f.

deterioration in its water table with an average decline rate of 1.5 metres per year and has made IRB the 'most overstressed aquifer in the world'.[32]

This large-scale extraction of IRB's groundwater does not only affect the quantity but also its quality. The resulting salinization because of large use of groundwater is putting the sustainability of irrigated agriculture in the basin under an extreme threat.[33] This situation makes the regions of IRB vulnerable to droughts which in turn could create social, economic, and political crises.

Climate Change

The climate changes in the IRB endangers access to freshwater, damage food production, and increase the recurrent extreme events such as droughts, floods, etc, which in turn, could result in the loss of agricultural land.[34] Climate change is going to have a negative impact on the sources of water in IRB which come from snow, glaciers, and rainfall.

The IRB has 18,495 glaciers with a total glacial cover of 21,193 square kilometres contributing more than fifty percent of the total flow of the Indus. Indus is the most glaciated basin among major basins of Asia.[35] Because of the rising global temperatures and shifting precipitation patterns, most of the Himalayan glaciers are receding. A study of 147 glaciers in the Kashmir valley used a time series of satellite data (1980-2018) to ascertain the glacier health. The study concluded that these glaciers have shown a recession of 28.82%.[36] Another

---

[32] See Tom Gleeson et al., "Water Balance of Global Aquifers Revealed by Groundwater Footprint," *Nature* 488, no. 7410 (2012): pp. 197-200, https://doi.org/10.1038/nature11295; Alexandra S. Richey et al., "Quantifying Renewable Groundwater Stress with GRACE," *Water Resources Research* 51, no. 7 (2015): pp. 5217-5238, https://doi.org/10.1002/2015wr017349; and A. F. Lutz et al., "Climate Change Impacts on the Upper Indus Hydrology: Sources, Shifts and Extremes," *PLOS ONE* 11, no. 11 (September 2016), https://doi.org/10.1371/journal.pone.0165630.

[33] Asad Sarwar Qureshi, "Water Management in the Indus Basin in Pakistan: Challenges and Opportunities," *Mountain Research and Development* 31, no. 3 (2011): pp. 252-260, https://doi.org/10.1659/mrd-journal-d-11-00019.1.

[34] Khan et. al, *Indus River Basin*, 196.

[35] Indus Basin Working Group, *Connecting the Drops*, 21.

[36] Shakil Ahmad Romshoo et al., "Satellite-Observed Glacier Recession in the Kashmir Himalaya, India, from 1980 to 2018," *Environmental Monitoring and Assessment* 192, no. 9 (2020), https://doi.org/10.1007/s10661-020-08554-1.

study on the implications of climate change on glaciers found that the Indus River may perhaps be more vulnerable to changes in glacier mass and extent than other rivers in the region.[37] Since most of the water bodies of the whole J&K receive supply from glacial waters, the loss of glaciers due to many causes of climate change could decrease the water availability affecting energy security and decrease the availability of water for irrigation affecting the food security.

On the other hand, the intensity of and occurrence of extreme weather events in IRB are projected to increase.[38] The monsoons, which contribute substantially to the flows of IRB rivers are becoming shorter and more extreme in nature causing frequent droughts and floods.[39] The increased intensity of the monsoons disrupts the natural ecosystem of the basin by accelerating the rate of soil erosion.[40] It is therefore apparent that climate change presents a severe risk to the water resources and food security in the IRB.

A Critical Reflection on Water Scarcity-Security Nexus in IRB

Measuring water security through the lens of only water scarcity or reduced water per capita availability could present some challenges in having a thorough understanding of water security. Water security and insecurity is not always determined by water scarcity or availability but is also dependent on social power relations. Not including the role of power relations within the society in analysing water security makes the marginalised people most vulnerable to water insecurity, majority of whom at the first place cannot even be blamed for the factors leading to water scarcity.[41]

---

[37] A J Wiltshire, "Climate Change Implications for the Glaciers of the Hindu Kush, Karakoram and Himalayan Region," *The Cryosphere* , no. 8 (2014): pp. 941-958, https://tc.copernicus.org/articles/8/941/2014/tc-8-941-2014.pdf, 952.

[38] Lutz et al, *Climate Change Impacts on the Upper Indus Hydrology*

[39] Andrew G. Turner and H. Annamalai, "Climate Change and the South Asian Summer Monsoon," *Nature Climate Change* 2, no. 8 (2012): pp. 587-595, https://doi.org/10.1038/nclimate1495.

[40] Khan et al, *Indus River Basin*, 196.

[41] Lyla Mehta, *The Limits to Scarcity: Contesting the Politics of Allocation* (Taylor & Francis Group, 2010), https://ebookcentral.proquest.com/lib/kcl/detail.action?docID=1144665.

In other words, when assessing water security, 'absolute scarcity' - which includes variables such as rainfall, receding glaciers, and depletion of water tables - ought to be augmented with a similar strong emphasis on 'structural scarcity' which include aspects such as history, technology, and political economy. This essay has already highlighted the 'absolute scarcity' of IRB in previous sections. As far as structural scarcity of IRB is concerned, Majid Akhter posits two main factors responsible for it – British canal colonisation and Green Revolution.[42]

In the nineteenth century, the first major structuring attempt in the history of IRB was made with the British project to irrigate the Indus plains.[43] Between 1867 to 1892, because of this British project, cultivated area in the colonial undivided Punjab grew eightfold and thousands of miles of canals were built, and the British assisted the migration of farmers thoroughly chosen based on caste and kinship. This resulted in the establishment of 'canal colonies' in southwestern and central undivided Punjab.

The progress of these 'canal colonies' benefited specific segments of society with land grants. These preferred cultivators who ultimately succeeded in obtaining formal property rights over land and water, belonged to conventionally prevalent agriculturist castes, such as Jats, Arain, and Rajputs.[44] This led to the formation of a new agrarian order centred around canals and the real control of the canal system acted in favour of landed notabilities in the area.[45] This seemingly gave access to the water resources to only some notable landlords and restricted the access to water to majority communities.

The Green Revolution in the second half of the twentieth century was a technical revolution in agriculture in which high yielding varieties of crops were used by farmers to

---

[42] Adeel and Wirsing eds., *Imagining Industan*, 23.
[43] David Gilmartin, *Blood and Water: The Indus River Basin in Modern History* (University of California Press, 2015), 3.
[44] Adeel and Wirsing eds., *Imagining Industan*, 27.
[45] Gilmartin, *Blood and Water*, 45.

increase crop production. Adoption of high yielding varieties of crops boosted the food production of Northern India and Pakistan. This period, however, also saw rising rates of landlessness. The increase in the food production was determined heavily by the increased availability of water which was provided by the construction of tube wells on a large scale by both Indian and Pakistani governments.[46] However, the impact of distribution of dividends from the Green Revolution was extremely unequal across classes evident from the deterioration of tenurial security of cultivators. Today, nearly half of the area of IRB is owned by only about two percent of the households.[47] As access to water resources depended heavily on the ownership of agricultural land, the rising landlessness threatens the water security of many landless people.

Governance of IRB as an International Transboundary River

The IRB is an international transboundary basin situated in a region which is fraught with intense suspicion, prolonged conflict, and debatable water policies. Though its course runs through four different sovereign nations, the structure of its governing mechanism is formalised only between two countries – India and Pakistan – in the form of IWT of 1960. This section will critically analyse the existing governing mechanism – IWT - highlighting the vulnerabilities concerning water security of IRB in terms of water availability, access, and adaptability.

The dispute surrounding the allocation and utilisation of water resources in the IRB became an international concern with the partitioning of British India in 1947, as the newly formed nations – India and Pakistan – got in disagreement over the sharing of waters of IRB and managing the previously unitary infrastructure of irrigation of IRB,[48] However,

---

[46] Adeel and Wirsing eds., *Imagining Industan*, 28.

[47] Madison Condon et al., "Challenge and Response in the Indus Basin," *Water Policy* 16, no. S1 (January 2014): pp. 58-86, https://doi.org/10.2166/wp.2014.004, 65.

[48] Gilmartin, *Blood and Water*, 185.

negotiations aided by the World Bank for almost a decade led the way for signing of IWT in 1960.[49] The treaty allocated all the waters of eastern rivers (Sutlej, Ravi, and Beas) to India for unrestricted usage except during the transition period during which water from these rivers had to be supplied to Pakistan, while Pakistan was allocated unrestricted usage of the western rivers (Indus, Jhelum, and Chenab) which India is obligated to flow without any interference with some exceptions of domestic and non-consumptive use which includes irrigation as well.[50]

The IWT is considered as an 'example of cooperation' and has demonstrated a successful conflict prevention mechanism earlier but is now engendering new developments and changes such as climatic variations, population growth, water scarcity, energy demands, and other actors such as China, Afghanistan, and Kashmir region through which its major tributaries flow before entering Pakistan.[51] The tensions over sharing of waters of the IRB are surfacing again.[52]

Water Availability

As discussed earlier, water availability does not mean only how much water is available in the basin, rather it encompasses both quantity and quality of water available to the people. The IWT does not include efficient obligatory conditions concerning water quality, instead the entire context during the negotiation was centred upon the issue of quantity.[53] Initially, India intended to get waters of all the eastern rivers (Ravi, Beas, and Sutlej) and seven percent of the western rivers (Indus, Jhelum, and Chenab), while Pakistan

---

[49] Mary Miner et al., "Water Sharing between India and Pakistan: A Critical Evaluation of the Indus Water Treaty," *Water International* 34, no. 2 (2009): pp. 204-216, https://doi.org/10.1080/02508060902902193, 1.

[50] Asit K. Biswas, "Indus Water Treaty: The Negotiating Process," *Water International* 17, no. 4 (1992): pp. 201-209, https://doi.org/10.1080/02508069208686140, 208.

[51] Daniel Haines, *Rivers Divided: Indus Basin Waters in the Making of India and Pakistan* (New York, NY: Oxford University Press, 2017, 3.

[52] Adeel and Wirsing eds., *Imagining Industan*, 69.

[53] Ibid. 78.

demanded seventy percent of the eastern rivers and all the western rivers.[54] Ultimately, the agreement was reached over the sharing of waters with eastern rivers allocated to India and western rivers to Pakistan.

So far, away from the terms of distribution, the IWT does not offer any significant commitments regarding the water quality of IRB. The existing IWT lacks any provision for the 'sustainable control and protection of the IRB' in terms of any efficient structure dealing with 'environmental flows, ecosystem services, or demand management' though it mentions the issue of pollution in a non-binding and ineffective manner.[55] It is not surprising given the time and space during which the treaty was framed when issues such as climate change were totally absent from the security discourse. Nonetheless, lacking any provision of addressing water quality of IRB would aggravate the vulnerabilities of IRB which put its water security under extreme threat.

Access to Water

The access to waters of the IRB for power generation has been a subject of various disputes and differences between India and Pakistan. The methodology of resolution on matters of water access given in the IWT is quite complicated. The Permanent Indus Commission, which is the main established tool of the agreement, plays an important part in the resolution of differences or disputes and as well as the principal means of exchange on all issues involving the implementation of IWT.[56] The treaty specifies that the matters which cannot be settled through Permanent Indus Commission will be considered 'differences' and vary upon their categorization, referred to a 'neutral expert'. The 'differences' shall be deemed a 'dispute' if the issues pertaining outside those matters mentioned in Annexure F of

---

[54] Biswas, *Indus Water Treaty*, 205.

[55] Adeel and Wirsing eds., *Imagining Industan*, 78.

[56] "The Indus Waters Treaty 1960 (with Annexes). Signed at Karachi, on 19 September 1960," UN Treaties Collection , accessed August 24, 2022, https://treaties.un.org/doc/Publication/UNTs/Volume%20419/volume-419-I-6032-English.pdf, 146.

the treaty, which shall be settled through negotiation, and if they are unsuccessful to deliver any effective outcome, are to be subjected to 'arbitration'.[57]

In 2005, the above-mentioned provision of settling 'Points of Differences' was used for the first time regarding the Baglihar hydropower plant on the Chenab River.[58] While the issues were resolved by a neutral expert, the procedure did not cope-up to calm down 'freshwater cooperation' between India and Pakistan nor did it give any prudent guidance.[59] It is obvious when we analyse the settlement of the first ever 'dispute' between India and Pakistan over accessibility of waters from IRB – The Kishanganga Arbitration.[60]

In 2010, Pakistan again raised concerns over the accessibility of waters of the IRB. This time on the construction of India's Kishanganga Hydroelectric Project having concerns over the design of the project which intended to divert waters from a damsite on Kishanganga or Neelum river in the Kashmir region to the Jhelum River – theoretically plummeting the hydropower generating capacity of the planned Pakistani Neelum-Jhelum Hydroelectric Project.[61] The Permanent Court of Arbitration in its final award stated that in determining the rate of minimum flow, it was essential to moderate adverse effects to Pakistan's agricultural and hydroelectric usages during the operation of the Kishanganga Hydroelectric Project, although protecting India's right to operate the Kishanganga Hydroelectric Project and to provide due regard to the 'customary international law requirements of avoiding or mitigating

---

[57] See note above, 150-152.

[58] "Baglihar Dam Cleared by Neutral Experts, MEA: Statements : Press Releases ," Ministry of External Affairs, Government of India, accessed August 25, 2022, https://www.mea.gov.in/press-releases.htm?dtl%2F2287%2FBaglihar%2BDam%2Bcleared%2Bby%2Bneutral%2Bexpert.

[59] Uttam Kumar Sinha, "Water a Pre-Eminent Political Issue between India and Pakistan," *Strategic Analysis* 34, no. 4 (2010): pp. 482-485, https://doi.org/10.1080/09700161.2010.483147, 483.

[60] See Alistair Rieu-Clarke, Ruby Moynihan, and Bjørn-Oliver Magsig, *UN Watercourses Convention User's Guide* (S.l.: IHP-HELP Centre for Water Law, Policy and Sciences (under the auspices of UNESCO), 2012), https://disco.dundee.ac.uk/en/publications/un-watercourses-convention-users-guide, and Kishor Uprety, "The Kishenganga Arbitration: Reviving the Indus Treaty and Managing Transboundary Hydropolitics:" *Chinese Journal of International Law* 14, no. 3 (August 2015): pp. 497-543, https://doi.org/10.1093/chinesejil/jmv029, 521.

[61] Adeel and Wirsing eds.*, Imagining Industan*, 79.

transboundary harm and of reconciling economic development with the protection of the environment'.[62]

Figure 1.2 The Kishenganga Arbitration (Source: Magsig, 2015[63])

However, the verdict worked as a valuable prompt for the possibility of peaceful dispute settlement in strained situations.[64] Nevertheless, it undermined the conclusion of the Baglihar difference case because it did not consider the Baglihar decisions and results as a model in which India was permitted to take down water beneath the dead storage level under certain conditions and use a method called 'drawdown flushing' to evade siltation in hydroelectric power plant. To the contrary, the verdict over Kishenganga Arbitration concluded that from now on this method shall be forbidden. Therefore, it appears misleading to anticipate an end of disputes spinning around the same issues, as separate to a verdict by a court which can establish a standard norm in place for future disputes.

Adaptability

Climate change and population growth challenge the adaptability of the governing mechanism of IRB. The whole governing mechanism seems like more of a divorce settlement, instead of a visionary treaty for the sustainable management of IRB.[65]

---

[62] "Indus Waters Kishenganga Arbitration (Pakistan v. India)," PCA, accessed October 25, 2022, https://pca-cpa.org/en/news/indus-waters-kishenganga-arbitration-pakistan-v-india/.

[63] Bjørn-Oliver Magsig, *International Water Law and the Quest for Common Security* (London: Routledge, 2015), 187.

[64] Shashank Kumar, "The Indus Waters Kishenganga Arbitration (Pakistan v. India)," *American Society of International Law Insights* 17, no. 13 (2013), https://www.asil.org/insights/volume/17/issue/13/indus-waters-kishenganga-arbitration-pakistan-v-india.

[65] Adeel and Wirsing eds., *Imagining Industan*, 80-81.

Nevertheless, it is essential to recognize the point that the governing mechanisms are not put in place in seclusion and the international law does not survive deprived of interpretation.[66] As the Kishanganga Arbitration has demonstrated, new disagreements concerning the use of the shared waters of IRB will have to bring the latest advances in international law into consideration – minimum to the point which is allowed within the process of treaty interpretation.[67] The lack of any agreement on the approach from which a treaty could be interpreted might cause even more uncertainty among the concerned parties.[68]

Because the IWT lacks any room for adaptable mechanisms, except for the usual guidelines of interpretation[69] It has been debated that the IWT ought to be revised to withstand climate change uncertainties.[70]

Conclusion

It can be concluded that the relationship between climate change and security is complicated. Climate change has put forth a big challenge in achieving water security while also raising the difficulty and costs of safeguarding it. Unlike food and energy, water security cannot be determined by only 'availability' of water resources, but also on the quality of water resources. The consequences of variability and extreme events are two core challenges in ensuring water security, especially in poorer countries which are struggling with inadequate institutional capabilities in managing water resources. The case of IRB in South Asia is no different.

---

[66] Andrea Bianchi, Daniel Peat, and Matthew Windsor, eds., *Interpretation in International Law* (Oxford: Oxford University Press, 2015), 78-110.

[67] Adeel and Wirsing eds., *Imagining Industan*, 81.

[68] See Eirik Bjørge, *The Evolutionary Interpretation of Treaties* (Oxford: Oxford University Press, 2014), 121; and Enzo Cannizzaro, ed., *The Law of Treaties beyond the Vienna Convention* (Oxford: Oxford University Press, 2011), 105-122.

[69] Adeel and Wirsing eds., *Imagining Industan*, 81.

[70] Pallava Bagla, "Along the Indus River, Saber Rattling over Water Security," *Science* 328, no. 5983 (April 2010): pp. 1226-1227, https://doi.org/10.1126/science.328.5983.1226-a.

The IRB has multifaceted hydrology and is wrenched with potentially dangerous hydro-political affairs amongst riparian countries. There are two major factors which threaten the water security of this basin – being an international transboundary river coupled with major global challenges such as pollution, increased population growth and urbanisation, decreasing surface water flows, deteriorating quantity and quality of groundwater, and climate change.[71]

When critically analysing the water scarcity-security nexus of IRB, it could be argued that water security and insecurity is not always determined by water scarcity or availability but is also crucially dependent on power relations within the society.[72] As access to water resources depends heavily on the ownership of agricultural land, the rising landlessness threatens the water security of many landless people throughout the IRB.

At the end, it can be also concluded that the governing mechanisms of IRB – mainly the IWT of 1960 between India and Pakistan does not address the vulnerabilities of IRB in terms of access, availability, and adaptability. The IWT of 1960 is heralded as a model for transboundary water cooperation but given the time-space during which it was drafted, it lacks to address the vulnerabilities arising because of the negative impacts of climate change.

[71] Magsig, "Introducing an Analytical Framework for Water Security" 62.
[72] Mehta, ''*The Limits to Scarcity"*

Bibliography

Adeel, Zafar, and Robert G. Wirsing, eds. *Imagining Industan Overcoming Water Insecurity in the Indus Basin*. Springer International Publishing, 2016.

Babel, Mukand S., Victor R. Shinde, Devesh Sharma, and Nguyen Mai Dang. "Measuring Water Security: A Vital Step for Climate Change Adaptation." *Environmental Research* 185 (2020): 109400. https://doi.org/10.1016/j.envres.2020.109400.

Bagla, Pallava. "Along the Indus River, Saber Rattling over Water Security." *Science* 328, no. 5983 (2010): 1226–27. https://doi.org/10.1126/science.328.5983.1226-a.

"Baglihar Dam Cleared by Neutral Experts, MEA: Statements : Press Releases ." Ministry of External Affairs, Government of India. Accessed August 25, 2022. https://www.mea.gov.in/press-releases.htm?dtl%2F2287%2FBaglihar%2BDam%2Bcleared%2Bby%2Bneutral%2Bexpert.

Bjørge, Eirik. *The Evolutionary Interpretation of Treaties*. Oxford: Oxford University Press, 2014.

Bianchi, Andrea, Daniel Peat, and Matthew Windsor, eds. *Interpretation in International Law*. Oxford: Oxford University Press, 2015.

Biswas, Asit K. "Indus Water Treaty: The Negotiating Process." *Water International* 17, no. 4 (1992): 201–9. https://doi.org/10.1080/02508069208686140.

Cannizzaro, Enzo, ed. *The Law of Treaties beyond the Vienna Convention*. Oxford: Oxford University Press, 2011.

Cheema, M.J.M. "Understanding Water Resources Conditions in Data Scarce River Basins Using Intelligent Pixel Information, Case: Transboundary Indus Basin." Thesis, VSSD, Delft, the Netherlands, 2012. https://repository.tudelft.nl/islandora/object/uuid%3A7b569411-9934-4b23-b631-36a58f60363f.

Cheema, M.J.M., W.W. Immerzeel, and W.G.M. Bastiaanssen. "Spatial Quantification of Groundwater Abstraction in the Irrigated Indus Basin." *Groundwater* 52, no. 1 (2013): 25–36. https://doi.org/10.1111/gwat.12027.

Climate-Diplomacy. "Water Conflict and Cooperation between India and Pakistan," January 1, 1947. https://climate-diplomacy.org/case-studies/water-conflict-and-cooperation-between-india-and-pakistan.

Condon, Madison, Don Kriens, Anjali Lohani, and Erum Sattar. "Challenge and Response in the Indus Basin." *Water Policy* 16, no. S1 (2014): 58–86. https://doi.org/10.2166/wp.2014.004.

Estham, Judy, Mac Kirby, Mohammed Mainuddin, and Mark Thomas. Working paper. *Water-Use Accounts in CPWF Basins: Simple Water-Use Accounting of the Indus Basin*, 2010. https://cgspace.cgiar.org/handle/10568/4696.

FAO AQUASTAT. "Transboundary River Basin Overview - Indus." Food and Agriculture Organization of the United Nations, 2011. https://www.fao.org/3/ca2136en/CA2136EN.pdf.

Gilmartin, David. *Blood and Water: The Indus River Basin in Modern History*. University of California Press, 2015.

Gleeson, Tom, Yoshihide Wada, Marc F. Bierkens, and Ludovicus P. van Beek. "Water Balance of Global Aquifers Revealed by Groundwater Footprint." *Nature* 488, no. 7410 (2012): 197–200. https://doi.org/10.1038/nature11295.

Grey, David, and Claudia W. Sadoff. "Sink or Swim? Water Security for Growth and Development." *Water Policy* 9, no. 6 (2007): 545–71. https://doi.org/10.2166/wp.2007.021.

Haines, Daniel. *Rivers Divided: Indus Basin Waters in the Making of India and Pakistan*. New York, NY: Oxford University Press, 2017.

Hirji, Rafik, and Hans Olav Ibrekk. "Environmental and Water Resources Management." *Environment Strategy Papers No. 2*, October 2001. http://web.worldbank.org/archive/website00662/WEB/PDF/ESP2WATE.PDF .

Immerzeel, Walter W., Ludovicus P. van Beek, and Marc F. Bierkens. "Climate Change Will Affect the Asian Water Towers." *Science* 328, no. 5984 (2010): 1382–85. https://doi.org/10.1126/science.1183188.

Indus Basin Working Group. Rep. *Connecting the Drops: An Indus Basin Roadmap for Cross-Border Water Research, Data Sharing, and Policy Coordination*. Stimson, Sustainable Development Policy Institute, Observe Research Foundation, 2013. https://www.stimson.org/2013/connecting-drops-indus-basin-roadmap-cross-border-water-research-and-policy-coordination-1/.

"Indus River." Encyclopædia Britannica. Encyclopædia Britannica, inc. Accessed August 18, 2022. https://www.britannica.com/place/Indus-River.

"Indus Waters Kishenganga Arbitration (Pakistan v. India)." PCA. Accessed October 25, 2022. https://pca-cpa.org/en/news/indus-waters-kishenganga-arbitration-pakistan-v-india/.

Khan, Sadiq I., and Thomas E. Adams, eds. *Indus River Basin: Water Security and Sustainability*. *ProQuest Ebook Central*. Elsevier , 2019. https://ebookcentral.proquest.com/lib/kcl/detail.action?docID=5633144.

Kumar, Shashank. "The Indus Waters Kishenganga Arbitration (Pakistan v. India)." *American Society of International Law Insights* 17, no. 13 (2013).

https://www.asil.org/insights/volume/17/issue/13/indus-waters-kishenganga-arbitration-pakistan-v-india.

Laghari, A. N., D. Vanham, and W. Rauch. "The Indus Basin in the Framework of Current and Future Water Resources Management." *Hydrology and Earth System Sciences* 16, no. 4 (2012): 1063–83. https://doi.org/10.5194/hess-16-1063-2012.

Lu, Shibao, Xiao Bai, Wei Li, and Ning Wang. "Impacts of Climate Change on Water Resources and Grain Production." *Technological Forecasting and Social Change* 143 (2019): 76–84. https://doi.org/10.1016/j.techfore.2019.01.015.

Lutz, A. F., W. W. Immerzeel, P. D. Kraaijenbrink, A. B. Shrestha, and M. F. Bierkens. "Climate Change Impacts on the Upper Indus Hydrology: Sources, Shifts and Extremes." *PLOS ONE* 11, no. 11 (2016). https://doi.org/10.1371/journal.pone.0165630.

Magsig, Bjørn-Oliver. *International Water Law and the Quest for Common Security*. London: Routledge, 2015.

Magsig, Bjørn-Oliver. "Introducing an Analytical Framework for Water Security: a Platform for the Refinement of International Water Law." *Journal of Water Law*, no. 20 (2009): 61–69.

"Mea: Statements : Bilateral/Multilateral Documents." Ministry of External Affairs, Government of India. Accessed September 19, 2022. https://mea.gov.in/bilateral-documents.htm?dtl%2F6439%2FIndus.

Mehta, Lyla. *The Limits to Scarcity: Contesting the Politics of Allocation*. *ProQuest Ebook Central*. Taylor & Francis Group, 2010. https://ebookcentral.proquest.com/lib/kcl/detail.action?docID=1144665.

Miner, Mary, Gauri Patankar, Shama Gamkhar, and David J. Eaton. "Water Sharing between India and Pakistan: A Critical Evaluation of the Indus Water Treaty." *Water International* 34, no. 2 (2009): 204–16. https://doi.org/10.1080/02508060902902193.

Pappas, Gregory . "Pakistan and Water: New Pressures on Global Security and Human Health." *Am J Public Health* 101, no. 5 (May 2011): 786–88. https://doi.org/10.2105/AJPH.2010.300009.

Qin, Pengcheng, Hongmei Xu, Min Liu, Liangmin Du, Chan Xiao, Lüliu Liu, and Brian Tarroja. "Climate Change Impacts on Three Gorges Reservoir Impoundment and Hydropower Generation." *Journal of Hydrology* 580 (2020): 123922. https://doi.org/10.1016/j.jhydrol.2019.123922.

Qureshi, Asad Sarwar. "Water Management in the Indus Basin in Pakistan: Challenges and Opportunities." *Mountain Research and Development* 31, no. 3 (2011): 252–60. https://doi.org/10.1659/mrd-journal-d-11-00019.1.

Richey, Alexandra S., Brian F. Thomas, Min‐Hui Lo, John T. Reager, James S. Famiglietti, Katalyn Voss, Sean Swenson, and Matthew Rodell. "Quantifying Renewable

Groundwater Stress with GRACE." *Water Resources Research* 51, no. 7 (2015): 5217–38. https://doi.org/10.1002/2015wr017349.

Rieu-Clarke, Alistair, Ruby Moynihan, and Bjørn-Oliver Magsig. *UN Watercourses Convention User's Guide*. S.l.: IHP-HELP Centre for Water Law, Policy and Sciences (under the auspices of UNESCO), 2012. https://disco.dundee.ac.uk/en/publications/un-watercourses-convention-users-guide.

Romshoo, Shakil Ahmad, Midhat Fayaz, Gowhar Meraj, and I. M. Bahuguna. "Satellite-Observed Glacier Recession in the Kashmir Himalaya, India, from 1980 to 2018." *Environmental Monitoring and Assessment* 192, no. 9 (2020). https://doi.org/10.1007/s10661-020-08554-1.

Sinha, Uttam Kumar. "Water a Pre-Eminent Political Issue between India and Pakistan." *Strategic Analysis* 34, no. 4 (2010): 482–85. https://doi.org/10.1080/09700161.2010.483147.

"State Action Plan on Climate Change Jammu & Kashmir ," State Action Plan on Climate Change Jammu & Kashmir §, accessed October 13, 2022. https://www.fao.org/faolex/results/details/en/c/LEX-FAOC194030/.

"The Indus Waters Treaty 1960 (with Annexes). Signed at Karachi, on 19 September 1960," UN Treaties Collection , accessed August 24, 2022, https://treaties.un.org/doc/Publication/UNTs/Volume%20419/volume-419-I-6032-English.pdf.

Turner, Andrew G., and H. Annamalai. "Climate Change and the South Asian Summer Monsoon." *Nature Climate Change* 2, no. 8 (2012): 587–95. https://doi.org/10.1038/nclimate1495.

UN Water. "Summary Progress Update 2021 – SDG 6 – Water and Sanitation for All." UN Water, 2021.

Uprety, Kishor. "The Kishenganga Arbitration: Reviving the Indus Treaty and Managing Transboundary Hydropolitics:" *Chinese Journal of International Law* 14, no. 3 (2015): 497–543. https://doi.org/10.1093/chinesejil/jmv029.

Wiltshire, A J. "Climate Change Implications for the Glaciers of the Hindu Kush, Karakoram and Himalayan Region." *The Cryosphere* , no. 8 (2014): 941–58. https://tc.copernicus.org/articles/8/941/2014/tc-8-941-2014.pdf.

World Bank. "High and Dry: Climate Change, Water, and the Economy," n.d. https://www.worldbank.org/en/topic/water/publication/high-and-dry-climate-change-water-and-the-economy.