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CLIMATE CHANGE AND INSTITUTIONAL CAPACITY IN THE INDUS BASIN

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Introduction

Climate change in South Asia is projected to aggravate water disputes between India and Pakistan. As per statistics, changes in seasonal flow of the Indus Basin, divided between the two countries through a treaty, are more than enough to ignite water discords in a readily volatile region. Contemporary literature on climate change in the Indus Basin is progressively more focused on water resource scarcity and resultant bilateral conflicts in the region. Thus one of the fieriest questions in the field is whether climate change is the primary reason for resource scarcity and bilateral water disputes between India and Pakistan.

India and Pakistan have concluded the Indus Waters Treaty (IWT) in 1960 to resolve water disputes arising out of partition of the subcontinent. The treaty has served well in terms of resolving water disputes during the post-partition period. This study analyzes the causes of rise in the number of water

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disputes between India and Pakistan. In doing so, it essentially focuses on socio-political factors in analyzing the water regime of the Indus Basin. These socio-political factors reveal that it is not resource scarcity induced by climate change that causes water disputes but lack of institutional capacity in the region to absorb this change.[1] It is the institutional lack of adaptability to climate change that is hindering bilateral resilience in the Indus Basin.

The IWT divides trans-boundary waters without managing them. There is no institutional response to climate change in the region, because the IWT does not cover all variability in the basin in physical terms. As the only existing bilateral institution on the subject, it rigidly focuses on water property rights for conflict resolution and ignores environmental aspects of water development across boundaries. Independent water policies indifferent to physical variations in the shared river basin are only deteriorating the aggrieved bilateral relationship. The interaction of trans-boundary water development (such as development of national hydropower) with long-term climate change impacts on political relationships in the Indus Basin is a serious threat to regional peace.

Current debates on climate change trends

Experts have projected huge seasonal river variations[2] supplemented by reports[3] of significant retreat and depletion[4] of glacier volume in the Himalayas,[5] a major source of water flow in the Indus Basin. Other climate reports[6] provide a contrasting evidence of glacier expansion mainly in high-level glaciers in the central Karakoram.[7] Both glacial surge or retreat could have serious implications for the hydrological cycle of the Indus Basin, which is dependent on monsoon precipitation and glacial melt for its flow. Half of the total annual average flow in the basin is contributed by snow and glacial melt.[8]

Hence any significant change in climate together with a reduced or high rainfall will produce serious consequences for the ecological system and socio-economic sectors of the society in the Indus Basin region. This could also worsen an already weak political relationship between India and Pakistan. Pakistan being the lower riparian has long been complaining of 'water stealing' by India as violation of the IWT, which the latter has declined on grounds of changes in river flow patterns due to climate variations.

Facts about the Indus Basin

Arising from the Tibetan Plateau, the Indus Basin travels through the Hindu Kush, Karakoram, and Himalayan mountains to enter the surrounding territories of Afghanistan, China, India, and Pakistan (see Table 1). Nearly 3,000 km long and with 970,000 square kilometres drainage basin, the Indus River is the 12th largest drainage basin of the world.[9] As one-third of the upper Indus Basin is glaciated,[10] snow and glacial melt contribute approximately 85 per cent to the annual flow of the River Indus.[11]

Table 1

Country areas in the Indus River Basin

	Area					
Basin	**Km^2**	**% of South Asia**	**Countries**	**Area of country in basin (km^2)**	**As % of total area of the basin**	**As % of total area of the country**
Indus	1,120,000	5.4	Pakistan	520,000	47	65
			India	440,000	39	14
			China	88,000	8	1
			Afghanistan	72,0006	11	

Source: Food and Agriculture Organization (FAO), 2011[12]

The Indus Basin has varying climate patterns. In Punjab and Sindh provinces of Pakistan, arid and semi-arid temperature varies with sub-humid weather.[13] In the north-western Himalayas of India and northern Pakistan, temperatures range from average summers in valleys to freezing weathers at higher altitudes.[14] Annual rainfall also differs between lower and upper Indus regions. More than 80 per cent of the flow in the Indus, as it emerges onto the Punjab plains, is derived from seasonal and permanent snowfields and glaciers. Monsoon rainfall makes an important contribution to the inflows of Chenab, Jhelum, Ravi, and Sutlej tributaries. This also affects glacier mass balance and ultimately the hydrological cycle.[15]

Climate change in the Indus Basin

The Indian subcontinent has showed an enhanced warming trend during the winter and spring seasons. A variety of factors are responsible for this warming trend, but it is widely attributed to environmental pollution resulting in rapid depletion of the western Himalayan glaciers.[16] The same temperature changes have resulted in glacial surges in the basin source elsewhere. According to Hewitt, "31 glaciers have expanded in the Karakoram in the past 150 years not because of lower temperatures, but because higher temperatures have caused the existing ice to move faster down slope."[17] The changes in rainfall are unreliable with both increasing and decreasing trends in different parts of the region. According to a report of the International Centre for Integrated Mountain Development (ICIMOD), "The most serious changes are probably related to the frequency and magnitude of extreme weather events, such as high intense rainfalls leading to flash floods, landslides and debris flows."[18]

It would suffice to note here that the Indus Basin region lacks reliable data sets to assess the region-specific reasons for climate change. The reasons for climate change in the Indus Basin are not yet clearly investigated; further research is needed in this regard.

Scientific trends in climate change

Scientific investigations find a close link between increasing temperatures and flow variations at different stations of the Indus Basin seasonally. Arora and others, studying the climate induced flow variations in Chenab, conclude that changes in stream flow during the four seasons are linearly related to the increase in temperature. The peak flow occurs in the pre-monsoon period due to high snow/ice melt runoff under a warmer climate.[19] For Scally, there is a strong relationship between winter snowpack and summer runoff in the River Kunhar, a headwater tributary of the River Jhelum in northern Pakistan. Indus and other snow-fed rivers are also likely to cause flooding due to a heat wave in early summer.[20]

Hydrological studies carried out for the Sutlej River have found that flow variations are related to seasonal climatic changes.[21] Specific inflow changes have also been investigated in the upstream areas of Indus, Jhelum, and Chenab rivers in Pakistan, which are largely attributed to land use changes, deforestation, and Indian construction of dams on the other side of the watersheds. Flow variations have also been reported in the downstream areas of the Indus Basin due to massive water divergence within the upstream areas, depleting water availability downstream. According to the findings, enormous amounts of water of the Indus and its tributary rivers have been diverted in the upstream areas of India and Pakistan during the last century. The continuous shrinking of the lower Indus Basin is projected to affect the monsoon system.[22]

Future projections about regional climate change

ICIMOD statistics project that some 40-80 per cent of the glaciers in the Hindu Kush and Himalayas would be lost by the end of the century, with the exception of the Karakoram, where the glaciers have been more stable.[23] Another study by the ICIMOD found that out of the 2,420 glacial lakes in the Indus Basin, 52 are potentially dangerous and can result in glacial lake outburst floods (GLOFs) with serious consequences.[24]

The regional climate model used by Rees and Collins has found that some areas might experience increased water availability whereas others could face a significant reduction in water flows (for details see 'seasonal changes' below).[25]

History of water conflicts in the Indus Basin

India and Pakistan were partitioned in 1947 as two independent nation states after a three-decade-long struggle against their British colonial masters. The hurried withdrawal of the British from the subcontinent left several partition legacies between India and Pakistan, most important of which are territorial dispute over Kashmir and sharing of transnational waters. While the former has caused three wars between the two countries, the latter was resolved with the division of international waters.

The immediate post-partition water dispute between India and Pakistan was regarding the supply of water from the Firozpur Headworks (Indian Punjab) to the Bari Doab Canal in Pakistan's Punjab province, a major source of irrigation for vast lands in Pakistani areas. The two countries tried to settle the issue through an arbitration tribunal, which was supposed to manage the assets division between the two parts of divided Punjab. The tribunal ceased to function on 30 March 1948, which allowed India to stop supply of water to

Pakistan, contending that "the property rights in the waters of East Punjab's rivers were vested in itself, and that West Punjab could not claim any share in those waters as of right."[26] Bilateral efforts to settle the water issues included a series of inter-dominion conferences and interim agreements without much success.[27]

It was only after the involvement of the World Bank that the two countries were able to reach an agreement in 1960 over the shared waters. Known as the Indus Waters Treaty, it gave full control of the three eastern rivers: Beas, Ravi, and Sutlej to India; and of the three western rivers: Chenab, Indus, and Jhelum to Pakistan. The treaty obliges both India and Pakistan to not interfere in the waters of the rivers allocated to the other side except for the limit specified for agricultural, domestic, and non-consumptive use. India was also given the right to generate hydroelectricity on waters of the western rivers through run-of-the-river projects, i.e., without altering the flow of water. The same right, however, was not given to Pakistan on the eastern rivers.[28] A Permanent Indus Commission (PIC) was created with representatives from each side for the "implementation of the Treaty and to promote cooperation between the parties in the development of the waters of the Rivers."[29] The treaty also provides for the appointment of a neutral expert to settle bilateral water disputes as well as referral to the court of arbitration for the resolution of intractable disputes.[30] In the post-treaty period, India and Pakistan have been involved in bitter water disputes, all of which were related to Indian construction of dams and hydropower plants on the western rivers of the Indus Basin. The western tributaries of the Indus River—Chenab and Jhelum—flowing through India before entering Pakistan are an important source of hydropower generation in the Indian-Held Kashmir (IHK).

India has planned a network of dams and hydropower plants across the major river basins including the Indus Basin tributaries. India is currently running more than 23 micro and macro hydropower stations on the western rivers of the Indus Basin with 12 new projects under study in the IHK.[31] The Indian haste to tap the hydropower potential of the eastern rivers of the Indus Basin has awakened the policy-making circles in Pakistan. In 2001, the Water and Power Development Authority (WAPDA) of Pakistan announced more than 33 schemes of irrigation dams and hydropower plants to be constructed and upgraded under the Water Vision 2025.[32] India and Pakistan have entered in a dam-building race on the Indus Basin, a lead factor for water tensions in the region. The post-IWT disputes between India and Pakistan revolve around general riparian politics in which the lower riparian inherits a sense of insecurity.

Disputes over Indian hydropower projects

Salal Dam project

In the post-IWT period, the first ever water dispute between India and Pakistan was regarding the Indian construction of the 690 MW Salal hydroelectric project on the River Chenab. The project involved construction of a dam across the Chenab near Riasi (in the IHK), a diversion canal, and a power station. Pakistan’s contention was that the dam would enable India either to interrupt the flow of the water or to flood its Punjab province, whereas India maintained that it would be impossible to cause flooding without causing much greater damage to its own territory.[33] The Salal Dam project remained the subject of bilateral negotiations from 1970 to 1978. India was able to suggest modifications in the design of the project to the satisfaction of Pakistan, which became the basis of settlement between the two countries. It was on 14 April

1978 that the two countries signed an agreement on the design of the Salal project providing that "in order not to prevent the flow of water to Pakistan the height of the dam would be a little less than 10 meters instead of 12 meters as originally proposed."[34]

Tulbul Navigation/Wullar Barrage project

This Indian project has been a long-standing contentious issue between India and Pakistan since 1984. The Tulbul project is a 'navigation lock-cum-control structure' on the River Jhelum in the IHK. Work on the project was stopped in 1987 after Pakistan raised objections over the design of the barrage. For Pakistan, the project is a clear violation of the IWT as the proposed barrage "envisaged 32 times more storage capacity against 0.1 million acre feet storage permitted to India under the Treaty."[35] The Indian position is that the Tulbul Navigation project does not intend to store water to the detriment of Pakistan. According to the Indian reports, controlled release of waters from this project will equally benefit the downstream power projects of Uri and Mangla in the IHK and Azad Jammu and Kashmir (AJK) respectively. [36] To date, the two countries have held 13 rounds of secretary-level talks, including four under the 'composite dialogue', on the subject without any final solution to the problem.

Any final settlement of the issue will need to satisfy Pakistan regarding due safety against any possible water manipulation by India. The belligerent relationship between the two countries is one of the main reasons behind Pakistan's resistance to Indian projects that alter the flow of water beyond the limit provided in the IWT irrespective of their perceived technical benefits to Pakistan. In order to maximize the mutual benefits of a unilateral project, the atmosphere of distrust and hostility needs to be transformed.

Baglihar hydroelectric project

After remaining a source of dispute between India and Pakistan for 8 years (1999-2007), the Baglihar hydropower project of India was finally settled through the legal opinion of a World Bank appointed neutral expert[37] Professor Raymond Lafitte, a Swiss professor. The Baglihar project located on the Chenab River in IHK (about 120 km upstream of the Pakistan territory) is a run-of-the-river plant with a capacity of 900 MW. Its first stage (450 MW) was completed and commissioned in 2008.[38] Pakistan's opposition to the said project was based on the point that "the design of the Baglihar Plant on Chenab Main does not conform to the IWT provisions and that the Plant design is not based on correct, rational and realistic estimates of maximum flood discharge at the site."[39] The Indian side did not agree with Pakistan's point of difference. Determinations given by the neutral expert pertain to technical analysis of the design of the dam and power house. While the expert agreed to the Indian position of gating the spillways on engineering grounds, he also agreed with Pakistan's position relating to reduction in the dam height, increase in the level of intakes for turbines, and modifications in the storage volume.[40] Both India and Pakistan raised objections to the neutral expert's legal determinations. The legal opinion of the expert can be termed as a win-win situation for India and Pakistan as some of its points favour India while others favour Pakistan.

Differences between India and Pakistan over Baglihar hydroelectric project represent a test case for both the countries to foresee inherent problems in the management of their respective water bodies. It is particularly important for Pakistan to put in place a proper system of water governance and infrastructure development. Given the dependence of the Indus River on seasonal rains and glacial melt, Indian haste in building controlled infrastructures on upstream tributaries of the Indus Basin is going to increasingly affect downstream water flow resulting in subsequent riparian rivalries. Pakistan needs to discuss the viability of numerous Indian projects on the western rivers. As in the case of Baglihar, the plant needs 860 cumecs (30,371 cusecs) of water whereas the flow of water in Chenab varies seasonally as much as reducing to 50 cumecs (1,766 cusecs) during winter.[41]

Nimoo Bazgo Dam

This 45 MW under-construction project is located on the River Indus in Leh district of IHK. With a 57 metres high dam, it is designed as a run-of-the-river scheme and was scheduled to be completed by December 2010.[42] According to the website of the National Hydroelectric Power Corporation (NHPC) of India, three units of the power station started operating by 2013. However the commercial production of power only began by the end of 2013.[43]

For Pakistan, the design of the Nimoo Bazgo project, like many other run-of-the-river schemes of India, could alter the seasonal flow requirements in Pakistani areas. The grant of carbon credits by the UN Framework Convention on Climate Change to India on the Nimoo Bazgo hydropower project was also opposed by Pakistan on grounds of cross-border environmental impacts.[44] From 2010 to 2012, Pakistan officially raised these objections over the then-ongoing construction of the said power project through mass media. The concerned authorities in the country also aimed at taking the case to the International Court of Arbitration (ICA). However, the results of technical rulings of the ICA in the earlier filed disputes of Baglihar and Kishanganga stopped Pakistan from pursuing any new dispute legally. Since the ICA prevented India from having permanent constructions on western rivers with ungated run-of-the-river schemes, the rulings became modus operandi for Pakistan as well as India in future disputes. Therefore, in Nimoo Bazgo project, Pakistan did not take case to the ICA.

Uri II and Chutak hydropower projects

This is for the first time in the history of the IWT that bilateral differences regarding the design of these two projects were resolved at the level of PIC. Both of these hydropower plants are in the process of construction in IHK. With regard to Uri II hydropower plant on River Jhelum, Pakistan had objections on the level of the gates and sedimentation issue. Both were addressed by India to the satisfaction of Pakistan. For Chutak hydropower plant on River Indus, Pakistan had conveyed its concerns to India about the design parameters of the project. India conceded to Pakistan's suggestion of providing openings in the design of the project to prevent over-storage to the detriment of Pakistan.[45]

In these two cases, resolution of technical differences by the design engineers of PIC can be taken as a precedent for the existing and future water conflicts. According to Pakistan's former Indus Commissioner Syed Jamaat Ali Shah, "The Commission should have the power or mandate with the help of technical advisors to resolve issues [at its level] and deliver results to the respective governments instead of looking up to non-technical people."[46] Empowering the PIC with technical experts besides ensuring transparency in information sharing will help avoid serious conflicts over cross-border water-sharing between India and Pakistan.

Kishanganga hydropower project

The said Indian project, located near Bandipore in Baramulla district of IHK, has been categorized as a 'dispute' under the IWT[47] (a term more serious than 'differences' as referred to in the case of Baglihar Dam) as Pakistan has moved the Permanent Court of Arbitration (PCA) on the subject. The reason for

Pakistan's opposition to the said Indian project is the possible adverse effects for Pakistan's own Neelum-Jhelum hydroelectric project (NJHP) on a tributary of the same river. The Indian project is destined to divert water from Kishanganga—a tributary of River Jhelum known as Neelum River in Pakistan—to Bonar Madmati Nallah, another tributary of Jhelum, which falls in Wullar Lake and joins Jhelum River thereafter.[48] For Pakistan, the most serious concern had been diversion of water from Neelum/Jhelum River, an act threatening the ecology and hydrology of the surrounding region. According to Ata-ur-Rehman Tariq, an engineer and professor at the Lahore University of Engineering and Technology,

> "The KHP [Kishanganga hydropower project] will seriously manipulate the water of Jhelum River by transferring water to the Wullar Lake in IHK. And although all the flow of KHP (with some system water losses) will reach Mangla Dam in Pakistan via Jhelum River, its time distribution will be altered by the KHP to an unknown extent, and it will certainly be not available to the NJHP thereby affecting the latter's power generation."[49]

In its final award, the PCA allowed India to go ahead with the construction of KHP with changes in design to save Pakistan downstream from any detrimental effects. The ruling of the court says, "The Court of Arbitration unanimously decided . . . that India shall release a minimum flow of 9 cumecs [318 cusecs] into the Kishanganga/Neelum River below the KHP at all times."[50] The award is binding on both the parties without any right of appeal and could be reconsidered at the level of PIC only after seven years from the first diversion of water from the KHP.

The IWT provides India limited storage capacity on western rivers of the Indus Basin, and Pakistan full control of the rivers. But the upper catchment area of the western rivers lies on the Indian side. This makes it impossible for both the countries to unilaterally enjoy full benefits of the divided resource. The treaty provides ample scope for future development of the rivers on the basis of joint efforts, an area still unexplored by the two countries.

Table 2

Status of hydroelectric development in the Indus Basin

Identified capacity as per assessment		Capacity developed		Capacity under construction		Capacity developed + under construction		Balance potential	
	MW	MW	%	MW	%	MW	%	MW	%
Indus* (India)	33,832	9,929.3	29.34	5,431.0	16.5	15,360.3	46.51	18,471.7	54.60
Indus** (Pakistan)	59,796	6,720	11.23	30,039	50.23	36,759	61.47	23,037	38.53

Sources: *Central Electricity Authority, Government of India[51]

**Private Power and Infrastructure Board, Government of Pakistan[52]

The Indus Waters Treaty and institutional capacity

The existing Indus Basin system as designed by the IWT suffers from growing physical and structural changes in water bodies of the region. Water scarcity exists at a wider scale in spite of revelations by tree-ring chronologies based research from the main upper Indus Basin in northern Pakistan that "the river flow has considerably increased over the last 21 years, possibly the highest sustained flow period of the past 500 years."[53]

It is not clear whether an increased flow in the upper Indus Basin is due to climate change induced glacial melt or high rainfall led runoff, but it does indicate a lack of effective policy concerning utilization of surplus water resources in the northern half of the subcontinent. There are many other areas which suffer from frequent droughts and shortage of rainfall such as southern and central parts of India and Pakistan (e.g., Ravi and Sutlej in Punjab). Domestic water crises in both India and Pakistan have placed an additional burden on Indus Basin tributaries where seasonal flow changes are not handled on a basin-wide scale. The treaty specifically deals with waters divided in terms of riparian usages and conflicts arising thereby. Lack of a basin-wise approach in dealing with seasonal changes and climate variability inhibits dispute resolution apparatuses of the IWT. A number of factors reveal lack of institutional resilience in the IWT, which are discussed below.

Fixation of water rights

The IWT is not a water-sharing treaty but a water apportionment accord. On the one hand, its focus on allocating water rights with a mechanism governing individual uses of water and settlement of bilateral water disputes has won credibility for institutionalization of dispute resolution in South Asia over a period of five decades.[54] On the other hand, however, it is this fixation of water uses which has given rise to disputes in a climatically vulnerable river basin. According to the Intergovernmental Panel on Climate Change (IPCC):

> "One major implication of climate change for agreements between competing users (within a region or upstream versus downstream) is that allocating rights in absolute terms may lead to further disputes in years to come when the total absolute amount of water available may be different."[55]

Under the treaty, India and Pakistan are authorized to utilize 100 per cent of their respectively allocated eastern and western tributaries of the Indus Basin system. Treaty's fixation of uses on each other's tributaries could be regarded as a rigid attempt in water allocation. For example, Pakistan is allowed non-consumptive domestic, and limited agricultural uses of waters on eastern tributaries of India flowing into Pakistan under Article II of the treaty. India has similarly been given non-consumptive domestic, agricultural, and hydropower generation (with some storage) rights on western tributaries of Pakistan as per Article III of the IWT.[56]

To compensate Pakistan for the waters of eastern rivers allocated to India, the treaty allowed a transition period of 10 years for unrestricted water availability from the eastern rivers and infrastructure development, combined with financial replacements as per Article II and Annexure H of the IWT.[57] These allocations were mutually agreed upon by taking into consideration the 'historical uses' of India and Pakistan at the time of drafting of the treaty. Such a division based on historical uses and property rights tends to ignore probable changes in demands and values necessitated by either economic growth or climate variability. The rising number of discords between India and Pakistan on hydropower development and interruption in regional flow requirements are challenging the institutional resilience of the IWT. For example, the fixed allocation of water storage and hydropower generation rights to India on western rivers has led to massive Indian planning of hydropower projects with a cumulative effect on drying up of river beds in the lower catchments of these rivers ravaging crops and water storage capacity on Pakistan side. The IUCN 2013 report is fair to ask that when flows are variable, how the water entitlements could be fixed for India[58] or Pakistan. The fixation of water rights by the treaty also does not take into account seasonal changes in the basin.

Seasonal changes

The temperature of the Indus Basin varies spatially and seasonally. Low winter runoff and high summer runoff is a common phenomenon for tropical basins like the Indus. Hydrological studies carried out for the Sutlej River have found that the flow variations are related to seasonal climatic changes.[59] Several scientific studies reveal that rainfall patterns in different river catchment areas of the Indus Basin show flow variations seasonally.[60] The regional climate model used by Rees and Collins[61] to assess the impacts of de-glaciation on the water resources of the Himalayas has found that some areas might experience increased water availability for the future whereas others such as the upper Indus Basin could face a significant reduction in water flows due to low rainfall and small runoff from the non-glaciated part. The study has indicated initial increase of 14 per cent in the flows of the upper Indus Basin for a few decades over a one century scenario followed by a decline of 30 per cent.

The Indus Basin, like any other heavily regulated river basin in the world, is prone to flooding. Daanish Mustafa, a London-based expert on water issues of South Asia, identifies one particular feature that makes the Indus Basin vulnerable to flooding. It is that the Indus River's drain, the western Himalayas, is one of the youngest mountain ranges in the world thus carrying high silt loads. In his words:

> "The extensive diversion and storage of water means that the Indus Rivers do not have enough flow to carry the silt, which gets deposited in the channels, thereby reducing the channel capacity to carry even minor floods. The river engineering has created a situation where an otherwise moderate flood flow can become a high flood and eventually a catastrophic flood."[62]

The Federal Flood Commission Islamabad also recognizes it:

> "The inadequate existing discharge capacity of some of the important structures (Barrages and Rail or Road Bridges) on Rivers Indus, Chenab and Ravi is one of the major reasons of flooding."[63]

Although the IWT obliges parties to exchange daily data of river inflows, water discharges, withdrawals, escapages from canals, and reservoir releases on a monthly basis (Article VI),[64] and has established permanent posts for Indus Commissioners from both countries, the whole mechanism rests on the principle of good faith. During the past few years, patterns of river inflows and discharges in all eastern and western rivers of the Indus Basin have changed profoundly due to changes in land use, ground water extraction, rainfall variations, and glacial melt in the Himalayas. The phenomenon of quick glacial melt means reduced water supply over longer periods after heavy flooding.

It is beyond the scope of the treaty to adjust flow variations to the rising demands and pressures for socio-economic growth in India and Pakistan (see Table 3). Division of basin waters with fixed quantities fails the treaty to address flow variations climatically and spatially which in turn have become a major source of potential disputes over water rights in the subcontinent. For instance, given the high seasonal variability of the Indus Basin, the engineering adaptations in water infrastructures have recently become the focus of a neutral expert in the case of Baglihar hydropower dispute between India and Pakistan. As mentioned above, the neutral expert in his determination agreed to the Indian position of gating the spillways on engineering grounds and conceded to Pakistan's position about reducing the dam height[65] to reduce the effects of water flow downstream.

Table 3

Cumulative impacts of seasonal variations on water resources in the Indus Basin

Change	**Results**	**Socio-economic Impacts**
High runoff – flooding	Land sliding/glacial outbursts/artificial dam formation	Road, rail infrastructure damages, loss of human and animal lives
	Increased sedimentation and reduced groundwater recharge	Temporary or permanent losses to hydropower dams
	Increased soil erosion	Loss of irrigation
Increased variability in rainfall patterns	Reduced reliability on canal networks for irrigation, industrial and domestic supply	Increased pressure for alternative water supplies
	High use of groundwater resources	Increased costs of crop yields resulting in food inflation
Low run off – water shortages/droughts	Increased gaps in demand and supply	Loss of irrigation, hydropower generation, inter-sector conflicts for water allocations, increased frequency of domestic and cross-border conflicts over water-sharing

Environmental inflows

The concept refers to maintaining adequate river flows for ecological system.[66] Integrity of a river basin has recently been highlighted as an important environmental concern to create a balance between river flows and its regulation. Both regional inflows and water abstraction relate to consideration of all aspects of river basin including environmental, social, economic, and cultural uses in a given regime.[67] Analyzing by virtue of these essentials, the IWT significantly lags behind in addressing environmental flow assessments as part of basin-wide planning or implementation. The reduced flow of fresh water in the Indus delta is threatening flora and fishery resources besides destroying the rich mangroves.[68]

For excess waters and flood discharge, the treaty leaves the matter to the use of natural waterways of the rivers with the provision of the 'no material damage' principle by either party. Communicating advance information is also a prerequisite in case of extraordinary discharges. The practical application of the no damage principle has become difficult in the past years with Indian releases of excess water in Ravi and Sutlej rivers almost every monsoon creating flood or flood-like situation in bordering Pakistani villages. During heavy rain-falls in the upper catchment areas of rivers Beas, Chenab, Ravi, and Sutlej, India cannot save itself without flooding Pakistan.

Then there is water pollution in the Indus Basin due to industrial and municipal discharges affecting livelihoods and agricultural production throughout the region. In both India and Pakistan, groundwater extraction is extremely high, an important source of saline lands and reduced crop yields, again left unaddressed by the IWT. With competing interests and uses of each nation, pressure is mounting on the Indus system affecting environmental flows and ecological balance.

Article IV (10) of the IWT prohibits water pollution but does not provide a mechanism to control such an environmental problem. There is another important provision of the 'no harm principle' in the IWT (Annexure D) corresponding to the international environmental law,[69] which prevents the riparian states from getting into a zero-sum game. Pakistan has invoked this provision to the Permanent Court of Arbitration (PCA) in the case of the Kishanganga hydropower project (KHP) of India. The court gave a partial award on 18 February 2013 restricting India "to maintain a minimum flow of water in the Kishanganga/Neelum River" in an attempt to ensure Pakistan's agricultural and hydroelectric uses downstream.[70] The PCA decision gave due regard to the environmental provisions of the international law and the IWT, which call for reconciliation between water resource development and environmental protection.

Many of the international environmental provisions have begun to affect the IWT. For instance, in the case of the KHP, India was asked by the PCA to submit environmental impact assessment (EIA) for ecological impacts. Such a provision does not exist in the IWT for sharing between the riparian states.[71]

Sharing of benefits

Comparing it with the international trans-border water laws, it becomes clear that instead of focusing on water cooperation and equitable sharing, the IWT is more of a dispute resolution mechanism. Although Article VII of the treaty allows future cooperation for optimal utilization of shared resources, the scope of the treaty for benefit-sharing remains limited in near future given the history of enmity between India and Pakistan on Kashmir.

The benefit-sharing approach shifts the focus from resource utilization as per individual needs to the distribution of benefits from mutual development of resource such as hydropower generation, substitutive crop production, or flood embankments.[72] One good example of benefit-sharing as part of institutional resilience is the Columbia River Treaty between Canada and the US. Under the agreement, Canada is being paid by the US for flood control upstream. Canada also diverts water in the Columbia River for hydropower development by the US, which either delivers half of the electricity generated to Canada or pays the value in amount.[73] Brazil and Paraguay are another example of benefit-sharing. The two countries signed a treaty in 1973 to construct a joint hydropower plant called Itaipu on the Paraná River. Out of the several provisions of the treaty, some govern equal share of electricity and royalties, without any taxes on the new joint entity and on electric services produced.[74]

In case of the IWT, allocation of water rights becoming incompatible with changing socio-economic pressures in India and Pakistan are resulting in a surge of unilateral water management either through diversion of surface flows by construction of reservoirs or by groundwater over-extraction for improvident irrigation and industrial uses. The over-ambitious plans of both countries to enhance hydropower generation capacity have started off a race, in which one nation's project has increasingly proved detrimental to the other's development. For example, India and Pakistan developed a dispute over Indian construction of the KHP because of Pakistan's objection to the project's planned diversion of waters resulting in reduced flows downstream for its own hydropower plant (Neelum-Jhelum hydropower project) and irrigation needs. Upon differences remaining unsettled by the Permanent Indus Commissioners for more than eight years, the dispute was referred to the PCA in 2010 for arbitration by Pakistan. What came up as a final legal settlement by the PCA could be categorized as best example of international diplomacy and dispute resolution both under the IWT and international environmental law. But PCA's fixation of minimum water release quantity by India at 318 cusecs in Jhelum River has reduced electricity generation capacity for both KHP and Neelum-Jhelum hydropower projects. For the KHP, maintaining a minimum flow means reduction in annual power generation by 5.7 per cent[75] and for Neelum-Jhelum in AJK, the construction of KHP itself means a possible loss of energy generation capacity by 10 per cent after India meeting the minimum flow requirement.[76]

It is also significant to note here that the IWT preserves the 'priority' clause in deciding about water development rights. Thus referring to the IWT, the PCA award allowed India to go ahead with the KHP (with minimum flow requirement) because it was started well ahead of Pakistan's own hydropower project on the same river. Such a settlement of difference makes the IWT vulnerable to only loss-sharing instead of benefit-sharing in a changing water regime.

Almost every Indian project on the western rivers in the Valley of IHK was opposed by Pakistan on grounds of treaty violations by India. From Salal and Baglihar on Chenab to Wullar and Kishanganga on Jhelum, Pakistan's contention has been regarding the possible obstruction to the timely required flow of water downstream. Any high storage capacity could put India in a position to alter the timing of flow and subsequently affect the irrigation needs in the northern areas of Pakistan. As a lower riparian, Pakistan has increasingly become concerned about cumulative impacts of Indian dams and hydropower projects on river flows during dry and wet seasons for anticipated droughts and flooding. In comparison to the Columbia River Treaty or the Itaipu Treaty, the IWT's lack of focus on benefit-sharing is itself a potential recipe for frequent dispute eruption in future over climate induced changes in the apportioned water regime.

Changing nature of disputes

Since the conclusion of the IWT, disputes arising out of water apportionment procedures have gone from bilateral institutional mechanism and third party consultation to judicial arbitration. In spite of the fact that all the disputes concerning water rights between India and Pakistan were resolved within the institutional framework of the IWT, the changing nature of disputes (see Table 4) is itself a cause of concern, and questions the institutional resilience of the IWT for future climatic variability in the apportioned waters.

Table 4

Indus Waters Treaty and changing nature of disputes

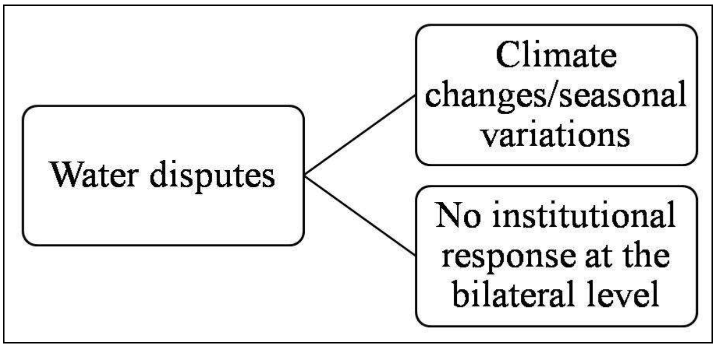
Dispute avoidance and resolution process	Bilateral negotiations	Third party settlement	International adjudication
	Permanent Indus Commission (Article VIII)	Neutral expert (Article IX Annexure F)	Permanent Court of Arbitration (Article IX Annexure G)
From bilateral to international resolution	Salal and Chutak hydropower projects	Baglihar hydro-electric power project	Kishanganga hydro-electric power project
Years in change	1978/2010	2007	2010
Indicators of change	Decline in farmland, energy insecurity, multi-sectoral pressures	Hydropower generation, rise in groundwater extraction, water recycling, soil salinity	Multi-purpose dams, Fresh water scarcity, Low crop yields and growing food insecurity, loss of ecosystem

Conclusion

The IWT does not cover all variability in the Indus Basin. Conflicting national interests and changing climate in the Indus Basin are becoming a source of conflict due to low institutional resilience in the region (see Figure 1). There are regions in the world which are threatened by fresh water scarcity. But resource scarcity leads to cooperation rather than conflict only in cases where institutionalization of water regime integrates socio-economic variability.

Figure 1

Water insecurity in the Indus Basin



The Indus Basin region suffers from lack of regional environmental laws, which, if present, can bind the governments to adopt environment-friendly water resource development policies. Analyzing the dam-building haste in the Himalayan region, a report by the International Rivers identifies that there is no cumulative impact evaluation of the construction of so many dams in one river basin or region. This will lead to disastrous consequences for the people and ecology of the region.[77]

With regard to the Tarbela Dam, Pakistan's largest and economically acclaimed reservoir, the negative ecological impacts include increased salinization of drinking water, intrusion of sea water due to reduced river flows, and long-time displaced population without being adequately compensated.[78] The recently sanctioned 272 metres high mega project of Diamer-Bhasha on the Indus River has also raised a number of environmental concerns in the project area—the Gilgit Baltistan region. The proposed location is the epicentre of catastrophic rock slides.[79] Moreover, the region is prone to glacial lake outburst floods which can cause unprecedented flood damages by overflowing large dams. On the Indian side, the Sutlej is suffering from widespread water pollution.

In the past as well, water insecurities induced by seasonal changes have resulted in water conflicts between the two nations. Limited capacity of the IWT to address growing water insecurities in the region could result in raising the number and changing the nature of water disputes though without affecting its dispute resolution procedures.

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