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Engr. Najam Waheed obtained his Bachelor's Degree from University of Engineering & Technology, Lahore in Civil Engineering. He has over thirty years of multifaceted professional experience leading and pursuing development and engineering projects which includes planning, project management, preparation of technical reports and contract documents. He is well-versed in various national and international codes, regulation, quality standards and their implementation. He worked on various prestigious and technically complex projects.

Engr. Najam Waheed has been a Council Member of Pakistan Engineering Congress for more than two decades. He has been an active member of the Congress serving as Secretary, Joint Secretary, Treasurer, and convener of all important Committees of the Congress, and was elected as the President of the Pakistan Engineering Congress in December 2021. His vision has been manifested in an digital transformation of the Congress's services and has laid a strong foundation for future growth and developments of Engineers Communities.

His dedication to engineering development and the Pakistan Engineering Congress played a significant role in developing effective synergies with important professional bodies in the country, which would significantly contribute to engineer's professional competence in a challenging environment of disruptive technologies and sustainable development.



Engr. Najam Waheed
President,
Pakistan Engineering Congress
(77th Session)

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Welcome Adress
By
Engr. Najam Waheed

President
Pakistan Engineering Congress

Welcome Address

By

Engr. Najam Waheed

President Pakistan Engineering Congress

On World Water Day, 2024

On the theme of "Leveraging Water for Peace"

Honorable Chief Guest, Engr. Asif Baig sb.
Distinguished Delegates,
Executive Council Members,
Fellow Engineers, Ladies & Gentlemen,

Assalam-o-Alaikum!

It is a matter of great honor and pleasure for me to welcome you all over here on the World Water Day. As we gather here today to commemorate World Water Day, we are reminded of the critical importance of water in our lives and the pressing need to leverage this precious resource for peace and prosperity. This year, the theme **"Leveraging Water for Peace"** calls upon us to recognize the transformative power of water in fostering cooperation, resolving conflicts, and building sustainable societies.

Ladies and Gentlemen!

Water is not merely a commodity; it is a fundamental human right and a cornerstone of development. Access to clean water and sanitation is essential for the health, dignity, and well-being of individuals and communities worldwide. Yet, millions of people still lack access to safe drinking water, while many more face the daily threat of water scarcity, pollution, and degradation.

In recognizing water as a shared resource, we must also acknowledge its potential to unite us across borders, cultures, and ideologies. Water knows no boundaries; rivers, lakes, and aquifers transcend geopolitical divides, connecting us in ways that go beyond politics and conflict. By embracing water as a catalyst for cooperation, we can overcome differences and work together towards common goals.

One of the most significant challenges we face in leveraging water for peace is the increasing competition for scarce water resources. As populations grow, economies expand, and climate change intensifies, the demand for water is rising, placing unprecedented pressure on freshwater

ecosystems. In many regions, water scarcity has become a source of conflict, aggravating tensions and undermining stability.

However, water scarcity does not have to be a source of conflict; it can also be an opportunity for collaboration. Through dialogue, negotiation, and cooperation, riparian states can find mutually beneficial solutions to shared water challenges. By fostering trust, transparency, and goodwill, we can transform water from a potential source of conflict into a catalyst for peace.

Ladies and Gentlemen

Investing in water infrastructure and management can yield significant dividends for peace and development. Sustainable water management practices, such as rainwater harvesting, wastewater recycling, and ecosystem restoration, can help alleviate water stress, enhance resilience, and promote social cohesion. By prioritizing investments in water and sanitation, we can address the root causes of poverty, inequality, and instability, laying the foundation for a more peaceful and prosperous future.

Moreover, water plays a crucial role in addressing some of the most pressing global challenges we face, including food security, public health, and environmental sustainability. By promoting sustainable agriculture, improving water efficiency, and protecting ecosystems, we can enhance food production, reduce poverty, and safeguard biodiversity. By ensuring access to clean water and sanitation, we can prevent disease, promote gender equality, and empower marginalized communities. By integrating water into climate change adaptation and mitigation strategies, we can build resilience, mitigate risks, and safeguard our planet for future generations.

Ladies and Gentlemen

Leveraging water for peace requires a collective effort and a shared commitment to cooperation, sustainability, and justice. As we mark World Water Day, let us recommit ourselves to harnessing the transformative power of water for the benefit of all. Let us work together to ensure that water flows freely, nourishing communities, fostering cooperation, and paving the way for a more peaceful and prosperous world for generations to come.

I would like to thank you all once again for being with us.

Thank you.

-: Pakistan Paindabad :-

Paper No.197

TRANSBOUNDARY WATER CONFLICTS INDO-PAKISTAN CONTEXT

Riaz Nazir Tarar

TRANSBOUNDARY WATER CONFLICTS
INDO-PAKISTAN CONTEXT

By

Riaz Nazir Tarar[1]

ABSTRACT

Water is essential for sustaining life on earth. Therefore, fresh water sources of rivers and lakes which traverse territories of two or more countries have remained a source of conflict throughout the history. Thus, satisfactory resolution of transboundary water conflicts is very important in ensuring peace and regional tranquilities.

Pakistani's Indus Plains with fertile lands and 'ideal lay of land' have history of river irrigated agriculture dating back of Indus Civilization of 3000 BC. Consequently, it now inherits world's largest contiguous irrigation system.

Indus Basin is endowed with life sustaining six major rivers and spread over 1.12 million km^2 (0.43 million mi^2) with distribution of: 52% in Pakistan; 34% in India; 8% in China; and 6% in Afghanistan. Out of current estimated Basin population (excluding nominal Chinese) of about 235 million, about 216 million (92%) living in Pakistan is dependent on Indus Basin for its livelihood.

At the time of Partition in 1947, boundaries of India and Pakistan were drawn without regard to hydrology of Indus Basin Rivers. This encouraged India to create water dispute with Pakistan in April 1948. After stalemate and prolonged negotiations under aegis of World Bank, this dispute got resolved through Indus Waters Treaty, 1960. Accordingly, water of: three Eastern Rivers of Indus Basin (Ravi, Sutlej & Beas) was assigned to India for unrestricted use; and three Western River (Indus, Jhelum and Chenab) allocated to Pakistani with limited permission to India for some consumptive and non-consumptive uses for development of hydroelectricity including storage. The element of hydroelectric development by India on Western Rivers could prove a major bone of contention (unfortunately this has become true).

Being a 'Treaty of mistrust' based' on division of Indus Basin Rivers, it had inherent potential of cross boundary conflicts. Indian occupation of Kashmir in 1948 with head waters of the major rivers provided another potent source of water hegemony to India as upper riparian. Sensing this, the Treaty contained specific provisions to avoid cross-boundary conflicts. Notwithstanding this, India started resorting to creation of water disputes soon after the Treaty. So far, India has created some major hydroelectric project related disputes through: Salal (1974); Wullar Barrage (1985); Baghliar (1992); Kishenganga (1994); and Ratle (2022).

[1] General Manager (R) WAPDA & Associate, National Development Consultants (NDC), Lahore

In all above disputes, Permanent Indus Commission (PIC), charged with primary responsibility of bi-partite resolution, failed and these had to be referred either to governments or third parties. Unfortunately, however, in almost all cases the third-party referees, Neutral Expert / Court of Arbitration, essentially overruled Pakistan's objections and allowed India to complete the projects. Under this prevailing trend, India has already completed a number of large projects aggregating to 3320 MW. Further, a number of projects is under construction and more are in the pipeline or under planning.

Along with above and further hydroelectric developments on Western Rives, India will acquire substantial hurting capability against Pakistan in case of wars or other transboundary tensions, such as Pulvama incident of February 2019. In such cases, Indian modus operandi could be to maloperate the storages conjunctively for inflicting serious damage upon Pakistan through: either canal water supply cut-off in winter; or flooding in summer.

In such future instances / water disputes, Pakistan first attempt would be to seek redressal through dispute resolution mechanism of the Treaty. However, based on upto date bitter experience, it is likely that India will be allowed to complete a number of hydroelectric projects, for further exploitation of hydropower potential on Western Rivers, estimated around 30,000 MW.

To cope with above situation, Pakistan must complete within its territory the contingency measures. These should comprise: priority completion of ongoing dam projects of Dasu and Diamer Basha; and taking up already engineered or planned Kalabagh, Akhori and Shyok Dam Projects. Another potent Indian threat of cutting critical water supplies of Chenab at Marala should be addressed through construction of Mangla – Marala Link.

On international platform including UN, Pakistan should actively pursue already started initiative for strict implementation of Indus Waters Treaty.

Last but not the least, a serious attention should be given to early consummation of Kabul water sharing agreement with Afghanistan, spadework for which has been already done.

1. INTRODUCTION

Water is the most precious resource and essential for sustaining life on earth. Being a vital constituent of human life, water with its diverse uses will continue to play a major role in achieving broader development objectives of food security, poverty alleviation and improvement of quality of life. Therefore, international freshwater sources of rivers and lakes etc. which serve as boundaries between states or traverse territories of two or more states have remained a source of inter-state conflicts throughout the history.

Such conflicts stem both from: absolute dependence of peoples upon water and the resulting interdependence of co-basin states; and uncertainties specific to certain basins in the context of applicable principles of international law on water

sharing. Interdependence further stems from the fact that sates only exercise effective control over such waters temporarily or partially as they flow through or along their territories. Further, the fact that utilization or development of a shared water resource by a co-basin state necessarily affects the quantity and quality of water available to a lower or neighboring basin state, or may have other detrimental results such as ecology.

Subject of transboundary waters, therefore, holds an important place in ensuring the global peace and the regional tranquilities.

2. INDUS RIVER BASIN

2.1 Geography

Transboundary Indus River Basin has a total area of 1.12 million km2 (0.431 mi2) distributed between Pakistan, India, China and Afghanistan as listed in Table-1.

Table-1: Country Areas in Indus River Basin

Basin	Area		Country	Area	
	km²	% of Southeast Asia		km²	%
Indus	1 120 000	5.4	Pakistan	582,000	52
			India	380,000	34
			China	88,000	8
			Afghanistan	72,000	6

Indus River Basin is also shown in Figure-1.

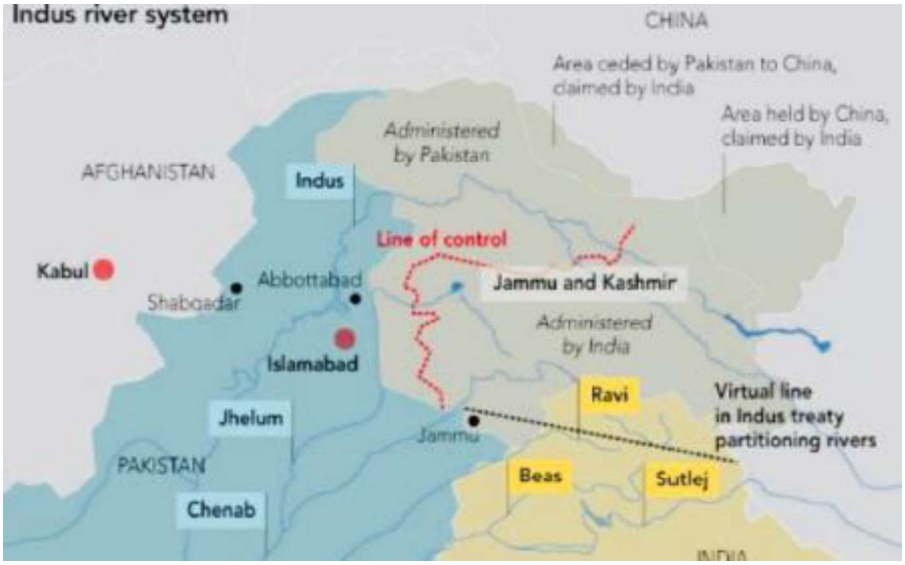


Figure-1: Indus River Basin

Basin stretches from Himalayan mountains in the north to dry alluvial plains of Sindh province in Pakistan in the south. Basin area in Pakistan is around 582,000 km2 (224,000 mi2). It covers about 52% of the Basin spread over whole provinces of Punjab and Khyber Pakhtunkhwa, most of Sindh province and the eastern part of Balochistan.

Drainage area lying in India is approximately 380,000 km2 (146,000 mi2), i.e. about 34% of the Basin and lying in the States of Jammu and Kashmir (disputed territory), Himachal Pradesh, Punjab, Haryana and Rajasthan. Only about 8 percent of the Basin lies in China and remining 6 percent in Afghanistan, where it accounts for 11 percent of the country's area.

2.2 Current Beneficiary Population

It is estimated that the current (2023) beneficiary population in the Basin is about 235 million as per country-wise break-up in Table-2.

Table-2: Estimated Population Dependent on Indus Basin Rivers

Sr. No.	Country	Dependent Population [a] (Million)		
		2017	(Million)	(%)
1.	Indian Occupied Jammu and Kashmir: -			
	i. Kashmir Valley	4.0	4.4 [c]	
	ii. Jammu	3.0	3.3 [c]	
	iii. Ladakh	0.3	0.3 [c]	
	Sub-total 1 (i+ii+iii)	**7.3**	**8.0**	**3.4**
2.	Pakistan			
	i. Four Provinces	202.5 [b]	229.4 [b]	
	ii. Azad Jammu & Kashmir	4.0	4.4 [c]	
	iii. Gilgit Baltistan	2.0	2.2 [c]	
3.	**Sub-total 2 (i+ii+iii)**	**208.5**	**216.0**	**92.1**
4.	Afghanistan	10.0 [d]	10.6 [c]	4.5
5.	**Total (1+2+3+4)**	**225.8**	**234.6**	**100.0**

a) Nominal population of China has been ignored.
b) Assumed as 95% of total population as per census.
c) At assumed annual compound growth rate of 1.7% from 2017.
d) Assumed as equal to 25% of population.

It is noteworthy that about 92% of current Basin population resides in Pakistan.

2.3 Climate

Climate is not uniform over the Basin. It varies from subtropical arid and semi-arid to temperate subhumid on the plains of Sindh and Punjab provinces of Pakistan to alpine in the mountainous highlands of North.

In semi-arid Lower Indus Plain (Pakistan), December to February is the cold season with mean monthly temperatures varying between 14 to 20 °C. Mean monthly temperatures during March to June vary from 42 to 44 °C. In Upper Indus Plain of Pakistan mean temperature ranges from 23 to 49 °C during summer and from 2 to 23 °C during winter.

Annual precipitation ranges between 100 and 500 mm (4 to 20 inches) in the lowlands to a maximum of 2 000 mm (80 inches) on mountain slopes. Snowfall at higher altitudes above 2500 m (8200 feet) accounts for most of the river runoff.

Upper Basin high mountainous region limits intrusion of monsoons, influence of which weakens north-west ward. Most of precipitation falls in winter and spring and originates from westerlies. Monsoonal incursions in lower catchment bring occasional rain to trans-Himalayan areas but, even during summer months not all precipitation derives from monsoons.

Climatic variables are strongly influenced by altitude. Northern arid valley floors receive precipitation from 100 to 200 mm (4 to 8 inches). This increases to 600 mm (24 inches) at 4400 m (14400 feet). Glaciological studies suggest precipitation accumulation rates of 1 500 to 2 000 mm (60 to 80 inches) at 5 500 m (18000 feet).

From 1961 to 1999 there were significant increases in winter, summer and annual precipitation accompanied by climatic warming whilst summer showed a cooling trend. These trends further accentuated with activated climate change at start of 21st century with impact upon water resource availability.

2.4 Water Resources

Outside the Polar Regions, Upper Indus Basin contains greatest area of perennial glacial ice of about 22,000 km2 (8,500 mi2) in the world. Glaciers serve as natural storage reservoirs that provide perennial supplies to Indus River System (IRS). Area of winter snow covers an order of greater magnitude. Annual river flows in the Basin comprise glacial and snow melt and rainfall runoff.

After debouching into plains of Pakistan, Indus River has two main tributaries, Kabul including Swat on the right bank and Panjnad on the left, which drains five rivers of Punjab, namely Jhelum and Chenab (Western Rivers) and Ravi, Beas and Sutlej (Eastern Rivers).

Indus River including major tributaries are perennial source of water supply to the entire Indus Basin Irrigation System within Pakistan and India. IRS runoff is seasonal with high flows and floods during summer monsoons and low flows during winter.

2.4.1 Indus River

Indus River is twelfth largest river in the world and originates near lake Mansarovar in north Himalayan range on Kailash Parbat in China at an elevation of 5 500 m (18,000 feet). Indus catchment area is unique in the sense that it contains seven of the world's highest peaks after Mount Everest. Famous among these are: 8600 m (28,200 feet) K2; 8100 m (26600 feet) Nanga Parbat; and 7800 m (25,600 feet) Rakaposhi.

River is about 3,200 km (1,987 miles) long out of which 322 km (200 miles) are in China, 792 km (1491 miles) in India while remaining 2,086 km (1,296 miles) traverse through Pakistan.

2.4.2 Jhelum River

Jhelum River originates in Indian Occupied Kashmir Valley, about 54 km (34 miles) east of Anant Nag and is 816 km (500 miles) long with a catchment area of 39,200 km^2 (15,100 mi^2) upstream of Mangla. It has 10 major tributaries, out of which Neelum / Kishan Ganga is the largest, with a length of 260 km (160 miles) and a catchment area of 3,968 km^2 (1,515 mi^2). Other major tributaries are Kunhar, Poonch and Kanshi.

2.4.3 Chenab River

Chenab River is formed at the confluence of two major tributaries of Bhaga and Chandra at Tandi in India. Its uppermost part is snow covered and forms the northeast part of Himachal Pradesh. From Tandi to Akhnoor the river traverses high mountains. River is 1232 km (770 miles) long with a catchment area at 41,760 km^2 (16,100 m^2). It enters Pakistan a little above Marala Barrage with sudden sharp change in slope. It has 12 major tributaries of: Dowara and Halsi above Marala in India; Jammu and Manawar Tawi originating in India but joining the river in Pakistan; and Palku and Bhimber in Pakistan. Largest Palkhu is 120 km (75 miles) long with a catchment area of 1,269 km^2 (490 mi^2).

2.4.4 Ravi River

Ravi River originates in lesser Himalayan range of India. It is 880 km (550 miles) long with a catchment area of 24,960 km^2 (11300 m^2). After debouching into plains above Madhopur, it traverses along Indio-Pakistan border till Ravi Siphon near Lahore. It has five major tributaries of Ujh, Bein, Basantar, Deg and Hudiara. These originate in India but drain into River Ravi below Madhopur. Largest is Deg Nullah with a length of 256 km (160 miles) and catchment area of 730 km^2 (280 m^2).

2.4.5 Satluj River Including Beas

Sutlej River also originates in China in Western Tibet in Kailash Parbat near the source of Indus, Ganges and Brahmaputra Rivers. It is 1,536 km (950 miles) long and has a catchment area of 75,369 km^2 (29000 mi^2) of which 70 percent is in

India. It flows into Pakistan (Punjab) near Ferozepur Headworks including flow of Beas River, which joins upstream at Harike. It eventually joins Chenab river upstream to Panjnad Barrage. Its largest tributary is Beas River, with a length of 464 km (290 miles) and catchment area of 9,920 km^2 (3800 mi^2) all in India. Sutlej river has eight other major tributaries in India except Rohi Nullah which originates in India but drains through Pakistan.

2.5 Stream Gauging of Indus River System

First stream gauging observation in Indus River System (IRS) was made on Indus at Attock in 1848. The next was on Chenab at Alexandria Bridge in 1879. Most important river gauging system at the rim-stations of all Indus Rivers was established in early 1920s by the Indus Discharge Committee. Since then, data of Indus River System (IRS) is now available for over a century.

2.5.1 Rim-Station Inflows

At the time of Partition in 1947, total average rim-station inflows of IRS were about 207 billion cubic meters (BCM) or (168 MAF). These also included Kabul River from Afghanistan with an estimated inflow of 18.5 BCM (15 MAF). However, about 2/3 of this was contributed by Kunar River, which originates in Chitral area of Pakistan, then enters Afghanistan and joins Kabul River near Jalalabad.

Mean annual Pre-partition rim-station annual inflow of IRS into Pakistan from India through Western Rivers (Indus, Jhelum and Chenab) was 166 BCM (135 MAF). On the other hand, corresponding mean annual rim-station inflow of Eastern Rivers (Ravi, Beas and Sutlej in India was 40.7 BCM (33.0 MAF).

3. DEVELOPMENT OF WORLD'S CONTIGUOUS LARGEST IRRIGATION SYSTEM IN INDUS BASIN

3.1 Nineteen Century

Due to lay of land and favourable climate for year-round cropping (Kharif and Rabi), over 3000-year-old Indus Civilization has its roots in irrigation. Under the British Colonial Rule, controlled canal irrigation began in 1859 with completion of Upper Bari Doab Canal (UBDC) from Madhopur Headworks on Ravi River. Until that time, irrigation was undertaken through a network of inundation canals, which functioned only during periods of high river flow. These provided water for Kharif (summer) crops and residual soil moisture for Rabi (winter) crops.

UBDC was followed by: Sirhind Canal from Rupar Headworks on Sutlej in 1872; Sidhnai Canal from Sidhnai Barrage on Ravi in 1886; Lower Chenab Canal from Khanki Head works on Chenab in 1892; and Lower Jhelum from Rasul Headworks on Jhelum in 1901. During the same period Lower and Upper Swat, Kabul River and Paharpur Canals, now in Khyber Pakhtunkhwa Province were completed during 1885 to 1914.

3.2 Twentieth Century

3.2.1 Triple Canal Project

In the beginning of twentieth century, it became apparent that water resources of some individual rivers were not in proportion to the potential irrigable land. Supply from Ravi, serving a large area of Bari Doab, was insufficient while Jhelum had a surplus. Consequently, an innovative solution, Triple Canal Project (TCP), was constructed during 1907-1915. TCP linked Jhelum, Chenab and Ravi Rivers allowing transfer of surplus Jhelum and Chenab water to Ravi River. TCP was a landmark in integrated inter-basin water transfer and provided the key concept for later resolution of the Indus waters dispute between India and Pakistan in 1960.

3.2.2 Other Projects

Sutlej Valley Project (SVP), comprising four barrages and eight (8) canals, was completed in 1933, resulting in harnessing of unregulated flow resources of Sutlej River including Beas and motivated planning for Bhakra Dam Project on Sutlej River. During the same period, Sukkur Barrage with its world's largest system of seven canals serving 2.95 million ha (7.30 million ac) in Lower Indus Basin was completed. It was also considered as the first modern hydraulic structure on Indus River. Haveli and Rangpur Canals from Trimmu Headworks on Chenab were completed in 1939 and Thal Canal from Kalabagh Headworks on Indus in 1947.

3.3 System New Inherited by Pakistan

System inherited by Pakistan at the time of its creation in 1947 is popularly known as Indus Basin Irrigation System (IBIS). It commanded large fertile flat Indus Plains and constituted the largest contiguous irrigation system in the world. Subsequently, inundation canals on Indus River were converted to weir controlled supplies through construction of three barrages at Kotri, Taunsa and Gudu.

A chorological history of IBIS development now lying within Pakistan is given in Table-3

Table-3: Chronology of the Indus Basin Irrigation Development in Pakistan

Sr. No.	Project	Year of Completion
1.	Upper Bari Doab Canal on Ravi River	1859
2.	Lower Chenab Canal on Chenab River	1982
3.	Sidhnai Canal on Ravi River	1882
4.	Lower Jhelum Canal on Jhelum River	1901

Sr. No.	Project	Year of Completion
5.	Lower and Upper Swat, Kabul River and Paharpur Canals in Khyber Pakhtunkhwa (previous North West Frontier Province)	1885-1914
6.	Triple Canal Project Linking Jhelum, Chenab and Ravi River	1907-1915
7.	Sukkur Barrage on Indus River	1932
8.	Sutlej Valley Project on Sutlej River	1933
9.	Haveli Canal Project on Chenab River	1939
10.	Thal Canal on Indus River	1947
11.	Kotri Barrage on Indus River	1955
12.	Taunsa Barrage on Indus River	1958
13.	Gudu Barrage on Indus River	1962

4. WATER CONFLICTS IN INDUS BASIN

4.1 Pre-Partition

Government of India Act 1935 made water a provincial subject. Before this Act, water was regulated by executive orders of the British Government of India. Thus, Indus River System (IRS) became a source of tension between the provinces of Punjab and Sindh even before partition of India in 1947.

In 1939, Sindh objected upon the water withdrawals by Punjab and requested the Governor General of India to review Punjab irrigation projects. In 1941, Indus (Rao) Commission was established. In 1942, the Commission submitted its report stating that withdrawals by Punjab would cause material damage, particularly to inundation canals in Sindh, and recommended management of IRS as a whole. However, the Report was not accepted by both the provinces. From 1943 up till 1945, Chief Engineers of both the provinces met but with no concrete results. In early 1947, the issue was referred to the Secretary of State for India in London. The issue remained in limbo till India was divided into two separate states in August 1947. Subsequently, issue became part of cross boundary conflict with India in 1948 and went into background.

4.2 Post-Partition Till Involvement of World Bank

4.2.1 Stand Still Agreement (December 1947)

In order to maintain order between the two newly born states of India and Pakistan till the institutionalization of new agreements, the Standstill Agreements was signed in December 1947. Agreement was also incorporated in the Indian

Independence Act of 1947. This agreement allowed supply of water from Indian headworks to Pakistan canals without any interruption until 31 March, 1948.

4.2.2 Unilateral Stoppage of Canal Waters by India (April 1948)

A day after expiry of Standstill Agreement, on 01 April 1948 India unilaterally stopped water supplies to two Pakistan (West Punjab) canals being supplied from upstream headworks of Madhupur and Ferozepur located in India. This action of India was based on the plea that continued flow of water would establish Pakistani "right" over the said waters from Ravi and Sutlej rivers in their territory. This action exposed Pakistani hydrological vulnerability to India because boundary line between two countries was drawn without regard to the river water sources of IBIS.

It also created an explosive Indo-Pakistan water dispute, which was subsequently resolved through Indus Waters Treaty, 1960.

4.2.3 Interim Inter-Dominion Agreement (May 1948)

Whatever the Indian motives were for unilateral stoppage of canal waters to Pakistan, this act became a great source of concern for the farmers of West Punjab.

Indo-Pak government level negotiations started on 30 April 1948. Resultantly, India agreed to resume the flow of water to canals but insisted that Pakistan would not claim those waters as a "right". Pakistan stuck to its prescriptive right to protect "Historical Use of Waters".

Subsequently, on 04 May 1948 an Interim Inter-Dominion Agreement was signed between India and Pakistan (under duress) according to which India would release canal water to meet Pakistan immediate needs through restoration of cut-off supplies. However, in return Pakistan would pay annual water charges. This boldened India also to subsequently lay claim on entire waters of Ravi, Beas and Sutlej (later on named as Easter Rivers in Indus Waters Treaty, 1960).

Different later interpretations of this Interim Agreement by the two states rendered it almost in-effective. Pakistan termed the agreement as hegemonious and on 16 June 1949 sent a note of extreme displeasure to the Indian Government. Notwithstanding this, by 1951 water issue between the two countries got stalemated to serious detriment of Pakistan.

5. DISPUTE RESOLUTION THROUGH WORLD BANK

5.1 Start of Negotiations (1951)

Indian Prime Minister Jawaharlal Nehru invited David Lilienthal, ex-chairman of US Tennessee Valley Authority (TVA), to India to study the ongoing water dispute between India and Pakistan. Lilienthal visited both India and Pakistan. On his return to US, he wrote an article in Collier Magazine, which was read by Eugene

Black the then president of World Bank. Eugene Black requested David Lilienthal for his recommendations and also contacted Prime Minsters of Pakistan and India. He offered services of the World Bank to resolve the dispute. In September 1951, both India and Pakistan agreed to the invitation.

5.2 Main Principles of Bank's Starting Offer

Bank's starting offer had three main principles. First, there was enough water in the Indus Basin River to meet needs of both the countries. Second, while resolving the dispute, Basin would be treated as a single unit. Finally, all the past grievance should be kept aside and purely technical approach adopted instead of a political one.

5.3 Initial Water Dispute Negotiations Between India and Pakistan (1952)

Indus mediation under aegis of World Bank started in Washington DC in May 1952. Subsequent meetings were arranged in Karachi in November 1952 and New Delhi in January in 1953, but no agreement could be reached over a common development plan of the Basin. Bank then asked both the parties to submit their own proposals. However, vast disagreement on demanded river water allocations under proposals of parties eluded integrated Basin approach. World Bank then asked both the parties to revise their proposals. Consequently, in 1953 both India and Pakistan gave their revised proposals to World Bank.

Initial and Revised Indian and Pakistani Proposals are compared in Table-4

Table-4: Initial and Revised Indian and Pakistani Proposals Presented to World Bank

Proposal	Proposed Water Allocation of Indus River System (MAF)	
	India	Pakistan
Initial Indian	29.0	90.0
Initial Pakistani	15.5	102.5
Revised Indian	All Eastern Rivers and 7% of Western Rivers	None of Eastern Rivers and 93% of Western Rivers
Revised Pakistani	30% of Eastern Rivers and none of Western Rivers	70% of Eastern Rivers and 93% of Western Rivers.

5.4 Bank's Plan (1954)

On 05 February 1954, the Bank came up with its own proposal of dividing IRS as its initial intent to get the whole Basin administered as a single unit by the two countries was turned down. Under the Bank Plan, India was allocated all the Eastern Rivers and Pakistan Western Rivers except a small amount from River Jhelum to India.

India Immediately accepted the Plan in March 1954, but Pakistan only expressed qualified acceptance in July 1954.

5.5 Bank's Aide Memoire (May 1956)

Pakistan considered Western Rivers unregulated supplies insufficient as a replacement of the Eastern Rivers existing supplies. Consequently, in May 1956 an Aide Memoir by Bank proposed storage facilities for Pakistan on the Western Rivers.

Side by side with the main mediations through World Bank till 1960, many ad-hoc agreements were also signed between the parties to keep canal water supplies to Pakistan for six to 12 months. These ad-hoc agreements were negotiated separately and practice lasted from 01 April 1955 till 31 March 1960.

5.6 Development and Funding of Replacement Plan in Pakistan

World Bank President Mr. Black visited India and Pakistan and pegged a fixed cost of the replacement on India. The responsibility of the extra cost was pledged to be shouldered by the Bank. India accepted the proposal and committed $174 million. In August 1959 a donor's consortium was organized by the Bank, which raised $ 893.5 million for the Indus Basin Development Fund (IBDF) for replacement works in Pakistan.

In 1958, Pakistan established an Indus Basin Advisory Board (IBAB), which prepared the Replacement Plan. This was later named Indus Basin Project (IBP) for implementation through World Bank arranged / administrated funding.

6. RESOLUTION OF INDO-PAKISTAN WATER DISPUTE

6.1 Indus Waters Treaty (1960)

After nine years (1951-1960) of lengthy and hectic engagement, both India and Pakistan signed Indus Waters Treaty (IWT) on 19 September 1960. It was signed in Karachi by the then President of Pakistan, Ayub Khan and Prime Minister of India, Jawaharlal Nehru in partnership with World bank and financial aid from USA, United Kingdom and other western friendly countries through IBDF. In January 1961 the Treaty was ratified by both the countries in New Delhi. However, under Article XII (2) the Treaty entered into force retrospectively from 01 April 1960.

IWT defined and fixed the contending water rights of India and Pakistan on IRS and was therefore considered remarkable achievement in settling a contentious water dispute between the two countries.

6.2 River Water Allocations to Parties Under Treaty

As per IWT, all the waters of three Eastern Rivers (Ravi, Beas and Sutlej) were allocated to India for un-restricted use except during the specified transition period.

Transition period would begin on April 1, 1960 (6 months before signing of the Treaty) and end on March 31, 1970. However, on specific request from Pakistan, this would be extendable upto a maximum of three years with payment of penalty.

Pakistan shall receive for un-restricted use all the waters of the three Western Rivers (Chenab, Jhelum and Indus) without any interference by India except for insignificant domestic and non-consumptive uses and some specified agricultural uses before their waters enter Pakistan. Non consumptive water use for generation of hydro-electric power from run-of-river plants on Western Rivers in India shall remain within limitation of the Treaty.

6.3 Treaty Water Allocations to India on Western Rivers

6.3.1 Agricultural Uses

Provisions in this regard are contained in Annexure C to the Treaty titled "Agricultural Use by India from the Western Rivers". Accordingly, over and above the cropped area existing on the effective date ending March 1960, India will make withdrawals from the Western Rivers only to the extent necessary to meet the irrigation needs of additional area. River Basin-wise total cropped area permitted to India by Treaty on Western Rivers is shown in Table-5.

Table-5: Maximum Development of Cropped Areas Permitted To India Under Treaty on Western Rivers

Sr. No.	River / Drainage Basin	Maximum Permitted Irrigated Cropped Area (Acres)
i.	Indus	70,000
ii.	Jhelum	400,000
iii.	Chenab: -	
	a. Within Drainage	225,000
	b. Outside the Drainage (Deg Nullah)	6,000
	c. Sub-Total (iii)	231,000
iv.	Total (i+ii+iii)	701,000 [a)]

a) With 462,000 acres on the effective Treaty date of 01 April 1960

6.3.2 Treaty Permitted Water Storage to India on Western Rivers

This is covered under Article lll (4) of the Treaty and elaborated in Annexure E titled 'Storage of Waters by India on the Western Rivers'. Accordingly, the aggregate storage capacity of all single and multi-purpose reservoirs which may be constructed by India after the Effective Date on each of the river systems is shown in Table-6.

Table-6: Storage Capacity Permitted to India Under the Treaty on Western Rivers

Sr. No.	River System	Purpose of Storage with Capacity (MAF)			Total (MAF)
		General a)	Hydropower b)	Flood b)	
1.	Indus	0.25	0.15	0.00	0.40
2.	Jhelum (excluding Jhelum Main)	0.50	0.25	0.75	1.50
3.	Jhelum Main	0.00	0.00	0.00	0.00
4.	Chenab (excluding Chenab Main)	0.50	0.60	0.00	1.10
5.	Chenab Main	0.00	0.60	0.00	0.60
6.	**Total**	**1.25**	**1.60**	**0.75**	**3.60**

a) Consumptive use for development of additional irrigation
b) Non-consumptive use

7. REPLACEMENT WORKS IN PAKISTAN

7.1 Replacement Plan Concept

As per Treaty, the basic concept of Replacement Plan was that: -

i. Pakistan shall use its best endeavors to construct and bring in operation, with due regard to expedition and economy, that part of a system of works which will accomplish the replacement of water supplies for its irrigation canals dependent on water supplies from the Eastern Rivers.

ii. Implementation of various works in Pakistan under the Treaty, commonly known as Indus Basin Project, will enable: -

   a. Transfer of waters form three Western Rivers to meet existing irrigation uses in Pakistan which were hithertofore dependent upon waters of the three Eastern Rivers.
   b. Provide substantial development of irrigation in Pakistan by laying the foundation for proceeding with systematic development of surface water resources including dams on the Western Rivers.
   c. Develop hydroelectric potential through dams.
   d. Make an important contribution to solve reclamation and drainage problem.
   e. Afford some measure of flood protection.

7.2 Indus Basin Project

System of works to be constructed in Pakistan under Indus Basin Project (IBP) was not described in the Treaty but set forth in simultaneously signed Indus Basin Development Fund (IBDF) Agreement. This Fund, created by the World Bank through grants / loans from the western friendly countries and a fixed contribution by India, was to finance the related infrastructure to be built in Pakistan. However, it had to be subsequently supplemented by raising additional finances for timely completion of the essential works. Furthermore, a special Tarbela Development Fund (TDF) was later on created by the World bank for construction of Tarbela Dam Project.

Indus Basin Project (IBP) was fully constructed and made operational over the period of 1960-77 comprising:

i. Eight inter-river link canals with capacities varying from 4,000 to 21,700 cusecs.
ii. Five barrages and one gated syphon.
iii. Remodeling of one existing headworks and three link canals with capacities varying from 5,000 to 22,000 cusses.
iv. Three storage reservoirs at Mangla, Chashma and Tarbela with aggregate initial live storage capacity of 15.1 MAF

A list of works completed under IBP is given in Annex-01.

7.3 Present River Water Infrastructure in Pakistan

As a result of these extensive developments, Pakistan now possesses the world's largest contiguous irrigation system commonly known as Indus Basin Irrigation System (IBIS). It commands a full water control equipped area of 14.87 million ha (36.7 million ac) of which 36 percent is under Mangla command and 64 percent under Tarbela command. It encompasses Western Rivers including three storage reservoirs (Tarbela, Mangla, and Chashma), 23 barrages / headworks / siphons, 12 inter-river link canals and 45 canals commands extending for 60,800 km (37800 miles). Distribution network comprises watercourses, farm channels, and field ditches covering another 1.6 million km (1 million miles) to serve over 90,000 farmers.

A 'Schematic Diagram of Indus Basin Irrigation System in Pakistan' is shown in Figure-2

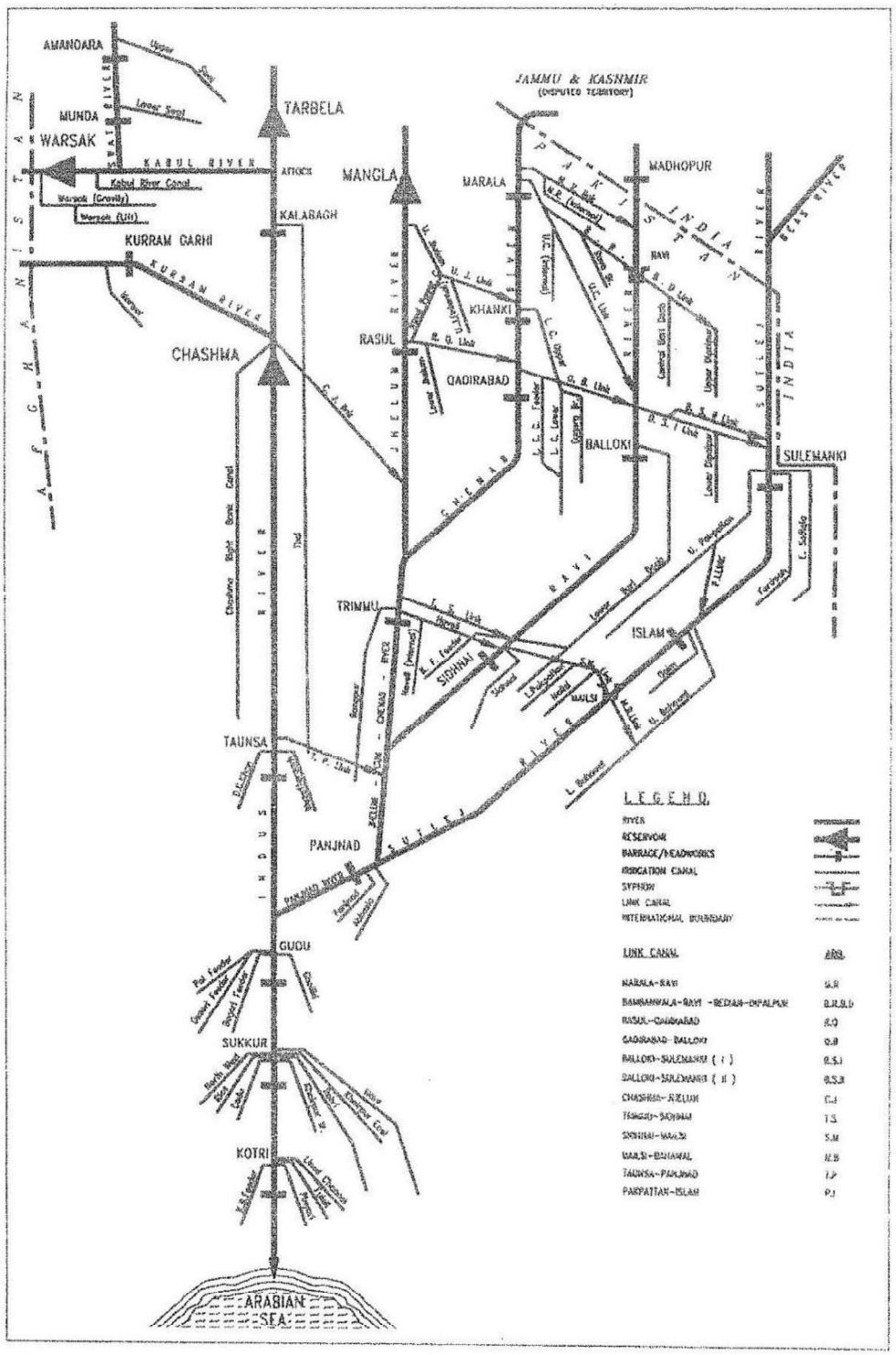


Figure-2: Schematic Diagram of Indus Basin Irrigation System in Pakistan

8. PROS AND CONS OF TREATY INCLUDING DISPUTE RESOLUTION MECHANISM

8.1 Pros and Cons of Treaty

Division of Indus Basin Rivers under the Treaty was a distinct departure from the concept of international law of upper and lower riparian rights (protection of existing uses from the same source). Thus, Pakistan had to forgo perennial water (33.0 MAF) of three Eastern Rivers of which it used substantial proportion historically for irrigation.

From Pakistan's point of view, Indus Waters Treaty 1960 had some pros and cons as highlighted in the following.

8.1.1 Pros

These were: -

i. After completion of IBP in Pakistan and Indian works on Eastern River's each country became independent of other with regard to control of assigned rivers.
ii. Each country would be responsible for planning, constructing and administering its own facilities in its own interests and free to allocate its supplies within its own territories, as it deems fit.
iii. This would provide strong incentives to each country to make the most effective use of water through water storage, transfer and reduction of losses by integrated system operation.
iv. Assurance against interference by the upper riparian with supplies on which lower riparian depended would reduce the chances of disputes and tension.
v. Before completion of IBP as a sequel to Treaty, entire irrigation system in the Indus Basin was based on run-of-river supplies. Hydrology of the rivers was such that about 80% of total water was generated during summer monsoon period of July-September and winter supplies in low flow / drought periods became very critical. With availability of augmented supplies through storages, low flow period availability would be assured including drought conditions. (Factually, Pre-partition average annual canal withdrawals of about 67 MAF in IBIS of Pakistan increased to 104 MAF after full commissioning of IBP in 1977 through Tarbela reservoir).

8.1.2 Cons

Broadly speaking these comprised: -

i. Eastern River stretches of Pakistan would be seriously affected in the following manner.
   a. Traditional flood (Sailaba) irrigation which was the most ancient way of using river waters on Sutlej and Ravi river stretches in Pakistan would disappear due to full development of Eastern Rivers by India. Consequently, these flood flows cut-off would force the farmers to resort to ground water development. Over time, these aquifers would be mined to the extent of extinction. On the

other hand, these areas would be exposed to devastating flooding during exceptional uncontrolled discharges from India.

b. Once Eastern Rivers are bottled up by India, their channels in Pakistan would get aggraded and any subsequent floods would cause great havoc in addition to other adverse environmental effects. (Most recent event was extensive flooding of Sutlej flood plain area in 2023).

ii. For up-keep of IBP link canals, barrages and storages, a very heavy additional financial burden would be imposed upon Pakistan for their operation and maintenance. Besides, rapidly depleting storages would not substitute perennial flow water loss of Eastern Rivers.

iii. Another very potential threat was water hegemony by India through although restricted use of Western Rivers as permitted under the Treaty. (This has already resulted in almost continuous disputes between India and Pakistan).

8.2 Dispute Resolution Mechanism of Treaty

Anticipating cross-boundary water conflicts between the parties, institutional arrangements under provisions of Article VIII (1) of the Treaty required that both India and Pakistan would appoint a Commissioner for Indus Waters. Each Commissioner, unless either Government decides to take up any particular question directly with the other Government, would decide to take up any particular question directly with his counterpart for all matters arising out of the Treaty.

Two Commissioners would together form the Permanent Indus Commission (PIC). Purpose and functions of PIC would be to establish as well as implement Treaty to: i Promote co-operation between the Parties in the development of waters of Rivers; ii make every effort to settle promptly any questions / disputes arising between the Parties; and iii undertake periodic tours of inspection of Rivers in both the countries to ascertain facts.

9. TRANS-BOUNDARY WATER CONFLICTS UNDER TREATY

9.1 Potential Causes

Based on the concept of division of Indus River System, there is an 'inherit element of mistrust' in the Treaty.

Indus River Basin is mainly shared by India and Pakistan (refer Table-2) with current (2023) estimated beneficiary population of about 235 million. Out of this, about 93% lives in Pakistan, 3% in India, and 4% in Afghanistan (also refer Table-2). With rapidly increasing population, sustenance of supporting economy may compel the co-shares to enhance water utilization through various developments. Particularly, such actions by the upper riparian (India) may be to serious detriment of lower riparian (Pakistan).

Pakistan's geographic disadvantage of lower riparian, further compounded by highly conflicting Indo-Pakistan pollical environment of unending Kashmir dispute, had potential for contributing to water conflicts. (This is factually happening).

Though major Indo-Pakistan water conflict after Independence got settled through Treaty, its element of mistrust led to future transboundary water conflicts. Particular bone of contention was the Treaty permitted use of Western Rivers by India for hydroelectric generation.

9.2 Treaty Restrictions to Avoid Conflicts

9.2.1 Restrictions

To avoid / minimize conflicts, Treaty places restrictions on the design and the operation of hydroelectric plants, storage and other related works to be constructed by India on the Western Rivers. Accordingly, India is required to supply to Pakistan certain specified information related to these works at least 6 months in advance of undertaking to enable Pakistan satisfy itself that the design conform to criteria set out in the Treaty. Within a specified period, ranging from two to three months, Pakistan has the right to communicate to India, its interim objections regarding proposed design based on non-conformance to certain criteria specified in the Treaty. Treaty also restricts the total irrigated cropped area to be developed by India in the basins of Western Rivers. Furthermore, it also provides for a regular exchange of daily hydrological data and other information under Articles VI and VII (2) to monitor specified operation of works constructed on the Western Rivers by India.

9.2.2 Self-Generating Procedure for Dispute Resolution

Treaty provides a self-generating procedure for resolution of any differences and disputes. Any question, which arises between the Parties concerning the interpretation or application or existence of any established fact, might constitute a breach of the Treaty. This would be first examined by the Permanent Indus Commission, (PIC) with endeavour to resolve through mutual agreement including government-government level negotiations. However, if efforts fail, the dispute could be referred by the Parties to a Neutral Expert (NE) and / or Court of Arbitration (CoA).

10. MAJOR WATER CONFLICTS UNDER TREATY AND THEIR CURRENT STATUS

10.1 Major Conflicts

So far, the trans-boundary water conflicts have arisen under the Treaty provision allowing India to develop hydroelectric projects on Western Rivers. Hydroelectric Projects already completed / under construction on Wester Rivers along with their current status are listed in Table-7.

Table-7: Major Indian Hydroelectric Projects Completed / Under Construction on Western Rivers

Sr. No.	Hydroelectric Project	Location	Installed Capacity (MW)	Status	Dispute Resolution
1.	Salal	Chenab Main	690	Completion in 1987	Through Foreign Secretary level government to Government agreement
2.	Wullar Barrage	Jhelum Main	Navigation	On hold	Started unilateral construction in 1985 but suspended in 1987 on World Bank intervention
3.	Baghliar	Chenab Main	450 (Stage I)	2008	Through Neutral Expert (NE) who overruled all basic objections of Pakistan
4.	Kishenganga	Neelum Tributary of Jhelum	330	2018	Through an adverse decision of Court of Arbitration (CoA) against Pakistan
5.	Ratle	Chenab Main	850	Under construction since 2022 & scheduled for completion in 2026	Ongoing concurrent deliberations by NE and CoA with construction permitted by CoA through interim award.
6.	Pakal Dul	Tributary of Chenab	1000	Under construction since 2018 & scheduled for completion in 2024	Construction started by India without informing Pakistan and going on despite its persistent objections.
	Total		**3320** [a)]		

10.2 Current Status

A brief history of these projects and their current status is contained in **Annex-02.**

10.3 Other Completed / Ongoing Hydroelectric Projects by India

During heated conflict regarding Baghliar and Kishenganga Projects India, has completed the following hydroelectric projects on the Western Rivers: -

i. Uri-I Barrage on Jhelum main in 1997 through 21.5m (71 ft) high diversion dam with a gross storage of 360 m^3 (0.003 MAF) and installed Capacity of 480 MW.
ii. Dul Hasti Dam on Chenab Main near Kishtwar in 2007 through 65m (213 ft) high dam and gross storage of 10,660 m^3 (0.008 MAF), live storage of 9380 m^3 (0.005 MAF) and installed capacity of 780 MW.
iii. Chutak Barrage on Suru tributary of Indus near Kargil in 2012 with a 15 m (49 ft) high dam with gross storage of 588 m^3 (0.005 MAF) and installed capacity of 44 MW.
iv. Nimoo Bazgo Dam on Indus Main in 2013 near Leh with a height of 5.9m (19 ft), gross storage of 52620 m^3 (0.04 MAF) and installed capacity of 45 MW.
v. Uri-II Barrage (Dam) on Jhelum Main in 2013 near Baramula with a height of 44m (144 ft) gross storage of 6343 m^3 (0.005 MAF) and installed capacity of 280 MW.

Probably due to small storage capacities of these projects, Pakistan either did not object or overlooked.

Hydroelectric projects of Miyar Nullah (20 MW) and Lower Kalnai (48 MW) on Western Rivers are under different stages of construction by India.

Pakal Dul Project on Chenab with largest installed capacity of 1000 MW is being constructed by India despite Pakistan's repeated protests through PIC.

10.4 Under Construction Indian Projects Despite Pakistan Objections

These are: (1) Tamasha; (2) Kalarous II; (3) Baltikulan; (4) Durbuk Shyok; (5) Nima Chilling; (6) Kiru; (7) Kargil Hunderman; (8) Phagla; (9) Kulan Ramwari; and (10) Mandi.

11. PAKISTAN'S REACTION TO THIRD PARTY ADVERSE DECISIONS ON BAGHLIAR AND KISHENGANGA PROJECTS

Pakistan got frustrated by the rulings of NE and CoA on Baghliar and Kishenganga Projects, respectively (details in **Annex-02**). These rulings severely harmed its interest as well as increased water insecurity. In addition, these provided a cover to India to keep building numerous hydroelectric projects on Western Rivers in Disputed Jammu and Kashmir.

In the meantime, India started unilateral construction of Ratle Hydroelectric Project on Chenab which was objected to by Pakistan. Consequently, as mentioned above, the case is now undergoing concurrent parallel arbitration under NE and CoA. Though Pakistan is vigorously defending its case, it is worrying that CoA has already intimated that objections to Project were submitted after Treaty stipulated period of 3 months as prescribed in Annexure D. Hence, India may continue construction on the project.

Above situation is not so encouraging but there should be no let-up on the part of Pakistan.

12. DECLARATION OF VIRTUAL WATER WAR BY INDIA AGAINST PAKISTAN

Another extremely worrying factor is virtual declaration of 'Water War' by India with Pakistan. After Pulwama incident of February 2019, Narender Modi, Prime Minister of India declared that 'blood and water can't go together'. Consequently, India decided not to share with Pakistan any water data of Indus River System. This has rendered Permanent Indus Commission (PIC) dysfunctional which is since continuing.

In addition, during 2023 India served upon Pakistan a notice to terminate the Treaty, which was outright rejected by Pakistan. Notwithstanding, this, India is consistently propagating among international community at least for renegotiation of the Treaty under the garb of Indus II.

13. POTENTIAL WATER CONFLICT CHALLENGES TO PAKISTAN

Broadly speaking these are: -

i. Geographical
ii. Political including water aggression
iii. Socio-economic
iv. Climatic Change
v. Indian hurting capability through maloperation of hydroelectric project storages on Western Rivers.

13.1 Geographical

This factor puts Pakistan in disadvantaged position of lower riparian. In fact, this was the major reason why Pakistan accepted Bank Plan of 1954 based on division of Indus Basin Rivers. However, this is natural / situational fact about which Pakistan can't do anything.

13.2 Political Including Water Aggression

From day one, India had inimical designs against political creation of Pakistan. These were manifested in the following aggressive actions against Pakistan: -

i. Water aggression through unilateral cut-off in canal supplies in April 1948, which presaged later full-fledged water dispute.
ii. Kashmir aggression with physical occupation in 1948 creating dispute which triggered, three wars and is still unresolved.
iii. Ceding prescriptive water rights on Eastern Rivers to India under the Treaty.
iv. Indian annexation of significant areas of Azad Kashmir with Occupied Kashmir during East Pakistan invasion of 1971.

v. Start of major water aggression against Pakistan under the garb of Treaty provision allowing hydro-electric generation by India on Western Rivers through: -

   a. Construction of: -
      - Salal Dam on Chenab River near Riasi in 1987.
      - Baghliar Dam on Chenab near Udhampur in 2008 after go ahead through Neutral Expert.
      - Kishenganaga Dam on Neelum Tributary of Jhelum in 2018 after go ahead through Court of Arbitration.
   b. Starting unauthorized construction on: -
      - Pakal Dul Dam near Kishtwar on Marsudar tributary of Chenab in May 2018, and getting go ahead through partial award of CoA (nearing completion in 2024).
      - Ratle Dam on Chenab near Kishtwar in early 2022 again getting go ahead through partial award of CoA (planned for completion by 2026).
      - Bringing into pipeline another 27 contentious hydroelectric projects to enhance control on waters of Western Rivers.

vi. Bottling up of Eastern Rivers through construction of major storages under Treaty with gross capacity of about 20.7 BCM (16.8 MAF) as shown in Table-8.

Table-8: Storage Capacity Developed by India on Eastern Rivers

Sr. No.	Dam	Nearest City	River	Year	Height (m)	Capacity		Main Use
						BCM	MAF	
1.	Nangal	Nangal	Sutlej	1954	29	0.020	0.016	I, H
2.	Bhakra	Nangal	Sutlej	1963	226	9.620	7.796	I, H
3.	Pong	Mukerian	Beas	1974	133	8.570	6.940	I, H
4.	Pandoh	Mandi	Beas	1977	76	0.041	0.032	I, H
5.	Thein (Ranjit Sagar), Ujh and Shahpur Kandi	Upstream of Madhupur Headworks	Ravi	All completed except Shahpur Kandi	NA	2.469	2.00 [a)]	I, H
6.	**Total (1 to 5)**					**20.72**	**16.784**	

Notes: I= Irrigation, H= Hydropower

BCM = Billion Cubic Meters

a) Based on Indian statement of creating equivalent storage

MAF = Million Acre Feet

Table-8 shows that out of the average Eastern Rivers rim-station inflows of 40.7 BCM (33.0 MAF), India has created a storage of about 45% on Eastern Rivers as compared to only about 10% of Pakistan on Western Rivers.

13.3 Socio-Economic

Current (2023) population of Pakistan including Azad Kashmir and Gilgit-Baltistan is about 248 million. It is estimated that about 95% of Pakistan and 100% population of Azad Kashmir and Gilgit-Baltistan is dependent upon Western Rivers of Indus Basin for their livelihood, This adds up to about 235 million and is further growing at an alarming annual compound rate of around 2% (refer Table-2).

Above population explosion has exposed Pakistan to acute water scarcity. According to criteria developed by Malin Falkenmark, a Swedish Hydrologist, at below 1000 m^3 pe capita availability the countries start experiencing chronic water stress. Pakistan has almost approached this situation, which may further aggravate due to rapid population growth. Thus, in managing this situation to sustain national economy in the face of Indian water aggression, Pakistan could suffer a serious setback.

13.4 Climate Change Related

In the context of twenty-first century it is now well established that global climate change is accentuating with consequent increased risk and conflict over shared transboundary freshwater sources. The resulting trends of rapid melting of glaciers, irregularity / extremity in snowfall and rainfall patterns, droughts and flooding have created serious development challenges.

Growing water-related disputes under Treaty have created multiple complexities that may lead to disrupting regional peace and stability.

Though Pakistan is most glaciated country on the Planet outside the Polar Region, scarcity of water has been increasing due to vulnerability of its basic water sources. More than one-third of the Indus River flows are derived from glaciers. Due to this melting, icy lakes in the Indus Basin downstream areas are being affected by the glacial lake outburst floods (GLOFs). These lead to fatalities, damage of infrastructure and ecological hazards.

As a result of accelerated glacial melting in Upper Indus Basin, large variability of river flows is already being experienced in Pakistan. According to World Bank projections including other concerned international agencies, this process may drastically reduce Indus River flows by 2050 and by the end of 21st century, the situation may become extremely grave.

Climatic impacts on Indus River System along with Treaty related conflicts over water, may thus subsequently lead to desertification of large agricultural tracts in Pakistan resulting in food insecurity.

13.5 Indian Hurting Capability Through Storages on Western Rivers

It is a stark reality that India can cause serious agriculture damage to Pakistan through maloperation of 3.6 MAF storage on Western Rivers as permitted under

the Treaty (refer Table-5). An actual demonstration of this came through initial filling of Baghliar in August 2008.

Uptil now India has acquired substantial storage capacity through various hydroelectric projects constructed on Western Rivers. For the major projects its aggregates to 1.40 BCM (1.13 MAF) as per details in Table-9.

Table-9: Indian Existing Hurting Capability Created Through Hydroelectric Projects on Western Rivers

Sr. No.	Project	River Basin	Gross Storage Capacity		Installed Capacity (MW)	Year of Actual / Scheduled Completion
			BCM	MAF		
1.	Salal	Chenab	0.281	0.228	690	1987
2.	Baghliar	Chenab	0.475	0.381	450 [a)]	2008
3.	Kishenganga	Jhelum	0.222	0.180	330	2018
4.	Ratle	Chenab	0.300	0.235	850	2024
5.	Pakal Dul	Chenab	0.126	0.102	1000	2024
6.	**Total (1 to 6)**		**1.404**	**1.126**	**3320**	

a) Stage I development with ultimate capacity of 900 MW
BCM: Billion Cubic Meters
MAF: Million Acre Feet

Interestingly, already developed storage of 1.126 MAF is not such off from total Treaty permitted Indian storage of 1.6 MAF for hydropower development on Western Rivers (refer Table-5).

14. SUGGESTED COPING STRATEGY FOR PAKISTAN

It crystalizes from the preceding that Indo-Pak cross-boundary conflict is not only technical but has become very complex due to the following adverse factors: -

i. Lower riparian geographical disadvantage.

ii. Extreme politicization due to intensification of unending Kashmir dispute.

iii. Socio-economic compulsion of burgeoning population.

iv. Unfavourable awards on Baghliar and Kishenganga Hydroelectric Projects by Neutral Expert and International Court of Arbitration (CoA), respectively.

v. Provisional award by CoA to go ahead with construction of largest 100MW Pakal Dul Hydroelectric Project despite objections by Pakistan.

vi. Virtual start of water aggression against Pakistan by the Indian Government of Narendra Modi.

To cope with the above dire situation, the following strategy is suggested for Pakistan: -

i. Despite its limitations, Treaty is only available shield to Pakistan and any efforts either to revisit or Indian threat of its unilateral abrogation by India should be thwarted.

ii. a. Maximum efforts should continue to seek conflict related redressal / relief under Treaty dispute resolution mechanism despite some unfavourable results so far.

   c. For the ongoing parallel considerations by Neutral Expert and CoA regarding Ratle Hydropower Project. Pakistan should redouble the defence efforts through lining up highly competent technical / legal expertise (it is hoped that for the ongoing efforts this is already in place).

iii. To cope with hurting capability of India through maloperation of storages permitted to India on Western Rivers under Treaty, Pakistan should complete the following in-country contingency measures on top priority: -

   a. Expeditious completion of ongoing Dasu (1.1 MAF live storage), and Diamer Basha Dam (6.4 MAF live storage) Projects.

   b. Obtain national consensus on the stalled Kalabagh Dam Project.

   c. Seriously consider early implementation of non-controversial Akhori Dam Project (7.0 MAF live storage) whose feasibility report is already available.

   d. Expedite engineering of Shyok Dam Multipurpose Project near Khaplu with a live storage of 5.5 MAF.

iv. To minimize / mitigate the inherit Indian hurting capability particularly on Chenab River through: -

   a. Construction of Mangla – Marala Link.

   b. Construction of Chiniot Dam Project.

v. To finalize on priority basis, water sharing agreement for Kabul River with Afghanistan, spadework on which has been already done through advice of the World Bank.

vi. On international political platform, Pakistan should keep on highlighting the adverse climate change impacts further compounded by transboundary conflicts under Treaty. A good start was made by Pakistan's Permanent Representative at UN during February 2024 address to Security Council debate on climate and water scarcity. As reposted in Daily Dam of 15 February 2024, it was particularly emphasized that:

   "Pakistan attaches high priority to The strict implementation of the Indus Waters Treaty agreement and aims to reinvigorate the Indus River Basin"

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ANNEX-01

INDUS BASIN PROJECT, PAKISTAN

Sr. No.	Description of Work			
	Link Canal (Year of Completion)	**Designed Capacity**	**Between Rivers**	**Command**
1.	i. Trimmu – Sidhnai (1965)	11,000 cusecs	Chenab - Ravi	Tarbela / Chenab
	ii. Sidhnai – Mailsi (1965)	10,000 cusecs	Ravi - Sutlej	
	iii. Mailsi – Bahawal (1965)	4,000 cusecs		
	iv. Rasul – Qadirabad (1967)	19,000 cusecs	Jhelum - Chenab	Mangla
	v. Qadirabad – Balloki (1967)	18,000 cusecs	Chenab - Ravi	
	vi. Balloki Suleimanki II (1967)	6,500 cusecs	Ravi - Sutlej	
	vii. Taunsa – Panjnad (1968)	21,700 cusecs	Indus - Jhelum	Tarbela
	viii. Chashma – Jhelum (1971)	12,000 cusecs	Indus - Chenab	
2.	**Barrage Syphon (Year of Completion)**		**Ravi**	
	i. Sidhnai (1965)	167,000 Cusecs	Ravi	Mangla
	ii. Mailsi Syphon (1965)	1,100,000 Cusecs	Chenab	
	iii. Qadirabad (1967)	900,000 Cusecs	Chenab	Mangla
	iv. Rasul (1967)	850000 Cusecs	Jhelum	
	v. Marala (1968)	950,000 Cusecs	Indus	Tarbela
	vi. Chashma (1971)	429,000 Cusecs	Sutlej	
3.	**Dams (Year of Completion)**		**Ravi**	
	i. Mangla (1967)	5. 3 MAF	Jhelum	Mangla
	ii. Chashma Reservoir (1971)	9.3 MAF a)	Indus	Tarbela / Chashma
	iii. Tarbela (1977)	0.5 MAF	Indus	
4.	**Remodeling of Existing Works (Year of Completion)**			
	i. Balloki Headworks (1965)	18,500 Cusecs	Ravi – Sutlej	
	ii. Balloki - Suleimanki Link I (1967)	22,000 Cusecs	Chenab – Ravi	
	iii. Marala - Ravi Link (1968)	5,000 Cusecs	Chenab – Ravi	Mangla
	iv. BRDB Link (1968)	200,000 Cusecs	Ravi	

a) Initial aggregate live capacity of 15.1 MAF.

ANNEX-02

BRIEF HISTORY OF MAJOR INDIAN HYDROELECTRIC PROJECTS COMPLETED / UNDER CONSTRUCTION ON WESTERN RIVERS WITH CURRENT STATUS

1. Salal Hydroelectric Project on Chenab

Project design received by Pakistan from India in 1974 was not found conforming to criteria laid down in the Treaty in following respects: -

i. Works proposed appeared to be capable of artificially raising water level in the reservoir beyond full conservation in contravention of Paragraph 8 (a) of Annexure 'D' to the Treaty.

ii. A gated spillway had been provided in the design, although site permitted provision of an ungated spillway, in contravention of Paragraph 8(e) of Annexure 'D' to the Treaty.

iii. Outlets had been provided below the Dead Storage Level which are not necessary in terms of Paragraph 9(d) of Annexure 'D' to the Treaty.

iv. Intakes for the turbines are proposed to be located at a level lower than required in contravention of Paragraph 8 (f) of Annexure 'D'.

Even this first conflict remained unresolved at the level of Permanent Indus Commission. (PIC). Subsequent efforts at the level of Foreign Secretaries of India and Pakistan also failed. Finally, negotiations between two Governments were held in April 1978 at New Delhi and the following agreement reached: -

i. Height of the spillway gates will not exceed 30 feet.

ii. All the 6 low level outlets will be plugged within one year of the completion / operation of the Project.

iii. Intakes for the turbines will be located as proposed in the present design.

iv. Pakistan agrees to the diversion programme as proposed by India.

Project has a gross stage capacity of 0.28 BCM (0.23 MAF) and live storage capacity of 0.012 BCM (0.010 MAF) with installed capacity of 690 MW was completed in 1987.

2. Wullar Barrage on Jhelum

In February 1985, Pakistan learnt through reports that India was planning to construct a Barrage, namely "Tulbul Navigation Project", at the downstream end of Wullar Lake on River Jhelum. In March 1985, Pakistan conveyed its concerns to India and sought details of the scheme for its examination. India supplied some details of the scheme in March 1986. According to information supplied by India, Wullar Barrage, located at the outfall of Wullar Lake on Jhelum Main, would be 131 m (439 feet) in length, with a gated weir and under sluices and a 12 m (39 feet) wide navigation lock. It would have a maximum discharge capacity of 1417

m^3/s (50,000 ft^3/s) and enable pond level in the lake to be raised and maintained at elevation 1578 m (5,178 feet). Thus, it might be possible to manipulate additional storage of approximately 0.414 km^3 (0.336 MAF) of water in the lake.

Matter was accordingly taken up by PIC for resolution under Article IX (1) of the Treaty but it failed to resolve the issue. Construction of works already started by India on piers / abutment of barrage and navigation lock was, however, got suspended by Pakistan in September 1987 through intervention of the World Bank. Current status remains the same.

3. Baglihar Hydroelectric Project on Chenab

India supplied information about the project to Pakistan in May 1992 under the relevant provision of the Treaty. Project was to be located on river Chenab about 147 km (91milles) upstream of Marala Barrage. Project design envisaged construction of 317 m (1040 ft) long and 144.5 m (474 ft) high concrete gravity dam with gross storage of 0.475 BCM (0.384 MAF) and live storage of 0.04 BCM (0.03 MAF). In Stage-I, three units of 150 MW each would utilize 439 m^3/s (15,475 ft^3) of water. Three similar units would be installed in Stage-II. An orifice type gated spillway would be provided in the middle of the dam with crest level at elevation of 808 m (2650 ft).

Pakistan raised objection on the design of orifice type gated spillway, excessive pondage / operating pool behind the dam and higher water seal at the intake of the power tunnel. India disagreed and maintained that design was in conformity with the Treaty provisions. A study made by Pakistan on the effects of Indian design revealed that low level gates could provide India a manipulatable storage capacity of about 0.20 km^3 (0.16 MAF) behind the dam. If maloperated for stoppage, it could reduce / stop supplies of Chenab reaching Marala for about 26-28 days during winter months with serious to off-taking canal supplies.

After having discussed Pakistan's objections on the Project design in various meetings of PIC, in February 2003 the Commissioners recorded failure in resolving the issue. This was followed by a notice to India on 08 May 2003 about Pakistan's intention to proceed with resolution through the Neutral Expert under the Treaty. Since the two Governments were unable to appoint Neutral Expert till June 2003, in January 2005 the World Bank was requested for the appointment. In May 2005, the World Bank appointed Dr. Raymond Lafitte of Switzerland as Neutral Expert (NE).

After few meetings with parties, NE gave his verdict in 2007 holding that India had not violated the Treaty and Baghliar Dam could be completed with slight modifications in design and without any impact on the 450 MW power component. NE however determined that India should reduce the dam freeboard from 4.5 to 3m (15 to 10 feet) which India had even offered before to Pakistan. Another objection by Pakistan was related to gross storage that India could maintain in this run-of-the river project. India had claimed 37.5 million m^3 (0.0303 MAF), which was reduced by NE to 32.58 million m^3 (0.0263 MAF). Simultaneously, NE upheld

India's methodology of calculation and rejected Pakistan's suggestion of a pondage of only 6.22 million m^3(0.005 MAF). NE also cleared the project and found it compliant with provisions of Treaty much to the chagrin of Pakistan.

India completed the Project and formally commissioned it on 10 October 2008. For this commissioning, India filled the reservoir dead storage in August 2008 but did not abide by specific provisions of the Treaty as to maintain a minimum flow of 1,580 m^3/s (55,000 m^3/s) at Marala Barrage in Pakistan. Inspite of repeated requests by PCIW, India did not provide details of schedule for initial filling of Baghliar reservoir or testing / commissioning of Plant. Protest on reduction of flow at Marala was lodged by PCIW in meeting of PIC held in was arranged in India from 18-25 October 2008. After inspection of site by PIC during the meeting, PCIW demanded compensation for loss of water due to impounding behind Baghliar Dam in violation of the Treaty provisions. Similarly, hourly data for the operation of initial filling was asked to jointly agree an the quantum of reduced flows. India, however, did not cooperate as well as refused compensation of reduced flow to Pakistan.

4. Kishenganga Hydroelectric Project on Neelum Tributary of Jhelum

Kishenganga Hydroelectric Project was to be located in Occupied Jammu and Kashmir on River Neelum a major tributary of River Jhelum. Original project design envisaged construction of 268 m (879 ft.) long and 75 (246 ft) high concrete dam with gross reservoir capacity of 22.3 million m^3 (0.018 MAF) and live storage of 11.3 million m^3 (0.014 MAF) for power regulation. River water would be diverted through a 21 km (13 miles) long tunnel to generate 330 MW power and drain into Wullar Lake via a small Bunar Madumati Nallah and flow down their Jhelum Main River.

After receiving this information from India in June 1994, Pakistan raised objections on unauthorized diversion of a tributary flow and design of the Project in contravention of Treaty provisions. Issue was formally taken up through the meetings of PIC from May 2003 to November 2005. Upon failure of PIC to resolve the issue, Pakistan Commissioner initiated proceedings for reference of case to the Court of Arbitration (CoA). However, Indian Commissioner intimated in June 2006, that under Paragraph 15(a) of Annexure E the Project had now been revised as a run-of-river plant. Revised information, as specified in Appendix-II to Annexure D to the Treaty was also supplied to Pakistan.

After examining information supplied by India, Pakistani Commissioner raised following objections on the Project: -

i. It still contravened provisions of Paragraph 10 of Annexure E to the Treaty.

ii. Diversion of flow of one tributary (Kishanganga / Neelum) to another (Bunar Madumati Nallah) in Jhelum catchment was not permitted as per Annexure E to the Treaty.

iii. It di not conform to design criteria (a), (c), (e), (f), and (g), mentioned in Paragraph 11 of Annexure E to the Treaty.

Further it was going to harm Pakistan power potential and agricultural uses in lower Neelum Valley with a direct bearing on the socio-economic life and ecological aspects of the area. Importantly, Pakistan had already started work on Neelum Jhelum Hydropower Project (NJHP) at Nauseri to utilize water for generating 969 MW power. Therefore, Indian Project, if constructed as per their proposed design would result in about 21% reduction in the average annual water flow of Neelum at Nauseri and at least about 10% reduction in power generation of NJHP.

India had factually started Project construction during 2002-2003 and work on headrace tunnel, power house and temporary water diversion was going on. In the mean while Commissioner level negotiations between Pakistan and India were getting prolonged without any resolution in sight.

Being alerted by above status quo and with India continuing Project construction, Pakistan approached the World Bank to initiate proceedings under Dispute Resolution Mechanism of the Treaty. Having bitter experience with National Expert in case of Baghliar Project, upon Pakistan request the World Bank established an International Court of Arbitration (CoA). CoA gave partial award in February 2013 allowing India to carry on with construction of the Project with a ruling that India shall release a minimum downstream ecological flow of 9 m^3/s (320 ft^3/s).

Ruling of CoA on various aspects of the dispute, including objections of Pakistan was almost entirely against interests of Pakistan as enumerated below: -

i. a. Court began by rejecting Pakistan's arguments that the Project violated provisions of the Treaty. Then it considered whether it satisfied Treaty requirements for hydroelectric plants. Article III(2) of Treaty obligated India to "let flow all the waters of Western Rivers" and "not permit any interference with the waters". Pakistan argued that Project violated Annexure D of the Treaty in respects of; (1) permanent diversion of waters from one tributary to another; and (2) failure to conform to Treaty requirement of a run-of-river plant location at the dam site rather than diversion to another tributary.

   d. CoA rejected the above objections of Pakistan

ii. Final question was whether the diversion met the requirement of protecting "the then existing agricultural or hydro-electric use by Pakistan". CoA, addressed the issue through reference to Vienna Convention and rejected Pakistan's "ambulatory" interpretation that all its future uses that might evolve over time were protected. On the other hand, it upheld India's interpretation that only those uses existing when Pakistan was given complete information about the Project were protected. CoA, also determined that NJHP of Pakistan had not "crystallized" at the time of designing Kishenganga Project. Hence, it was not protected by Treaty provisions.

iii. CoA upheld India's right to proceed with Kishanganga Project, but also concluded that the Treaty and customary international law required India to ensure a minimum environmental flow along the Kishanganga/Neelum

riverbed. After requesting additional data from India and Pakistan to determine the requirements for this minimum flow, CoA arrived at 12 m^3/s (420 ft^3/s) at river crossing point into Pakistan. Balancing this figure against India's right to satisfactory operation of the Project, it set down 9 m^3/s (320 ft^3/s) as the required minimum flow to be ensured at all times. Remaining 3 m^3/s (160 ft^3/s) flow would be compensated by the flows generated downstream of Kishangana Dam till crossing of the stream into Pakistan Further, excess storage above the gates would provide the minimum environmental flow during the lean flow season.

iv. a. Pakistan had also questioned using drawdown flushing for clearing the sediments accumulated below the 'dead storage' level. India argued that sedimentation was a serious problem among Himalayan rivers. Consequently, Salal Dam Project on Chenab River constructed without drawdown flushing facility got filled up with sediment within two seasons. Consequently, for Baglihar Dam, India had insisted on the drawdown facility, thing Pakistan objected under the Treaty. It was referred to Neutral Expert appointed by the World Bank, who ruled that the drawdown flushing facility was necessary. Thus India had utilized this precedent in designing flushing on Kishanganga Project.

b. Pakistan's basic concern was that drawdown facility would equip India with manipulable storage of water. If this water in dead storage was drawn down for sediment flashing, then, for refilling the gates would be closed and starve downstream areas of water. In the event of a war or conflict, India would have the ability to flood downstream areas by using drawdown facility and then shut-off water while refilling the reservoir. So, Pakistan perceived the drawdown facility as a key security issue. Indeed, the Indus Water Treaty stipulated that the water storage in the reservoir should be maintained above the dead storage level except in emergencies:

c. India also argued that ability to flush sediment was necessary to protect its right to avoid damage hydroelectric plant. CoA obtained technical evidence and expert opinion before determining that drawdown flushing was an absolute necessity, because other methods of sediment control were available even if they were less economical. Court also read Treaty provisions regarding depletion and the limits on live storage restricting India ability to manipulate flows. According to former World Bank water expert John Briscoe, it might be convenient for India to practice sediment flushing, but it had to be balanced against Pakistan's water security. CoA, implied that the Baglihar NE erred in not balancing the two concerns. It overruled this decision for all future projects.

v. After above rulings of CoA, there were restrictions on construction of Project. Consequently, India completed the Project and commissioned it in 2018. Almost concurrently, Pakistan commissioned its 969 MW NJHP. However, this

project would perpetually face a generation loss of about 10% as a consequence of Kishenganga Project.

5. Ratle Hydroelectric Project

Ratle Hydroelectric Project is located on Chenab main at Drabshalla in Kishtwar district of Indian occupied Jammu and Kashmir. It consists of a 133m (436 ft) high concrete gravity dam and two power stations with aggregate installed capacity of 850 MW. Its storage capacities were: gross 0.290 BCM (0.235 MAF), and live 0.010 BCM (0.081) MAF.

India unilaterally started construction in January 2022 with targeted completion of 2026. Upon knowing this, Pakistan raised objections citing violations of the Treaty.

Being wary of unfavourable decisions of the NE on Baghliar Project, Pakistan requested the World Bank for establishment of (CoA). On the other hand, India insisted upon appointment of a NE. After hiatus and pause suggested by the World Bank, in 2023 both CoA the NE were established. The matter is now undergoing concurrent deliberations by CoA and NE. The following disputes, mostly technical in nature, are under deliberation whether Indian: -

i. Proposed design for a maximum pondage of 0.290 BCM (0.235 MAF) is based on a method of calculations that contravenes the Treaty, particularly Paragraph 8(c) of Annexure D?
ii. Proposed design for submerged power intakes contravenes the Treaty, particularly Paragraph 8(f) of Annexure D?
iii. Proposed design for low-level sediment outlets in the form of a deep orifice spillway with five large gated openings at depth far below the dead storage level contravenes the Treaty, particularly Paragraph 8(d) of Annexure D?
iv. Proposed design for gated spillways for flood control with crest level of approximately 31 m (102 ft) below the dead storage level contravenes the Treaty, particularly Paragraph 8(e) of Annexure D?
v. Proposed design for 2 m (6.2 ft) of freeboard contravenes the Treaty, particularly Paragraph 8(a) of Annexure D?

At the outset, CoA indicated that objections to the Project were submitted by Pakistan after a period of three months not meeting stipulation as per Annexure D (10) of Treaty. This states that if no objection is received by India from Pakistan within the specified period of three months, then Pakistan shall be deemed to have no objection to the project.

6. Pakal Dul Hydroelectric Project

Pakal Dul Hydroelectric Project is located near the village of Drangdhuran in Kishtwar district on Marusudar tributary of Chenab. With an installed capacity of 1000 MW it is the largest hydroelectric project so far taken up by India on Western

Rivers. It has gross and live storages of 0.126 BCM (0.102 MAF) and 0.108 BCM (0.088 MAF), respectively.

Project comprises: 167m (548 ft) high concrete faced rockfill dam; two power headrace tunnels of 7.2 m (24 ft) diameter each 9.6 km (6 miles) long; two 423 m (1390 ft) long 6 m (12 ft) diameter steel lined pressure shafts; and further bifurcated into four 685 m (2247 ft) long and 3.9 m (13 ft) diameter penstocks. Underground powerhouse measuring 157 x 20.2 x 49 m (515x66x160ft) will have four 250 MM capacity Francs turbines and generators aggregating to installed capacity of 1000 MW; and four harshoe shaped 5.5 m (18 ft) diameter tailrace tunnels each 125 m (410 ft long).

India unilaterally started construction of this project in May 2018, with completion target of end 2023 and commissioning in March 2024, (almost at hand).

Considering a shear violation of the Treaty, Pakistan Commissioner for Indus Waters has constantly raised serious objections to this project.