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1. Hydro Diplomacy: Trans-boundary Water Issues between Pakistan and India

1.1. Preamble

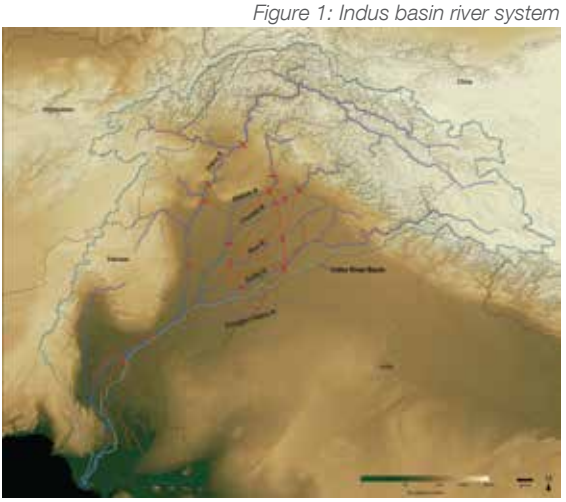
The underlying concept of this brief is to help promote cooperation and understanding related to waters of the Indus Basin between Pakistan and India for the benefit of all the stakeholders. Both countries regard the Indus Waters Treaty as sacrosanct and therefore, initiatives for promotion of cooperation within the framework of this Treaty need to be actively pursued.

The purpose of this brief is to develop an objective understanding of the current/recent issues and then describe how hydro-diplomacy can be deployed as a vehicle to help to achieve cooperative solutions.

Hydro-diplomacy is not a one-time exercise. The dynamic nature of the water relationships require that this be institutionalized. For effective hydro-diplomacy, however, capacity of the relevant institutions needs to be enhanced through proper staffing, training and development of the knowledge needed for hydro-diplomacy.

1.2. Historical Background

Figure 1: Indus basin river system



The Indus Waters Treaty (IWT) between Pakistan and India was signed in 1960 following a period of mistrust and tensions in the backdrop of the hostilities during the partition of the sub-continent. Consequently, though initial attempts were made to harness the potential of Indus basin through mutual cooperation for managing the shared water resources, the only feasible settlement was found to be division of waters. Pakistan was unwilling to allow means of control of flow of waters to India in the wake of the incidence of stoppage of water flowing to Pakistan in 1948, while India wanted sovereignty over waters flowing through its territory. Fortunately, it was possible to exclusively allocate three rivers, each, to divide the water between the two countries to overcome the impasse. India was allocated Sutlej, Ravi and Beas Rivers (called the Eastern Rivers) and Pakistan was allocated Indus, Chenab and Jhelum Rivers (called the Western Rivers). However, India was allowed some use of waters of the Western Rivers for domestic, non-consumptive, agricultural uses and generation of power based on Run-of-River (ROR) Power Plants as well as storages quantified in the Treaty[1]. Design and operational criteria was laid down in respect of ROR and storage based power plants and other hydraulic infrastructure allowed under the Treaty so as to ensure that India would "let flow" waters of Western Rivers without any "interference" beyond the exceptions allowed under the Treaty (Figure 1).

[1]*Likewise Pakistan was also allowed some limited use of water of Eastern Rivers for domestic and Agriculture uses (but not for power generation)..*

1.3. Water Issues between Pakistan and India

The fundamental cause of all the issues described below is that both the states are having positional stances in respect of trans-boundary waters. The major question is how to move from positional stances to a stance where they work together for water cooperation for sharing the benefits of waters.

1.3.1. The Trust Issue

The fundamental issue between Pakistan and India continues to be that of "trust". Starting from the bloody partition of the sub-continent, stoppage of water by India in 1948, start of a number of water use projects by India without addressing concerns of Pakistan and various other political and military misadventures, the trust gap continues. At times it appears that the trust gap is narrowing down between the two countries, but such impressions appear are short-lived when some untoward events created by vested interests result in political crossfire from both sides.

In respect of trans-boundary water, Pakistan had been apprehending that India would try to attain greater control and storage of the waters of the Western Rivers under the garb of technical design and operational requirements, while India feels that Pakistan is objecting to their projects unnecessarily.

Trust gap also emerges when the water flow in the Western Rivers declines. There are apprehensions that this may be due to water thefts or unauthorized filling of reservoirs upstream (e.g. Baglihar dead storage) or mal-operation of storages instead of general natural decline in the availability of water. Furthermore, irresponsible statements from various segments of the society, the media and politicians also fan the mistrust.

1.3.2. Transparency in Sharing of Data

The Treaty requires that a set of "data with respect to the flow in, and utilization of waters of the Rivers shall be exchanged[2]" by the parties as per the intervals prescribed in the Treaty. In addition, data may be requested by either party relating to "the hydrology of the Rivers, or to canal or reservoir operation connected with the Rivers, or to any provision of this Treaty,--[3]". India is supplying the flood flow data during flood season (1st July to 10th October) every year as per the arrangements made in 1989 except for the data on inflow and reservior level of Bhakra, Pong and Thein Dams and the base flows. Pakistan needs this information to assess the availability of storage cushion to absorb any excessive flood inflows and the likely releases down stream towards Pakistan. Similarly data is not being provided about operation of Baglihar Dam and other RoR plants to enable Pakistan to monitor compliance with the Treaty[4]. There is also reluctance to provide complete data in respect of projects to be constructed by India exacerbating the mistrust. As serious concerns are emerging on the over abstraction of aquifer by India and deteriorating quality of water flowing from India, exchange of data on aquifers and quality of water is also becoming essential[5].

[2] *Article VI of IWT*
[3] *Article VI of IWT*
[4] *Annexure D, para 15.*
[5] *IUCN, 2010. Beyond Indus Water Treaty: Ground Water and Environmental Management – Policy Issues and Options. IUCN Pakistan, Karachi. 10 pp. prepared by Dr Shahid Ahmad*

1.3.3. Unilateral Start of Projects

As per the Treaty, India is required to communicate certain project information specified in the Treaty, six months in advance of the beginning of construction of any new Run of River or Storage project[6]. It further envisages that within three months of receipt of this information, Pakistan shall communicate its objections, if any. However, as the Treaty does not explicitly forbid India from starting a project without settlement of these objections in accordance with the dispute resolution mechanism in the Treaty, India starts the project (e.g. Baglihar and Kishenganga) disregarding Pakistan's objections. This creates serious reactions from Pakistan. On some other occasions, India started projects without informing Pakistan (e.g. Wullar). It is a matter of simple common sense that the purpose of obtaining Pakistan's comments is to resolve these before the start of the project.

1.3.4. Bilateralism vs. Multilateralism

The IWT envisages a mechanism for "Settlement of Differences and Disputes[7]". In short, it envisages appointment of Neutral Expert to settle matters of technical nature (including design and operation) and a Court of Arbitration (CoA) for matters of legal nature. India had, however, been averse to referring the points of differences or disputes to a third party. It has a preference for bilateral negotiations but the record shows that it has resulted in years and years of meetings and correspondence without much substance, culminating into unilateral commencement of the project by India. Pakistan had been protesting on this dilly dallying approach and proposing reference of issues to a suitable third party as soon as possible.

1.3.5. Issues - Development of New Projects in India on the Western Rivers

The IWT provided for unrestricted use of all the waters of the Western Rivers by Pakistan obligating India to let flow all the water without any interference except for the following uses:

a. Domestic Use;
b. Non-Consumptive Use;
c. Agricultural Use, as set out in Annexure C [of IWT]; and
d. Generation of hydro-electric power, as set out in Annexure D [of IWT].

Restrictions on design, construction and operation of storage/hydraulic works on the Western Rivers were also specified in the Annexures D & E of the IWT. Specific river-wise ceilings were given in the IWT for the categories of General, Power and Flood Storages and that which is incidental to a barrage on Jhelum Main and Chenab Main Rivers. Except for the issue on Wullar Barrage (discussed below), no other issue has arisen so far with regard to storages.

With regard to the Run of River (RoR) power generation projects the Treaty did not envisage any ceiling for the number or capacities of the projects as long as those met the criteria/restrictions laid down in the Treaty. Issues have, however, arisen between Pakistan and India in respect of RoR projects. Pakistan had been objecting to the design of the projects on the grounds that India had not strictly adhered to the design and operational criteria/restrictions laid down in the IWT as well as India's interpretation of IWT related to these projects. On the other hand India had rejected Pakistan's stance and started projects unilaterally (also mentioned above). Pakistan and India could settle the issue of the Salal Dam through bilateral negotiations but the issues related to Baglihar Dam and Kishanganga Hydro Electric Projects described below, had to be taken up under the mechanism of "Settlement of Differences and Disputes" under the IWT.

[6] *The time limits for smaller or then on-going projects were different.*
[7] *Article IX of IWT*

Baglihar Dam

Information about the Baglihar Dam, on the River Chenab, was communicated by India to Pakistan in 1992. Pakistan had objected to the design of the Baglihar Hyro-electric Plant within the period of three months prescribed in the IWT. The essence of the objections was that the project, as designed, would enable India to acquire potential to store excessive water and strengthen its capability for greater control on waters of Chenab River than permissible according to the design criteria given in the Treaty. Regarding the potential to store, Pakistan objected that the free board (empty space over the full reservoir level) and the pondage (operational storage of water to meet the fluctuations in the discharge of the turbines arising from variations in the daily and weekly loads of the plant) were excessive. Regarding control on waters, Pakistan's objection was that the location of power outlets (tunnels) and the orifice spillway (five submerged gates with cill level 32 feet below the full pondage level) provided capability to India to exercise control over waters of Chenab River. Pakistan's view was that the power outlets can be moved up and the orifice spillways can be converted to surface spillway by moving the gates to the suface of water. This would truncate India's capability to control flow of waters. Pakistan's objections were based on the specific design criteria given in the Treaty[8] meant to minimize India's storage and control on waters of Western Rivers. The two Commissioners continued exchanging letters and debating the procedure for sttlement of the issues upto year 2000 when it was learnt that India had started implementation of the project. As the matter could not be resolved at the Commission and Government Levels it was referred to a Neutral Expert in 2005, appointed in accordance with the provisions of the Treaty. The Neutral Expert accepted the essence of all the objections by Pakistan but in his final determination he allowed India to retain the orifice spillway, wrongly interpreting the Treaty[9]. The design in respect of all the other features of the dam on which Pakistan had objected was, however, modified. Pakistan felt that the Neutral Expert had overstepped his jurisdiction by induldging in legal interpretation in respect of the spillway. Therefore, it took up the matter of misinterpretation of the Treaty in the subsequent case of Kishenganga Hydro Electric Project before the Court of Arbitration[10] (CoA), who ruled in favour of Pakistan on 18 February 2013. Now it is to be seen whether India complies with this decision in future plants on Western Rivers. The matter is of great importance to Pakistan as India has planned a large[11] number of projects on the Western Rivers and the cumulative effect of Treaty violations can be substantial, specially in the dry years.

Kishenganga Hydro-Electric Project (KHEP)

The project is based on diversion of waters of Kishenganga river (called Neelam River when it enters Azad Jammu and Kashmir) just before it enters from Indian Occupied Kashmir to Azad Jammu and Kashmir (AJ&K) to a nullah leading to Wullar lake and Jhelum River (see map). Pakistan found out about activities for this project in 1987-88 through its own sources. Upon inquiry India informed that only preliminary investigations were being carried out. In 1994 India formally submitted details of the project to Pakistan.

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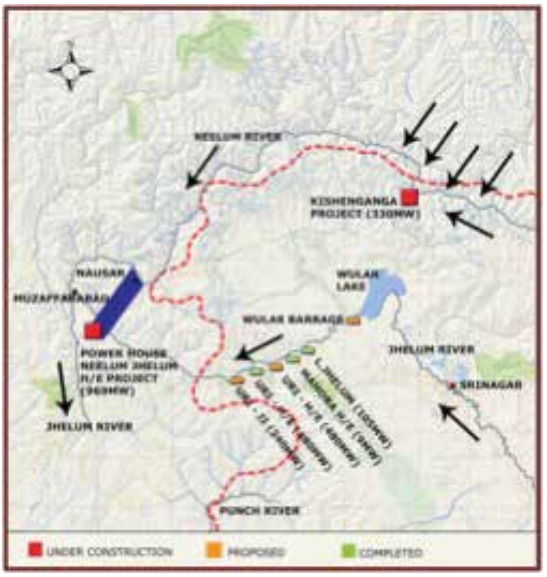
[8] *Annexure D IWT*

[9] *The N.E noted in his draft determination, "a difficulty results from the definition of the Dead Storage contained in the Treaty which states that it cannot be used for operational purposes". He then went on to make the suggestion that India may draw down water below Dead Storage Level for operational (maintenance) purposes, which would result in justification of orifice spillway. He observed, "This is a suggestion of the NE, conscious that he is beyond the scope of his mandate". In the final determination, he converted his suggestion to final decision, consciously over stepping his mandate and misinterpreting the IWT knowing well that he was not a lawyer.*

[10] *Annexure G IWT*

[11] *170 planned and constructed; 31 on Indus,63 on Jhelum and 76 on Chenab with total capacity of 17207 MW. Source: Proceedings of KHEP case before the CoA*

Figure 2: Jhelum river system and developments



Kishenganga project attracted two types of objections from Pakistan. Firstly, the diversion of water from Kishenganga River would create severe adverse environmental effects and affect the existing agricultural and hydro-electric uses downstream (it is estimated that the annual hydro-electric generation will suffer by 13.6 % worth millions of dollars (US $ 142.6 million annually[12]). The second set of issues pertains to project design features, similar to those described for Baglihar Hydro-electric Project above (i.e. related to level of power intake, pondage, free board and location of orifice spillways). The first set of issues was referred to the Court of Arbitration (CoA) along with the issue of the interpretation of the Treaty in respect of the level of gates of orifice spillway[13]. The CoA has upheld Pakistan's position in respect of the latter which does not leave any justification with India to construct orifice spillways instead of surface spillways. However, the CoA has allowed India to divert water for power generation. The exact quantum of water allowed to be diverted has been decided by the CoA. The losses that Pakistan may suffer will have to be recalculated in the light of the final decision of the CoA (Figure 2).

With regard to the second set of issues on the design of the project, the matter has not yet been referred to a Neutral Expert.

Wullar Barrage/Tulbal Navigational Project

India has planned (since 1985) to construct a barrage at the mouth of the Wullar Lake, which will have a capacity to store 0.395 billion m^3 (0.32 MAF) of water as against 0.01234 billion m^3 (0.01 MAF) allowed under the Treaty on the main stem of the River Jhelum. India says that this barrage (called Navigational Project by the Indians) will help maintain a draft of 4.5 feet (1.37 meters) downstream[14], needed for navigation during lean water months. Pakistan objects on going beyond the specific storage limit provided in the Treaty (10,000 AF or 0.01234 billion m^3). It also does not buy in the Indian story that it wants to improve navigation, as such a scheme is not feasible. Many people feel that India has tried to camouflage its real objective i.e. use of Wullar Lake as a storage for water diverted from Kishenganga River and increase the hydro-electric generation capacity of the plants downstream of Wullar Lake (Lower Jhelum HEP, Uri I & II and Mahora HEP). Despite many meetings at various levels, the work on the project has remained suspended since September 1987[15].

[12]Pakistan's submission to CoA on Day 1 and NESPAK
[13]The N.E noted in his draft determination, "a difficulty results from the definition of the Dead Storage contained in the Treaty which states that it cannot be used for operational purposes". He then went on to make the suggestion that India may draw down water below Dead Storage Level for operational (maintenance) purposes, which would result in justification of orifice spillway. He observed, "This is a suggestion of the NE, conscious that he is beyond the scope of his mandate". In the final determination, he converted his suggestion to final decision, consciously over stepping his mandate and misinterpreting the IWT knowing well that he was not a lawyer.
[14]PCIW brief on Wullar Barrage
[15]PCIW

Nimobazgo and Chuttak Projects on River Indus

Issues of project design were raised initially, but were sorted out mutually. However, there had been a lot of concern on Pakistan's side when it was learnt that India had been able to obtain carbon credits despite the fact that any such award would have required Pakistan's clearance as the projects are in the disputed territory.

1.3.6. Other issues

Sharing of Shortages

India's entitlements on use of waters of the Western Rivers are fixed in the Treaty in terms of area to be irrigated (in acres)[16] but no mechanism is prescribed for the sharing of shortages due to large variability in flows during dry and wet years. Wet years received more than double of the flows of the dry year. It is the dry years in which Pakistan is vulnerable and has to take the full brunt of the shortages.

Abstraction of Trans-boundary Aquifers

Trans-boundary aquifers were not dealt with in the IWT. However, water abstraction in the border areas is now causing concerns. According to the Stimson and SDPI report, "Abstractions[17] from the Indus aquifers reflect both the most intensive and the most unsustainable levels of groundwater exploitation on Earth". Estimates based on satellite data show that during April 2002 to June 2008 Indus basin aquifers lost groundwater at a rate of 10 k m^3 per year. (Figure 3; According to other studies[18] about 109 k m^3 was lost during 2002-08).It is more than half of the combined capacity of India's six large dams in the Indus basin, or almost half the available water storage in all the reservoirs of Pakistan[19]. Studies also conclude that one of the main reasons for over abstraction is the subsidized electricity rates for tubewell pumping in India. Studies reveal that groundwater is vanishing in the Northern India as the groundwater levels in Indian Punjab, Rajasthan, Haryana and Delhi are falling by 0.3 m per year. When the groundwater is abstracted, it takes years to recharge. As abstraction is likely to increase in future years, the situation will become even more precarious and result in serious impacts on Pakistan[20].

Pollution of Rivers

Maintenance of water quality is becoming an issue. In particular, there are serious concerns on the deteriorating quality of the water of the River Ravi, particularly through Hudiara Drain, due to discharge of effluent on the Indian side of the border. Shukla (2009)[21] indicated that most of the Indian rivers are grossly polluted due to the disposal of untreated sewage and industrial effluents into the rivers[22]. "Entry of effluents into freshwater rivers and tributaries feeding the Western Rivers on the Indian side is causing serious environmental implications for India-Pakistan. The extensive development of agriculture around the Western Rivers in India, with higher use of fertilizers and pesticides, is a concern for Pakistan.

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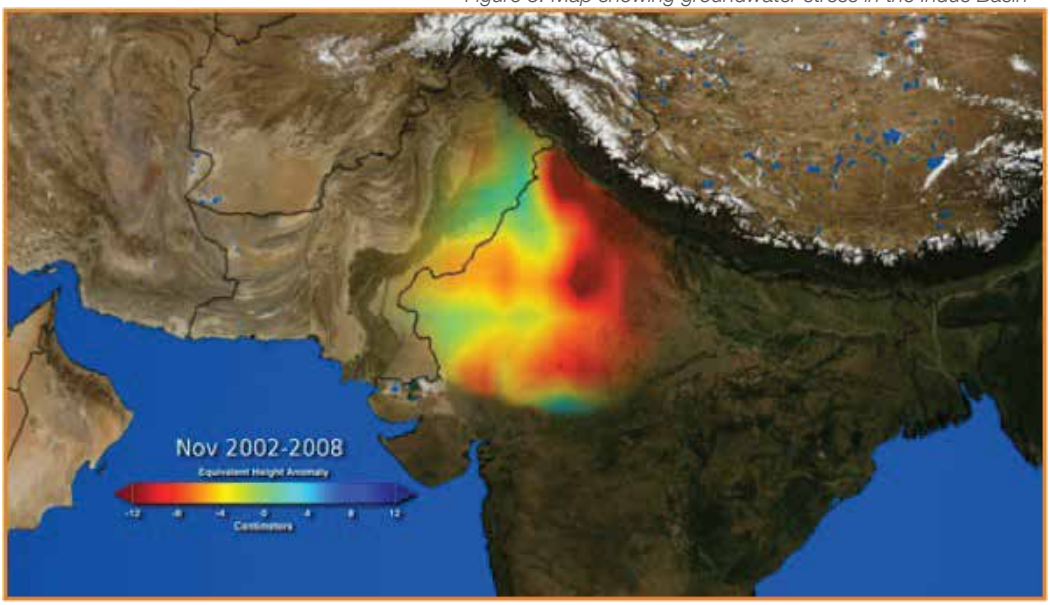
[16] *Except for Ranbir and Partab canals.*
[17] *Connecting the Drops, Stimson – SDPI Report, Observer Research Foundation 2013.*
[18] *(i) Groundwater Vanishing in India says NASA. 2009. Online edition of India's National Newspaper, The Daily News Hindu. Banglore, Friday, Aug 14, 2009. ePaper, Mobile/PDA Version and (ii) Rodell, J., T. Schindler, J. Famiglietti and G. C. Anderson. 2009. NASA Satellites Unlock Secret to Northern India's Vanishing Water. NASA Earth Science News Feature, NASA, USA*
[19] *Ibid 15*
[20] *IUCN, 2010. Beyond Indus Water Treaty: Ground Water and Environmental Management – Policy Issues and Options. IUCN Pakistan, Karachi. 10 pp. prepared by Dr Shahid Ahmad*
[21] *Shukla, K. S. 2009. . Indian River systems and pollution. The Encyclopedia of Earth. //www.eoearth.org/article/ Indian_river _systems_and_pollution. Last Updated November 12 2009.*
[22] *IUCN 2010. Beyond Indus Water Treaty: Ground Water and Environmental Management – Policy Issues and Options. IUCN Pakistan, Karachi. 10 pp. prepared by Dr Shahid Ahmad*

The domestic effluent is also a serious issue due to rapid urbanization around water bodies. Furthermore, the drainage channels from India entering into Pakistan are now flowing with effluents having higher concentration of chemicals and causing environmental impacts on the livelihood of rural population, livestock and groundwater quality. Mortality of livestock has been reported due to the use of drainage water as stockwater. The further increase of chemical agriculture in India would further deteriorate the quality of drainage effluents entering in to Pakistan[23]". Pollution of rivers and drains are also affecting the aquifers.

Figure 3: Map showing groundwater stress in the Indus Basin[24]



Watershed Management

Increasing human and animal activities and cutting of forests, watershed management are emerging serious concern in view of the siltation of reservoirs and soil erosion. Pakistan is concerned about watershed management in upper reaches of Western Rivers.

Miscellaneous Issues

- Apprehensions of water thefts have also been occasionally expressed thereby demanding telemetry of water flows at various gauging stations.

- It is understood that India has also not given green light to donors such as the World Bank to finance the Basha Dam Project as it is located in the Disputed Territory even though the project will have no effect on India and that India has itself constructed many projects on its side of the Disputed Territory.

- "Flash in the pan" type issues arise from time to time but are settled either through mutual assurances or die down with the passage of time (e.g. release of water in Sutlej River during floods without proper warning, initial filling of Baglihar Dam Reservoir beyond the period allowed under the Treaty, etc.).

[23] *Ibid 14*
[24] *Ibid 15*

1.4. Effects of Climate Change

The headwaters of the Indus rise in the glaciers of the Himalaya Hindu Kush (HKH) often called the "water towers". In future the melting of the Hindu Kush-Karakorum-Himalaya glaciers will have a significant impact on the availability of water. "Rising temperatures cause more precipitation to fall as rain instead of snow and this, in turn, leads to shrinking glaciers. Initially glacial melting results in increased water flow in the summer months, which may appear as a comforting sign at first. Ultimately, however, it compromises hydro-power generation and reduces production capacity for foodstuffs and commodities like cotton. This, in turn, may lead to growing poverty, rising food prices in the cities and an escalating rural-urban migration. Therefore, the melting of the Hindu Kush-Karakorum-Himalaya glaciers will have a significant impact on the daily lives of millions of people. (Vining and Vecchia 2007)[25]. Extreme events are also predicted to increase the frequency and intensity of floods, storms and droughts. Pakistan being solely dependent on Indus River System will be adversely affected and the water scarcity problem will be further compounded. The region, as a whole, is expected to be more jealously safeguarding its share of waters.

1.5. Maximizing Benefits of Finite Water Resources

1.5.1. Concept of Benefit Sharing

Division of water is inevitable in many circumstances as was the case for India and Pakistan. However, the benefits of one party may result in losses to the other party thus resulting in a "Zero Sum" game e.g. the allocation of waters of Sutlej River to India benefitted the people on their side of the border but the people on Pakistan side were even deprived of water for maintaining environmental flow. Thus, the division of water may not be seen as an end in itself. Wherever the division of water becomes essential; the sharing of benefits can be achieved within the context of the division. In the case of IWT it was expedient to divide waters for the reasons briefly explained in the historical background mentioned above. The two countries can now turn the page of unpleasant history and resort to mutual cooperation as envisaged in the Treaty to maximize the benefits of Indus Waters. They have to move from their current positional stance to sharing benefits and cooperative management of river basin within the bounds of the IWT.

Maximization of benefits of water through basin wide approach would be a "win-win" situation for all the communities dependent on the waters of the rivers. The "benefits[26] may include reduced effects of hydrologic variability, flood and drought mitigation, increased system-wide yields of water, improved environmental management, and hydropower generation". All of these have economy-wide impacts, directly affecting productive output, employment levels, poverty, and human health".

1.5.2. Conceptual Framework for Benefit Maximization & Sharing under IWT

The principle of attainment of the most complete and satisfactory utilization of the waters of the Indus Waters while fixing and delimiting the rights and obligations of each party through cooperation and mutual consent was enshrined in the IWT[27]. More specifically, Article VII of the Treaty dealt with "Future Cooperation". In this spirit, the two sides need to identify areas of cooperation which can help enhance the benefits e.g. watershed management, coping with effects of climate change, management of aquifers, mitigating adverse environmental effects, observing water quality standards, sharing water shortages, power generation, incorporation of new technologies, flood control and water management as a whole.

[25] *USAID, USGS Study on Availability of Water in Kabul Basin, Afghanistan.*
[26] *Source: Practical approaches to trans-boundary water benefit sharing. Halla Qaddumi , hqaddumi@worldbank.org Former Research Associate at ODI, July 2008*
[27] *Preamble IWT*

Within the framework of apportioned rivers and waters, both the countries need to look into options of sharing the benefits.

Determination and equitable sharing of benefits requires application of knowledge of various disciplines of science and technology as well as social and economic sectors to harness basin wide benefits through participatory approach. Methodologies should be agreed amongst the stakeholders regarding the dynamic nature of the calculation of the benefits and equitable sharing. The two countries can then agree on scopes of works which each country should take responsibility of, if mutually agreed, within the framework of the Treaty. The process of arriving at mutual agreement should be broad based i.e. engaging not only the water experts but other stakeholders such as politicians, water users' associations, NGOs, media, scholars/thinkers, economists and social scientists. These goals can be pursued through hydro diplomacy.

1.6. The Role of Hydro Diplomacy

Hydro diplomacy is both art and science of resolving complex issues. It is an art because it deals with perceptions, political limitations, psychology of riparian and, a science because it deals with finding solutions based on technology, study of climate change and quantification of benefits. The ingredients of the trans-boundary diplomatic process[28] are:

- The need to integrate multiple perspectives. Water diplomacy argues that resolving problems over shared water resources requires hydrologists, engineers, politicians, economists, sociologists and all stakeholders to work together to develop a nuanced understanding of the multifaceted nature of water demands and disputes.

- The importance of negotiation, mediation and intercultural communication. Water diplomacy seeks negotiated solutions informed by science and technology to help resolve problems of apportioned rivers and quality of water.

- Support for the wider diplomatic process. Engaging in water diplomacy is a bilateral or multilateral enterprise that can be important in defining regional and international foreign policy. It offers an opportunity to develop mutual relationships and international partnerships. Cooperation on scientific aspects and capacity building can also provide a route to other forms of political dialogue."

A Water diplomat has to have cross sectoral knowledge and skills; he can be a lawyer, economist, sociologist or a water engineer by basic training, but above all he should have the training and skill of integrating multiple perspectives and persuasion of stakeholders backed with sound knowledge of laws of treaties. Some universities and institutes run degree programs on the specific discipline of hydro diplomacy[29].

The process of negotiating on water issues usually precedes at different levels where water diplomats[30] can play a useful role is briefly described below:

Bilateral efforts: Often positions are taken on apportioned rivers and water entitlements based on historical and existing flows, fear of upper hand of the "mighty" (usually the upper Riparian),

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[28] *Hydro diplomacy: A Tool for Enhancing Water Peace and Sustainability in the Arab Region by Dr. Magdy A. Hefny, UNESCO , Nov 2011 (Draft Technical Report)*

[29] *Some of the programmes are: Oregan State University , Institute for Water and Watersheds, Program in Water Conflict Management and Transformation, Netherland Jnstitute of International Relations "Clingendael", Water Governance Centre, International Hydrological Programme, UNESCO,Hydro diplomacy@Tufts , The World's Water, The Pacific Institute, MIT, Harvard, University of Dundee, Institute of Hydraulics Netherland*

[30] *A water diplomat is the one who is a neutral broker capable of skilfully integrating multiple perspectives through negotiations, mediation and communication.*

losses that may result due to unfair dispensations, etc. Both sides tend to take extreme and rigid positions and the dialogues at expert or working level do not make much progress. The official negotiators are afraid that if they take a decision without internal consensus (often difficult to achieve), they would have to face the wrath of the people back at home. The intellectuals, academicians, independent fair minded water experts and thinkers often remain side-lined.

Third party" intervention as neutral broker: In view of the difficulties of bilateral process as explained above, it becomes inevitable in many situations to involve a "third party" to help resolve the issues. Of course, it requires a mutual consensus to appoint a third party to facilitate negotiations. The third party can be an expert of repute or a panel of experts or an organization such as the World Bank or countries like the Netherlands with hydro diplomacy as a foreign policy niche. The "third party" involvement has many advantages. It takes away the burden of making settlement and its consequent fallouts from the administrations and politicians of the parties involved.

Multilateral and bilateral donors support: Large financing institutions can help facilitate settlements by offering funds for water infrastructure projects which help in achieving the most complete and beneficial use of trans-boundary waters. They can also link their support in other development projects with the settlement of the water issues. This leverage is often helpful.

International political manoeuvring: Sometimes, international political players intervene or apply behind the scene diplomatic tactics to help resolve issues in the larger interest of regional stability. In the international diplomatic arena, parties proactively disseminate their points of views and interpretations to various political leaders, opinion makers, think tanks, intelligentsia and media to gain sympathies.

Track II diplomacy: Formal bilateral or "third party" parleys can be reckoned as Track I diplomacy. In these, the parties take official positions and find it difficult to go beyond their briefs. In "Track II", usually experts, retired government functionaries, civil society, lawyers, academicians and politicians participate on non-attributable basis. Here they can be more candid, flexible and cooperative. Track II is thus an effort to search for a fair and mutually beneficial solution in an open atmosphere and helps broaden the range of options.

1.7. Framework of Dialogues for Water Cooperation under IWT

This section of the paper describes a framework of dialogue for water cooperation for sharing benefits of apportioned rivers. It envisages that cooperation between Pakistan and India should be sought within the ambit of IWT which is being regarded as sacrosanct by both the parties. Following may be the framework:

Setting the Stage – Enabling Environments: The key to success of diplomatic effort; is the building of mutual trust, confidence and professional respect. A number of confidence building measures can be taken up front such as positive political statements, propagation of the potential of information regarding benefits of water through cooperation, media interviews with a cross section of society, etc. Building trust is an arduous task. It may take time but if the leadership on both sides perseveres with this task, the efforts will pay dividend. Trust building efforts in the water sector are important and pay much quicker dividends if the overall relationships between the two parties improved.

Avenues of Cooperation: While regarding the Treaty as sacrosanct, avenues of cooperation can be explored and exploited to maximize benefits of the Indus Waters. To begin with, many areas of common interest and benefit not involving the thorny issues of yielding control of water can be

pursued jointly, "in a spirit of goodwill and friendship[31]". Once this begins to bring the parties together, cooperation on more sensitive issues can be expected to be gradually achieved over time, within the ambit of IWT. Step by step approach is thus highly recommended. In this context following areas can be considered[32]:

• Develop effective cooperation in collection and sharing of real-time river flow data using telemetry, sharing of data on trans-boundary aquifers, water quality, and policies on energy tariffs for abstracting groundwater

• Full compliance with decisions of N.E and CoA in future projects

• Commitment to settle project issues before commencement of implementation of the projects.

• Monitor the pollution of rivers, drains and aquifers and take mitigation steps. Study the example of other joint commissions on water issues, such as the Joint Commission between the United States and Canada, which provides non-partisan advice, including scope for a joint scientific body;

• Mechanism of sharing of shortages of waters in the Western Rivers during the dry years.

• Develop agreements on carrying out studies jointly and individually and sharing of data and results, including:

a. variability and seasonality of river flows at agreed points;
b. lowering of water table in trans-boundary aquifers;
c. rivers right to flow including environmental flow requirement for the eastern rivers;
d. environmental aspects of drainage effluents flowing into Pakistan;
e. effects of global warming, climate change particularly Himalayan/Karakoram glaciers and their environmental, social and human impact.
f. disaster management and flood control
g. watershed management
h. monitoring the outcome of joint studies and research

Platform for Promoting Communication and Interaction: Promotion of mutual communication and interaction should be institutionalized. Focal institutions should be designated to promote interaction amongst water sector organizations as well as exchange of knowledge on water issues, science and technological practices, and socio-economic implications. This can be achieved through seminars, workshops and field visits, etc. Such interactions will promote mutual understanding and goodwill besides sharing of knowledge and best practices.

Expanding the Stakeholders Participation: Water dialogues usually engage technical experts in dealing with water infrastructure, irrigation and lawyers. The participation needs to be widened to include academicians, researchers, scholars, thinkers, sociologists, environmentalists, economists and other groups from the civil society projecting the views of the ultimate users of water whose lives depend on water.

[31] *Preamble IWT*
[32] *Including many suggestions from "The Way Ahead ,Report of the India-Pakistan Track 2 Water Dialogue held in Lahore on 27-28 September 2012" The Atlantic Council, USA*

Drivers of the Dialogue Process: There should be institutional ownership of the process of hydro-diplomacy so that some institution is responsible for undertaking the activities mentioned above. The primary drivers of the process of cooperation are the Commissioners for Indus Waters and the two governments. There has to be commitment to move forward to promote cooperation. Any one of these can take the initiative of hydro-diplomacy to break the ice. Media, thinkers, NGOs, civil society, researchers, academia and other water institutions can play a supporting role.

1.8. Capacity Building of Pakistan's Commission for Indus Waters (PCIW)

A Permanent Indus Waters Commission comprising of one Commissioner each from Pakistan and India was created under the Treaty. Each Commissioner is to "serve as the regular channel of communication on all matters relating to the implementation of the Treaty[33]". While the qualifications for the position of the Commissioner laid down in the Treaty demand engineering competency in the field of "hydrology and water use", his functions lay emphasis on establishing and maintaining "cooperative arrangements[34]" and promoting cooperation. So far, however, the offices of the two Commissioners had focused more on engineering, data and legal aspects of the Treaty through a narrow lens.

The Office of the Pakistan Commission for the Indus Waters has a total sanctioned strength of 8 positions of BS 17 (initial officer grade) and above. However, out of 8 positions, 4 are vacant. The positions do not carry functional classification thereby implying that the incumbents are expected to have multifarious responsibilities, as needed. PCIW is finding it difficult to attract and retain professionals. Some of the reasons are the incompatibility of the salary and privileges commensurate with the importance of the job and the market, career suffocation in a very lean organization and limitations of opportunities of improvement of knowledge through education, training and practical field work. This leads to frustration, resignation and in-fighting. The PCIW is also charged with the responsibility to look after the Afghan Cell for water matters.

Based on the consultations with the present Pakistan Commissioner Indus Waters and the Office Engineering Advisor/Chairman Federal Flood Commission, Ministry of Water and Power and Consultant's analysis, following areas of improvement and capacity building are identified to support PCIW in carrying out its responsibilities including enhancing cooperation:

1.8.1. Organizational Improvements

- PCIW needs to be restructured along functional lines with adequate manpower. An illustration is shown in Annexure.
- Salary structure should be in line with the market to attract competent professionals.
- Recruitment rules require revision to enable induction of professional experts on purely merit basis (direct recruitment or on deputation) and secondment of the experts of PCIW in other national and international organizations to gain relevant experience. The post of the Commissioner should be for tenure (say 3 years) and preferably filled through a search committee purely on merit related to experience in trans-boundary issues and water diplomacy.
- A career program be developed for competent and devoted employees of PCIW by allowing employment on higher positions in sister organizations or within PCIW instead of suffocating in a tiny organization with no future in sight.

[33] *Article VIII IWT*
[34] *ibid*

- Creating incentives for training, higher education and in-house and/or collaborative research. A research endowment fund should be created for the organization so that their activities related to knowledge base management are sustained.

- PCIW should focus on its core responsibilities related to IWT. The Afghan Cell for water matters may be organized as another Commission on Kabul Water. These two Commissions then can be reorganized as an organization for "Trans-boundary Water and Water Diplomacy"

1.8.2. Development of Knowledge and Skill Base

PCIW needs to keep pace with the existing and modern knowledge. Its staff should be provided training, education and exposure in the fields of:

- hydrology, water use, trans-boundary water issues, design, construction and operation of water infrastructure, water management, hydropower, watershed management, flood control, ground water, glacier science, sophisticated mathematical and numerical models, water quality, telemetry, wetlands, flora and fauna, drainage, ecosystem and environment, water laws, treaties and agreements in the world, case studies of settlement of issues in various basins, specific provisions of IWT and techniques of dispute resolution.

- basin wide planning, introduction of joint projects for sharing of water benefits

- Negotiation, diplomacy and the art of communication.

For younger professionals, placement in degree programs or formal courses can be considered while for relatively senior and difficult to spare persons, short courses and purpose oriented programs can be preferred.

1.8.3. Management of PCIW

- The head of the PCIW has to be the Commissioner (an engineer) in accordance with the Treaty but at the same time strong background and experience in communication and diplomacy will be considered as additional qualifications. Selection of the Commissioner must be purely on merit. Engineers are now available with diversified education and experience. The salary of the commissioner must be equivalent to MP1 (highest management scale). However, to assist him in various functions, an advisory panel of experts with background of hydro technology, water laws, hydro diplomacy, strategic vision and human resource development may be constituted to meet on monthly basis. Its functions could include Treaty matters as well as HR development.

- PCIW needs to modernize its business processes. All the wealth of historical record needs to be digitized, properly catalogued and securely saved along with a back-up arrangement. The office should be IT enabled with state-of-the-art facilities. Business process re-engineering will greatly improve its efficiency and access to international knowledge.

- Being a permanent institution, it deserves to have a small, decent and modern permanent office. For this purpose land should be allocated and new building needs to be constructed. In the meantime, it should be moved in a decent office on rent basis from the present dilapidated old building in shanty environment.

- Allocation of funds for this important office should be appropriately increased.

Complementary Support

It must be understood that the above improvements will increase the efficacy of PCIW, but it will still need to contract and outsource services for specialized technical studies, legal matters and IT support. Capacity of Pakistani consultants in the field of water engineering is also limited. Efforts should be made to enhance knowledge, experience and number of professionals in other organizations and academia. Knowledge and skill in the engineering fields of hydraulics, water, dams, civil engineering, mathematic modelling, numerical simulation, flood control, hydropower, IT infrastructure, use of satellite imagery/GIS, model testing of projects and irrigation in Pakistan has rusted over the years after the Indus Basin Works. The world has made much progress in these fields while Pakistan is lagging behind. Special efforts should be made to upgrade the existing institutions, create "Water Chairs", provide fellowships to young Pakistanis to study at institutions of higher learning abroad and provide research grants. The HEC of Pakistan should be proactive in this regards. Water is a life line for a country. Pakistan should urgently attend to the need for training and education.

1.9. Financing Hydro diplomacy

Various activities for hydro-diplomacy and capacity building of institutions concerned require financial resource. Adequate resources should be made available to PCIW, the concerned federal Ministry and HEC and other academic institutions. It will be in the fitness of things to appoint Chairs in hydro-diplomacy, Trans-boundary water laws and water engineering.

1.10. Conclusions

1. Indus Waters Treaty, though based on division of waters, had the foresight of attainment of the most complete and satisfactory utilization of the waters of the Indus rivers, while fixing and delimiting the rights and obligations of each party through cooperation and mutual consent. There had been some cooperation in the past but of late it is covered under the shadows of various issues related to water infrastructure being built by India. Cooperation has to be brought in the foreground once again and proactively pursued by both the parties. This is extremely important in the wake of emerging issues of water scarcity, climate change, competitive demands for water from non-agricultural sectors, new technologies and water quality issues.

2. To begin with the new drive for cooperation, parties should jointly undertake programs such as mentioned under "Avenues of Cooperation" in Section 1.7.

3. The parties should focus on building trust, promote goodwill, avoid emotive and explosive statements on water issues, avoid unilateral start of projects, improve data sharing, provide platforms for interaction of stakeholders (people to people contacts) and improve mutual communications, etc.

4. PCIW be restructured, staffing position may be improved and its capacity be built to proactively address the emerging challenges in trans-boundary waters of Indus system of rivers. New service structure needs to be developed to attract best available manpower in the country. The restructuring be carried out with a view to develop a high-performance organization[35].

5. Programs should be undertaken to address the knowledge gap mentioned at 8.2 above[36].

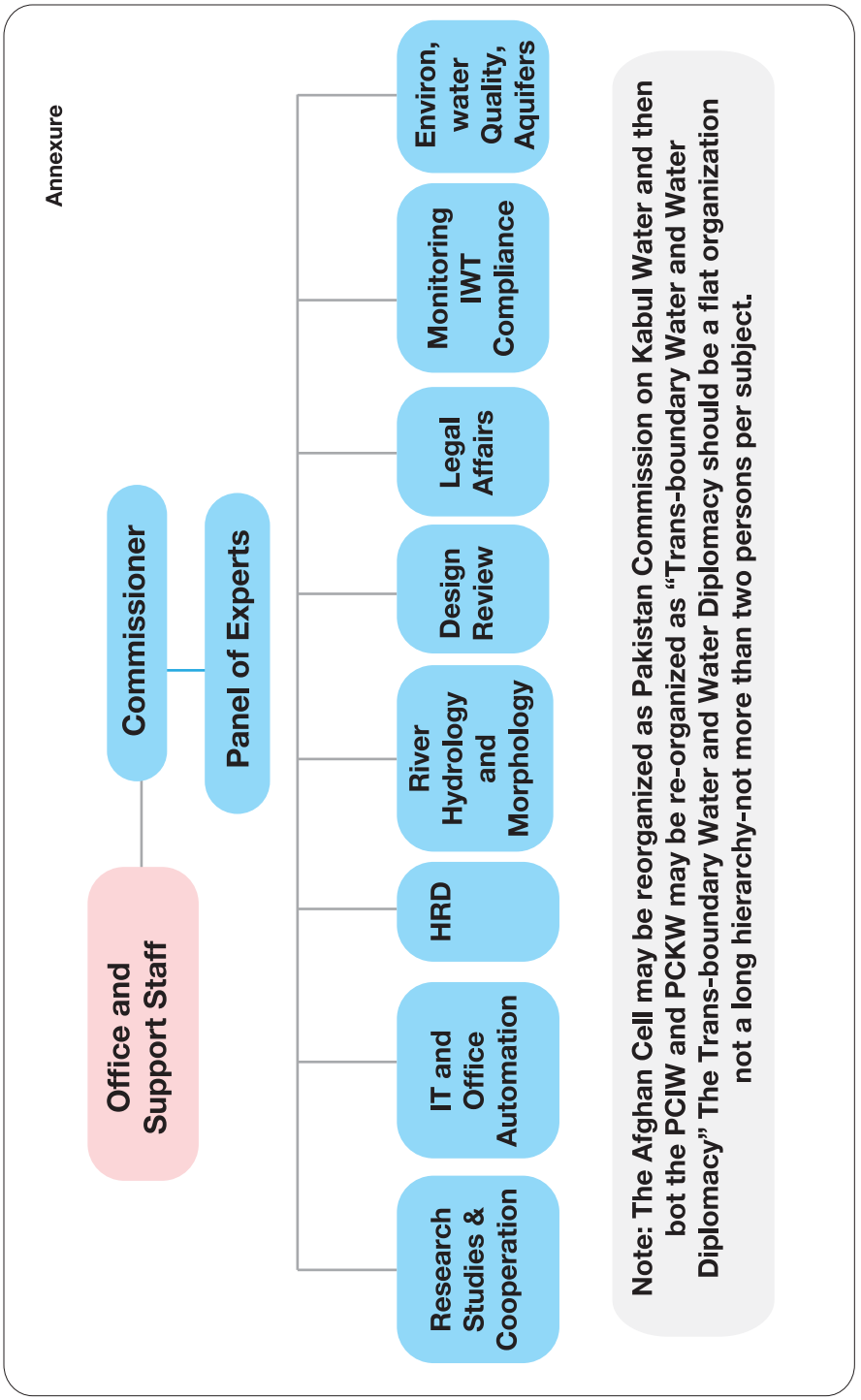
6. To avoid time consuming repeated referral to Neutral Expert or CoA, appointment of a standing panel or neutral entity be considered by the two countries to help resolve the issue as soon as these emerge.

7. Adequate funds should be made available for the initiative of hydro diplomacy.

[35] *Likewise, India may also take appropriate measures for capacity building.*
[36] *ibid*

Proposed Organizational Structure for the Office of Pakistan Commissioner for Indus Waters

Annexure



Note: The Afghan Cell may be reorganized as Pakistan Commission on Kabul Water and then bot the PCIW and PCKW may be re-organized as "Trans-boundary Water and Water Diplomacy" The Trans-boundary Water and Water Diplomacy should be a flat organization not a long hierarchy-not more than two persons per subject.

2. Hydro Diplomacy: Water Cooperation between Afghanistan and Pakistan

2.1. Kabul River

Kabul River traverses 560 kms in eastern Afghanistan[37] and enters in Pakistan near Landi Kotal. It covers a distance of about 140 km in Pakistan before it joins Indus River near Noshera, downstream of Ghazi Brotha Run of River (RoR) Project. Just before it enters Pakistan, it is joined by River Konar upstream of Dakah gauging station. The flow of the river Konar is largely contributed by the River Chitral originating in Pakistan (Figure 4). Thus Pakistan is both upper riparian as well as lower riparian of the waters of the river Kabul. The Kabul river basin encompasses about 12% of Afghanistan's territory and 26% of Afghanistan's total annual river flow[38].

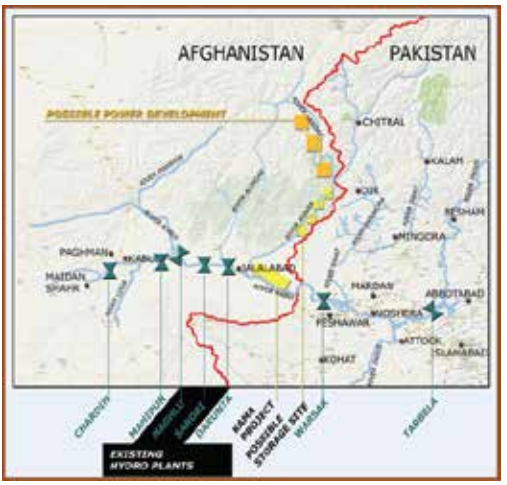


Figure 4: Kabul river and its tributaries

The Kabul River basin consists of three major watersheds (Figure 5):

a. two watersheds constituting the upper basins, namely the Logar-Upper Kabul and the Panjshir; and
b. third watershed, namely the Lower Kabul basin, into which the two upper basin watersheds discharge.

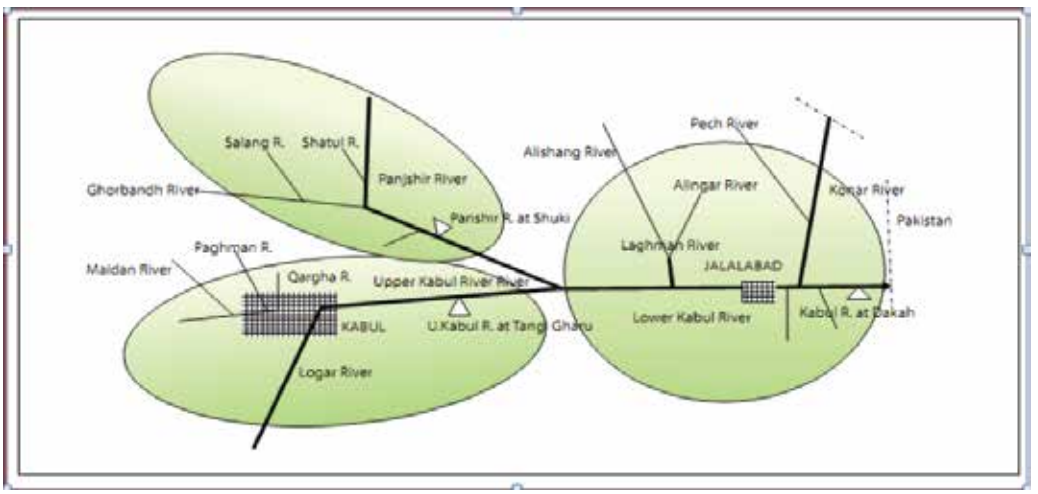


Figure 5: Schematic presentation of Kabul river sub-basins[39]

[37] *IUCN, 2010; Towards Kabul Water Treaty: Managing Shared Water Resources – Policy Issues and Options. IUCN Pakistan, Karachi. 11 pp. by Dr. Shahid Ahmad.*
[38] *The Politics of Water Security in the Kabul River Basin, Paula Hanaz, FDI Associate, Future Directions International Pvt. Ltd. www.futuredirections.org.au*
[39] *Scoping Strategic Options for Development of the Kabul River Basin, A Multi-sectoral Decision Support System Approach, Sustainable Development Department, South Asia Region,2010 The International Bank for Reconstruction and Development/ The W.Bank*

The average flow measured at the three sub-basins is presented in the Table 1. Out of the 19.25 billion m^3 (15.6 MAF) of water flowing from Kabul river to Pakistan, about 10.5 billion m^3 (8.5 MAF) is contributed by Chitral River[40].

Sub-basins	Drainage Area (km^2)	Average Flow (m^3/sec)	Average Annual Flow	
			billion m^3	MAF
Logar-Upper Kabul at Tangi Gharu	12,850	15.68	0.495	0.4
Panjshir at Sukhi	10,850	103.29	3.258	2.6
Lower Kabul at Dakah	43,660	611.6	19.287	15.6

Table 1: Comparison of Kabul River sub-basins[41]

The average annual flow at Dakah is 19.3 billion m^3 (15.6 MAF) while the recorded flow at Attock at the point of confluence with Indus River was about 23.5 billion m^3 (19 MAF) comprising of 4.9 billion m^3 (4 MAF) in Rabi and about 18.5 billion m3 (15 MAF) in Kharif seasons in 2007. There had been a decline in flows over last 70 years from about 34.6 billion m^3 (28 MAF) to 23.5 billion m^3 (19 MAF). Most of the decline is in the Kharif[42] season which may be attributable to climate change[43].

2.2. Potential of Kabul River Basin

The total new potential storage capacity identified in the Kabul River basin is approximately 4.8 billion m^3 (3.9 MAF). The characteristics of potential New Storage Sites[44] are given in Table 2 and locations are presented in Figure 6.

Note: Blanks mean that data is not available. RoR means Run of River Plants. 1 MAF= 1.234 billion m^3

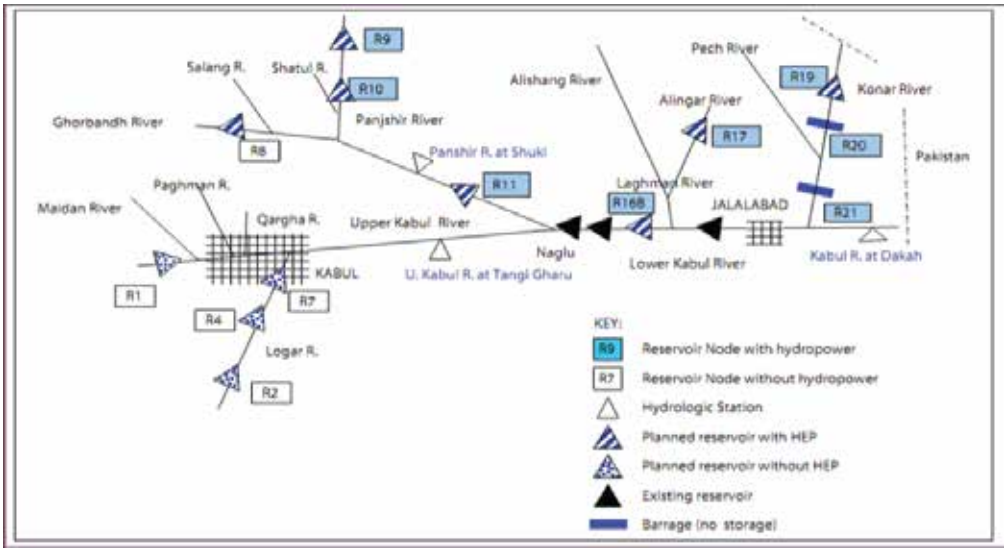
No	Sub-basins	Reference Fig 2 (m)	Dam Height (m)	Gross Storage (million m^3)	Live Storage		Installed Capacity (MW)
					(million m^3)	(MAF)	
A	**Panjshir Sub-basin**						
1	i. Totumdara	R 8	135	410	340	0.3	
2	ii. Barak	R 9	155	530	390	0.3	100
3	iii. Panjshir1	R 10	180	1300	1130	0.9	100
4	iv. Baghdara	R 11	40	400	330	0.3	210
	Total			2,640	2,190	1.8	410
B	**Logar-Upper Kabul Sub-basin**						
5	i. Haijan	R 12	50	220	200	0.2	
6	ii.Kajab	R 2	85	400	365	0.3	
7	iiiTangi Wardag	R 4	65	350	300	0.2	
8	iv. Gat	R 7	20	500	440	0.4	
	Total			1,470	1,305	1.1	
C	**Lower Kabul Sub-basin**						
9	i. Sarobi(RoR)	R 16B	200			0.0	210
10	ii. Laghman A	R 17		405	288	0.2	44
11	iii. Konar A	R 19		1212	1010	0.8	366
12	iv. Konar B (RoR)	R 20				0.0	81
13	v. Kama (RoR)	R 21				0.0	60
Total				**1,617**	**1,298**	**1.0**	**761**
Grand Total				**5,727**	**4,793**	**3.9**	**1,171**

Table 2: Potential new storage sites in the Kabul River basin[45]

USAID has also carried out an assessment of the potential of the Kabul River Basin and identified several major infrastructure projects as shown in the Figure 7.

[40] *The News May 12, 2011, India to help Afghanistan build 12 dams on Kabul River*
[41] *Ibid 3*
[42] *Kharif is summer period from June to October*
[43] *IUCN, 2010;Towards Kabul Water Treaty: Managing Shared Water Resources – Policy Issues and Options. IUCN Pakistan, Karachi. 11 pp. Dr. Shahid Ahmad .*
[44] *Ibid 3*
[45] *Ibid 3*

Figure 6: Approximate Location of Potential New Storage Sites[46]



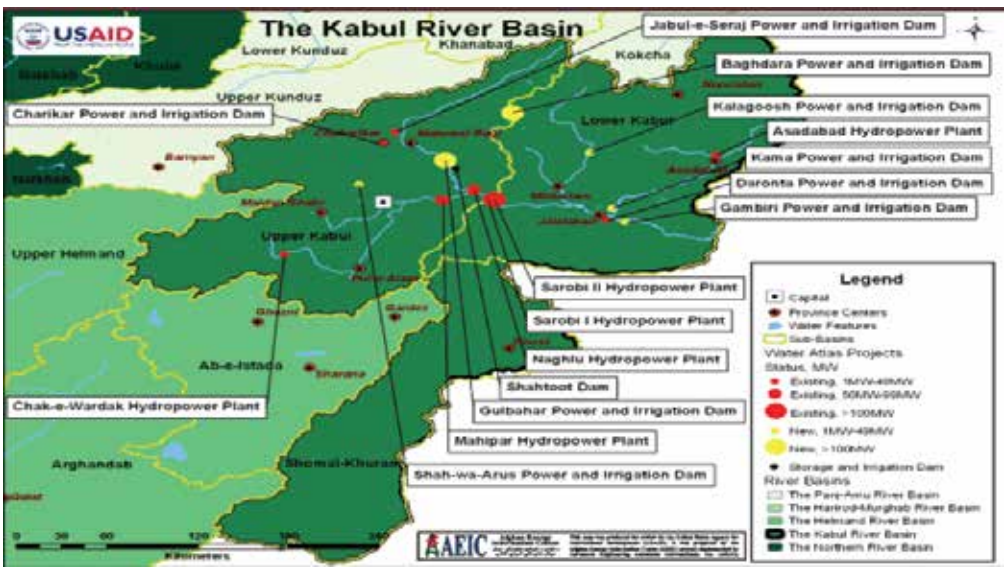


Figure 7: Major water infrastructure projects

2.3. Kabul River Basin Water Balance

The Kabul River basin water balance is given in the Table 3. The estimated average annual water supply of 19.206 billion m^3 (15.6 MAF)[47] is far in excess of the projected demand in Afghanistan. Similarly, the total new storage capacity of 4.8 billion m^3 (3.9 MAF) is also much less than the availability of water in the Kabul basin. However, there are disparities and difficulties at the sub-basin levels. In the Logar-Upper Kabul sub-basin, aggregate bulk water demand is more than twice the total average annual water availability. In contrast, aggregate bulk water demand is just over one-third of the total average annual water availability in the Panjshir sub-basin. However, unlike the Logar-Upper Kabul, the Panjshir has important hydroelectric power potential[48].

[46] *Ibid 3*
[47] *Small discrepancy from table 3 noted in the source document.*
[48] *Ibid 3*

Table 3. Kabul River water balance[49]

Parameters	Million m^3/Yr	MAF/Yr
Average Annual Supply	19,206	15.6
Basin Bulk Water Demand	3,874	3.1
Urban and Rural Drinking	401	0.3
Environ Flow	41	0.0
Mining	43	0.0
Irrigation	3,389	2.7
Surplus at Dakah	15,332	12.4

2.4. Pakistan's Dependence on Kabul/Chitral River Water

Kabul River's annual average contribution to Indus River at Attock is about 23.5 billion m^3 (19 MAF) water of which about 19.3 billion m^3 (15.6 MAF) is received from across the boundary (including 10.5 billion m^3 (8.5 MAF) from Chitral River in Pakistan). The pattern of flow shows that Kabul is an early riser as compared to Indus River as shown in Figure 8[50]. The streamflow begins to rise in March/April and peaks in June/July. The early rising characteristics is helpful as it supplies the much needed water for early Kharif sowing in southern Punjab and Sindh province. If water storages are constructed and use of water in Afghanistan is increased as shown in Table 3 above, the flow to Pakistan can reduce by an amount of about 4.93 billion m^3 (4 MAF). Pakistan is already almost at the threshold of water scarcity (1000 m^3 per capita) while the Afghanistan is in a much better position of 2250 m^3 per capita[51]. Reduction in water supply from Afghanistan will severely impact Pakistan's existing and future uses particularly in Southern Punjab and Sindh. Water is the lifeline of economy of Pakistan as agriculture contributes about 21% of GDP, employs about 80% of rural work force and 60 to 70% of its exports are agriculture based.

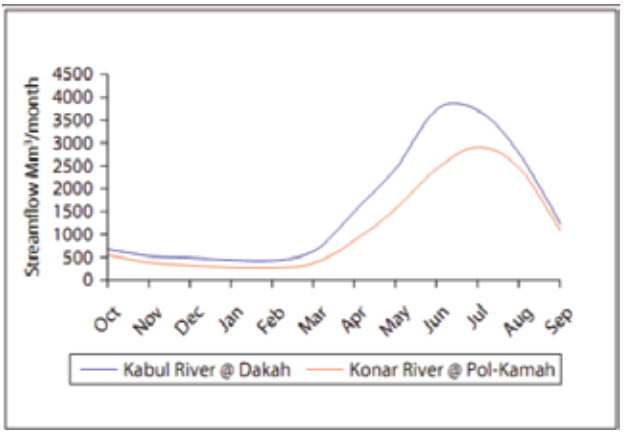


Figure 8: Konar and Kabul Rivers Average Monthly Streamflows

Warsak power plant is constructed on river Kabul 30 kms from Peshawar. The power plant was constructed in two phases in 1960 and 1980-81 with a capacity of 243 MW. The Warsak Dam has been silted and it is now operating as a run of river plant with much lower electricity generation than its original capacity. Rehabilitation of the project had been under consideration of WAPDA[52]. Power and irrigation potential of the Chitral River can also be harnessed by Pakistan and flood at Noshera (caused by Kabul River) can be managed if it is diverted to Panjkora and Swat rivers.

2.5. Effects of Climate Change

The glaciers, snow and rainfall at Hindu Kush Mountains are the main source of water in the Kabul River. In the past half century alone, larger glaciers in the Pamir and Hindu Kush Mountains have shrunk by 30% and smaller glaciers have disappeared altogether (UNEP 2008, p. 11)[53]. In future the

[49] *Ibid 3, Assumptions: Kabul river population grows to 8 million, environ flow of 1 cumecs, meeting full requirement of Aynak copper mines, irrigating 265,000 hectares at 35% efficiency with current cropping pattern. The demand for water has been based on the assumption of 35 % efficiency with the existing cropping pattern. There is a scope for reduction in demand through improved efficiency and cropping patterns.*

[50] *Ibid 3*

[51] *Ibid 3*

[52] *wapda.gov.pk*

[53] *The Politics of Water Security in the Kabul River Basin, Paula Hanaz, FDI Associate, Future Directions International Pty Ltd. www.futuredirections.org.au*

melting of the Hindu Kush-Karakorum-Himalaya glaciers will have a significant impact on the availability of water. “Rising temperatures cause more precipitation to fall as rain instead of snow and this, in turn, leads to shrinking glaciers. Initially glacial melting results in increased water flow in the summer months, which may appear as a comforting sign at first. Ultimately, however, it compromises hydro-power generation and reduces production capacity for foodstuffs and commodities like cotton. This, in turn, may lead to growing poverty, rising food prices in the cities and an escalating rural-urban migration. Therefore, the melting of the Hindu Kush-Karakorum-Himalaya glaciers will have a significant impact on the daily lives of millions of people. Changing monsoon patterns are projected to decrease precipitation over the region of the Kabul River basin by up to 20% (Renner 2009, p. 8). In Afghanistan and Pakistan, severe droughts are usually caused by low winter precipitation for two consecutive years, which occurs at least once every 10-15 years. During the last cycle of drought, however, the glaciers decreased in size, which poses additional, longer–term, threats to the water sector (GIRoA 2008, p. 8).” According to the fourth assessment report of the IPCC (2007) Inter-governmental Panel on Climate Change (2007) warming up of the climate is expected to result in 10% reduction in total annual precipitation in next 50 years in Afghanistan (Vining and Vecchia, 2007)[54].

2.6. The Role of Water Diplomacy[55]

Water diplomacy is both art and science of resolving complex issues. It is an art because it deals with perceptions, political limitations, psychology of riparian and a science because it deals with finding solutions based on technology, study of climate change and quantification of benefits. The ingredients of the trans-boundary diplomatic process[56] are:

- “The need to integrate multiple perspectives. Water diplomacy argues that resolving problems over shared water resources requires hydrologists, engineers, politicians,

- economists, sociologists and all stakeholders to work together to develop a nuanced under standing of the multifaceted nature of water demands and disputes.

- The importance of negotiation, mediation and intercultural communication. Water diplomacy seeks negotiated solutions informed by science and technology to help resolve problems of water allocation and quality and competing water needs.

- Support for the wider diplomatic process. Engaging in water diplomacy is a bilateral or multilateral enterprise that can be important in defining regional and international foreign policy. It offers an opportunity to develop mutual relationships and international partnerships. Cooperation on scientific aspects and capacity building can also provide a route to other forms of political dialogue.”

A water diplomat has to have cross sectoral knowledge and skills; he can be a lawyer, economist, sociologist or a water engineer by basic training but above all he should have the training and skill of integrating multiple perspectives and persuasion of stakeholders and sound knowledge of laws of treaties. Some universities and institutes run degree programmes on the specific discipline of water diplomacy[57].
The process of negotiation of water issues usually proceeds at different levels where water diplomats[58] can play a useful role as briefly described below:

[54] *USAID, USGS Study on Availability of Water in Kabul Basin, Afghanistan.*
[55] *Draft paper: Transboundary Issues Between Pakistan and India, Pakistan Water Programme, IUCN and Oxfam Novib,August 2013*
[56] *Water Diplomacy: A Tool for Enhancing Water Peace and Sustainability in the Arab Region by Dr. Magdy A. Hefny, UNESCO , Nov 2011 (Draft Technical Report)*
[57] *Some of the programmes are: Oregan State University , Institute for Water and Watersheds, Program in Water Conflict Management and Transformation, Netherland Jnstitute of International Relations “Clingendael”, Water Governance Centre, International Hydrological Programme, UNESCO, Water Diplomacy@Tufts , The World’s Water, The Pacific Institute, MIT, Harvard, University of Dundee, Institute of Hydraulics Netherland*
[58] *A water diplomat is the one who is a neutral broker capable of skillfully integrating multiple perspectives through negotiations, mediation and communication.*

Bilateral Efforts: Often positions are taken on water rights based on historical and existing flows, fear of upper hand of the "mighty" (usually the upper Riparian), losses that may result due to unfair dispensations, etc. Both sides tend to take extreme and rigid positions and the dialogues at expert or working level does not make much progress. The official negotiators are afraid that if they take a decision without internal consensus, they would have to face the wrath of the people back at home. The intellectuals, academicians, independent fair minded water experts and thinkers often remain side-lined.

Third party" intervention as neutral broker: In view of the difficulties of bilateral process as explained above, it becomes inevitable in many situations to involve a "third party" to help resolve the issues. Of course, it requires a mutual consensus to appoint a third party to facilitate negotiations. The third party can be an expert of repute or a panel of experts or an organization such as the World Bank or countries like the Netherlands with water diplomacy as a foreign policy niche. The "third party" involvement has many advantages. It takes away the burden of making settlement and its consequent fall outs from the administrations and politicians of the parties involved.

Multilateral and bilateral Donors support: Large financing institutions can help facilitate settlements by offering funds for water infrastructure projects which help in achieving the most complete and beneficial use of trans-boundary waters. They can also link their support in other development projects with the settlement of Water issues. This leverage is often very helpful.

International Political Manoeuvring: Sometimes, international political players intervene or apply behind the scene diplomatic tactics to help resolve issues in the larger interest of regional stability.

Track II Diplomacy: Formal bilateral or "third party" parleys can be reckoned as Track I diplomacy. In these, the parties take official positions and find it difficult to go beyond their briefs. In "Track II" usually, experts, retired government functionaries, civil society, lawyers, academicians and politicians participate on non-attributable basis. Here they can be more candid, flexible and cooperative. Track II is thus an effort to search for a fair and mutually beneficial solution in an open atmosphere and helps broaden the range of options.

2.7. Transboundary Water Concerns

Fortunately, water is not a front line issue between Pakistan and Afghanistan while there are ingredients that it may eventually become, if not handled diplomatically. Some of the reasons are:

Threat to existing uses of Pakistan: Recent studies have identified at least 13 potential dam sites for Run of River and storage-cum power projects besides potential schemes for irrigation[59]. These schemes are estimated to utilize/store about 4.93 billion m^3 (4.0 MAF) of water[60] with corresponding reduction of water supply to Pakistan impacting its existing and future uses. As shown in the Figure 8, the flow of water in the Kabul River, received at Pakistan's border after catering the existing needs of Afghanistan during the period October to March, was about 600 Million m^3/month. This coincides with the Rabi[61] season in which there is general shortage of water in Pakistan and every drop of water is extremely valuable. New agricultural and power uses besides the increasing urban water consumption in Kabul can reduce the much needed water for Pakistan in the Rabi season. Pakistan is already in the water stress situation and further reduction in water can add to food shortage and poverty in Pakistan. Stream flow in Kabul starts rising exponentially from March and reaches the peak flow of about 4000 Million m^3/month in mid-June. The characteristic of rising beginning of March is also valuable to Pakistan as it supports early sowing of Kharif crops in Sindh. If water is stored or consumed by Afghanistan during this period, it will have similar consequences as for the lean water period of October to March.

[59] *Ibid 3*
[60] *Ibid 3*
[61] *Rabi is winter crop period from November to March*

Threat of climate change: Climate change is likely to reduce water availability in future as described above. Afghanistan being upper riparian of Kabul River will be in a position to meet its full requirement (as projected demand would remain below the availability) and the entire brunt of the climate induced shortages will have to be borne by Pakistan. Glacial melt, changing pattern of precipitation and rising temperature will result in reducing annual average water availability of water. Because of rising temperature the timings of snow melt will also be earlier than at present[62]. This trend and shorter span of time for peak flow in river Kabul may form the basis of building of dams on the Kabul River by Afghanistan to store water at the expense of existing uses of Pakistan.

Possible diversion of Chitral river: Pakistan is also upper riparian in respect of Chitral-Konar rivers axis. Chitral River flows from Pakistan and joins Konar River in Kabul which in turn joins the Kabul River. Pakistan may divert water from Chitral (about 10.5 billion m^3 or 8.5 MAF) to Panjkora River/Swat River for meeting its needs for power, agriculture and flood control downstream.

Poor watershed management: Kabul watershed conditions are deteriorating due to overgrazing, runoff of flash floods and streams. In future years, more silt load will affect both Afghan and Pakistan projects.

Hydro metrological data sharing: The two countries do not have any formal and credible system of sharing of data. Floods, droughts, changing water flow patterns can cause misgivings.

Water quality: Growing population of Kabul is raising concerns about safe disposal of waste water and affluent. Water quality in the Kabul River may be an issue in future.

Groundwater: Data on the state of the tans-boundary aquifers is not adequate. As the surface water availability comes under stress as explained above, issues may arise with respect to sharing of groundwater resources.

2.8. Framework of Dialogues between the Stakeholders for Water Cooperation

There are two schools of thoughts to pursue water dialogue with Afghanistan. Some institutions and experts believe that the two countries should fast track preparation of a water treaty like Indus Waters Treaty (IWT) as it is better to make treaties when the disputes have not arisen. The concept is that given the potential water issues between Pakistan and Afghanistan, it will be harder to negotiate a treaty at the time when the crisis of water has occurred as the two sides may not find sufficient space to manoeuvre and strike compromises. The other school of thought is that starting a formal process will expedite the surfacing of issues and confrontation. The two sides will inevitably prepare their claims based on existing and future uses and contest these vigorously. It is apprehended that it will result in claims, counter claims, arguments and even thinking up issues. Outside influences and prompting to fan the issues cannot be ruled out as well. This will array the two sides across the table in the current sensitive political environments, with uncertain conduct of the media in the region and possible outside promptings. Though started in good faith, the process of negotiations may be counterproductive. So, the second school of thought does not favour immediate start of treaty negotiations. Preference is for the start of a process of engagement for developing cooperation and understanding as prelude to arriving at a water treaty.

The fact of the matter is that given the future planning of water projects by Afghanistan and their impact on existing uses of Pakistan, possible projects on Chitral river by Pakistan (being upper riparian) and projected adverse effects of climate change, a treaty or agreement between the countries will ultimately be inevitable. However, drawing parallel with the IWT may be a fallacy as

[62] *Ibid 3*

the IWT was prepared in the back drop of wounds of partition, hostilities, stoppage of water flow to Pakistan and mistrust with India being in a dominant position of a powerful upper riparian. Fortunately no such situation exists between Pakistan and Afghanistan though there is some political sensitivity. Under the present situation cooperation between Pakistan and Afghanistan should be sought within the following framework:

Setting the stage: The key to success of water diplomacy is the building of mutual trust, confidence and professional respect. A number of confidence building measures can be taken up front such as positive political statements, propagation of the potential of information regarding benefits of water through cooperation, media interviews with a cross section of society, etc.

Identification of avenues of cooperation: The dialogue of the stakeholders should be based on the concept of equity for all the people connected with the river basins in terms of sharing of benefits. Avenues of cooperation can be explored and exploited to maximize benefits of the Kabul River water. To begin with, different areas of common interest and benefit not involving any thorny issues may be explored. Once this begins to bring the parties together, cooperation on more sensitive issues can be expected to be gradually achieved over time.

Water cooperation between Pakistan and Afghanistan, if intelligently promoted, has a good chance of success. So, it will be appropriate if Pakistan seizes the opportunity and launches a **"Water Cooperation Initiative"** as a prelude to a treaty which may be made in due course of time. This will build confidence amongst the parties. Salient features of the diplomatic initiative:

a. **Forming stakeholders' fraternity:** The Treaty between Pakistan and Afghanistan may be preceded with a track record of mutual cooperation and trust. Professionals and other stake holders including water users and farmers need to be brought closer to develop understanding of mutual benefits. To begin with, frequent seminars, workshops and meetings should be arranged on matters of mutual interests such as climate change, efficient use of water, enhancing productivity, water management practices, water research, food security, technologies for water infrastructure, drinking water issues, watershed management, etc.

b. **Sharing of expertise:** Pakistan should be proactive to extend its expertise and know how to its counterparts in Afghanistan. Some of the areas of interest earlier indicated[63] by Afghanistan are data collection and sharing, technical assistance for small dams, efficient and mechanized agriculture, computerization, watershed development and preservation, reforestation and irrigation rehabilitation projects.

c. **Joint ventures:** Initiate joint venture projects with the support from Pakistan such as establishment of research institutions like NARC/PARC in Afghanistan, water testing labs, hydrology labs, material testing labs, joint manufacturing of equipment, water filtration plants etc.

d. **Joint studies:** A number of joint studies can be commenced on watershed management, effects of climate change and mitigation measures, efficient use of water, enhancing agricultural productivity, groundwater recharge, water quality etc.

e. **Study of Kabul river basin:** Joint study of Kabul River basin, groundwater recharge and water demand and supply options in future, mitigation of effects of climate change and flood control can be undertaken.

f. **Data collection and sharing:** Collection and sharing of hydro-metrological data (for which Pakistan can extend its resources), flood forecasting to start with. A joint repository of data may be created. This data may be shared freely and transparently between the parties.

[63] *Presentations for Pakistan US Afghan Trilateral Working Group on Watershed Rehabilitation and Irrigation Technology.*

g. Funds for promoting cooperation: Funds should be set aside by Pakistan for cooperative activities.

h. Academic collaboration: Pakistan's universities and agriculture institutes can offer fellowship, internship and training opportunities to Afghanistan. Joint research projects may be undertaken.

i. Support of diplomatic institutions: Pakistan's embassy to play an important role in facilitating the above activities.

j. Guidance to curb sensational communications: Media be educated and guided to avoid sensationalism. Politicians should avoid playing to the gallery and making provocative statements.

k. Reorganizing institutional support for diplomacy: The Afghan cell, presently with the PCIW, may be separated as an independent cell within a broader organization named as Trans-boundary Water and Water Diplomacy as an autonomous institution. The cell may be reorganized to undertake the kind of initiatives mentioned above.

Joint commission for water cooperation: The "Water Cooperation Initiative" is expected to pave the way for the cooperative development and sharing of benefits which should be the foundation of the Treaty between the two countries. Towards implementation of this initiative, it is proposed that a Joint Commission of the two countries be formed. The Commission can be the driver and the focal point for promotion and collaboration in the initiatives mentioned above.

2.9. Conclusions

Emerging water stress in Afghanistan and water scarcity in Pakistan, impending effects of the climate change, water supply and demand imbalance and planned water storage and irrigation projects in the two countries can affect relations between Pakistan and Afghanistan. The situation can be avoided through mutual cooperation and equitable sharing of benefits amongst all the stakeholders on both sides of the geographical border while isolating the political issues. This requires intelligent diplomacy, framework of which is described above. Efforts for establishing mutual confidence, trust and relationship amongst the water stakeholders should precede formal negotiations of agreement or treaty. Pakistan should immediately launch "Water Cooperation Initiative". Efforts in this direction should be started forthwith and institutionalized. It will be in the best interest of the two countries if they could form a Joint Commission for water Cooperation as soon as possible.

3. Interprovincial Water Cooperation in the Indus Basin of Pakistan

3.1. Preamble

Water is an essential resource, indispensable to all forms of life on earth. Adequate freshwater resources are crucial to human health and environmental integrity, as well as economic growth. While human population and economies continue to grow, the amount of freshwater will remain almost the same. Moreover, freshwater resource is often shared at multiple levels and is unevenly distributed in time and space. Its traditional management has been fragmented often subject to vague, arcane, and/or contradictory principles and practices. Contemporary water resources management on the other hand requires actors to integrate and balance the reconciling, coexisting and competing interests in a cooperative and mutually benefited manner. However, the competing interests and uses of water are often at odds and trans-boundary nature of the resource makes the situation even more complex. As a matter of fact and irrespective of the situation and location, the conflicts between upper- and lower-riparian regions are natural and universal. While taking the advantage of their physical control, the upper riparian states have difficulty in accepting the rights of lower riparian and tendency to use the freshwater resource as a key diplomatic and strategic tool to coerce the downstream states to submit to their demands. The lower riparian on the other hand generally tend to be very conscious about upstream developments but often overlook the important aspect of efficiently utilizing the precious freshwater resources at their end. This shows that the behavior of upper- and lower riparian are peculiar and these stances will continue in a water short system.

Many analysts maintain that water conflict and cooperation often coexist, embedded in more complex interactions. The underlying reasons for controversies over shared waters can be numerous, notably power struggles and competing interests, but all water disputes can be attributed to one or more of the four issues: quantity, quality, timing and infrastructure. Also, the differences over shared waters can occur at multiple scales, from sets of individual irrigators, to urban versus rural uses, to nations and states that straddle shared waterways. However, water has never been the critical reason for fierce conflicts at national level but there is evidence of water-related conflicts at sub-national level. The existing political or ethnic tensions can exacerbate and the potential for tensions increases when the resource is scarce. Disparities between riparian parties – whether in economic development, infrastructural capacity or political orientation – add further complications. Nevertheless, the vital nature of freshwater is also a powerful incentive for cooperation and dialogue, compelling the stakeholders to avert conflicts and reconcile even the most divergent views. Water cooperation refers to the joint and organized management and use of freshwater resources among various players and sectors at multiple levels. It is essential to properly address a broad spectrum of management issues including planning, development, regulation, forecasting, distribution, utilization, conservation and management of water resources; water quality management; water infrastructure and hydropower generation; protection of aquatic environments; and sharing or exchange of data, scientific knowledge, management strategies, and best practices. It is well recognized that water cooperation can act as a pathway for peace and security in shared river basins & aquifer systems, sustainable development, poverty eradication, and universal water access.

Pakistan depends fully on the Indus river basin for its survival and sustenance. Agriculture is recognized as an engine of economic development, but its growth is severely hampered by aridity, overall water scarcity and insufficient water infrastructure. Pakistan's reliance on a single river system, that is also trans-boundary and one of the hot spots of expected climate change, puts it at a high risk of water insecurity. Its water resources are seriously threatened by a variety of stressors

including increasing scarcity and variability, changing climate and/or climatic variability, deteriorating quality, expanding population, growing urbanization and industrialization, and above all, the recurring inability to develop an adequate platform of modern infrastructure and institutions. While opportunities for augmenting the existing water supplies are limited and becoming prohibitively expensive, fierce competition among uses and users is adding extra strain to already stressed freshwater resources. The political economy of trans-boundary waters and growing interprovincial mistrust over water sharing are the other thriving challenges. The historical rivalries and ongoing competition over water distribution are inextricably linked and deeply ingrained into the national and provincial politics and have become chronic source of severe tensions among the provinces thereby challenging the national harmony, integrity and solidarity. It is expected that intensifying issues over shared waters may excite and exploit the political, ethnic or sectarian inferiorities leading to conflicts. The inability to resolve river resource issues will undoubtedly limit country's ability to efficiently manage and optimally utilize the limited water resources. The interprovincial rivalry over water sharing has become a key hurdle in securing the consensus on future water development and associated economic growth. The government of Pakistan attempted numerous efforts to pacify, control and dilute the growing disagreements among provinces and resolve the long-standing interprovincial water dispute. A number of committees and commissions were constituted but failed to resolve the issues until 1991 when the seemingly perpetual conflict got settled through an interprovincial water accord.

3.2. The 1991 Water Apportionment Accord

After many years of distress and interprovincial contention, Pakistan recorded a landmark achievement in the South Asian history by creating a unique testament of political maturity and interprovincial solidarity on March 16, 1991. The enthusiastic and vivacious political goodwill enforced by the federal government finally secured consensus among the four provinces to resolve the longstanding and seemingly perpetual interprovincial water dispute through a water apportionment accord unanimously signed by the chief ministers of the four provincial governments. The Indus River System Authority (IRSA) was instituted through a parliamentary act, as IRSA Act 1992, to regulate and monitor the distribution of water resources of Indus River System in accordance with the accord amongst the provinces and to provide for matters connected there with and ancillary there to. The primary purpose of both 1991 water apportionment accord and IRSA was to address the apprehensions and suspicions of the provinces over operating rules of the Mangla and Tarbela reservoirs and institutionalize the water apportionment process to secure consensus among provinces on building additional storages and setting their operating rules.

The 1991 water accord allocated the existing as well as future Indus River System waters among the four provinces. The accord through its clause 2 apportioned 114.35 MAF of river water among the four provinces by allocating 55.94 MAF to Punjab, 48.76 MAF to Sindh, 5.78 MAF to Khyber Pakhtunkhwa (KPK) – (in addition to 3.00 MAF for un-gauged civil canals above the rim stations) and 3.87 MAF to Balochistan. Clause 4 of the accord laid down the distribution of the balance river supplies (including flood supplies and future storages) allocating 37% each to Punjab and Sindh, 14% to Khyber Pakhtunkhwa and 12% to Balochistan. While clause 6 admitted the need for storages wherever feasible on the Indus and other rivers, clause 7 recognized the need for below Kotri environmental flows and provisionally allocated an annual outflow of 10 MAF below Kotri barrage until the optimum volume is determined through separate studies. Provinces are allowed to undertake new projects or modify system-wise and period-wise uses within their accord allocations. Clause 14.a required system-wise allocations to be worked out separately on ten-daily basis for ultimate attachment with this agreement as part and parcel of it. Clause 14.b recommended the actual average system uses for the period 1977-82 as a guideline for developing the future regulation pattern of ten-daily uses adjusted pro rata to correspond to the indicated seasonal allocations of the different canal systems and the basis for sharing shortages and surpluses.

The 1991 accord indeed is a product of difficult and longtime efforts and has served an important moderating function in the interprovincial hydro-politics in Pakistan where discard is a common phenomenon. The accord has worked reasonably well, yet true implementation of its few aspects has never been articulated in a way to build trust among the riparian provinces. A couple of inbuilt weaknesses regarding sharing of shortages and environmental flows allow provinces to interpret the accord in the ways that address their own interests. It is believed that the incongruities in interpretations of the water accord are due to political motives, rather than differences over aspects of water management. This creates an environment of unease around the perceived interpretations of the accord, particularly when river supplies are scarce.

The root cause of conflicts in the post-accord era is that water allocations in the accord are based on average flows assuming that flows are constant. The provinces have assumed that average flows based water apportionments will be available to them every year. This assumption does not hold true. The apportioned flows at canal water heads are available only one out of two years. It is that 50% years when the interprovincial water disputes become severe.

3.3. Major Issues

3.3.1. Trust Deficit

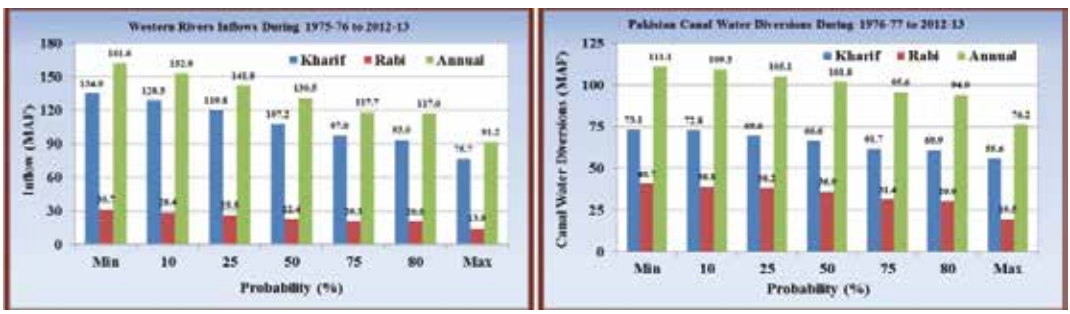
The fundamental reason for all the interprovincial issues in contemporary water resources development and management in Pakistan is the pervasive lack of trust especially at provincial level. The major reason for this distrust is that the provinces have their positional stances, apprehensions and opposition in the historic context, which has become the major hurdle in future water resources development bringing the country at the cross-roads of water insecurity. This trust deficit has been evolved over the time and usually exacerbates by sub-optimal decisions in addressing the interprovincial water issues. The 1991 water accord was envisioned to sow the seeds of national solidarity and interprovincial trust building to enable further development of water infrastructure. However, the accord appears to be partially successful to appease the interprovincial mistrust as no additional storages have been built post-Tarbela dam project. Provincial clashes on accord interpretations and IRSA's failure to enforce the accord in an equitable and universally acceptable manner allowed mistrust to brew and take center stage. Moreover, the political pressure from the provinces forces IRSA to deal with the inherent limitations of the accord in a non-transparent and non-professional manner thereby blocking the key infrastructural and institutional developments. As the IRSA is being operated by the four members nominated by the provinces and a federal member, the decision making is made on majority basis therefore in-affectivity of IRSA is due to the interests and behavior of the four provincial members and a federal member. All the decisions are made by the provincial members of IRSA and thus they have the full responsibility of these decisions.

3.3.2. Hydrological and Physical Limitations

The flow pattern of the IRS is highly uncertain and irregular. Very high annual as well as seasonal variability of river inflows coupled with declining trend and limited storage capacity is posing serious challenges to the distribution of water of the Indus River System among the provinces as per water accord. The situation becomes grimier during the low flow periods when river flows are less than water entitlements. For example, the four western rivers (Kabul, Indus Jhelum and Chenab) registered 9.31 MAF (6.66%) decrease in their inflows from Pre-Tarbela (1937-1975) to Post-Tarbela (1975-2013) period at 50% probability. Figure 9 indicates that the river inflows from these rivers cannot meet the accord allocations at canal heads for one out of two years taking into account the upstream and downstream ecological requirements and system losses before canal water diversions. The Rabi season western river inflows of 22.4 MAF together with combined storage capacity of 14.262 MAF from the three storage reservoirs cannot meet Rabi season accord allocations of 37.01 MAF.

The accord apportioned 114.35 MAF of river water against the Post-Tarbela (1976-1990) average uses of 102.86 MAF. The apparent reasons for such an over-apportionment are i) the anticipated volume of water that would have been available in the system through additional storages, which the Accord was envisioned to facilitate and ii) the anticipated increases in water use by different provinces once additional storage was built. However, the apportioned water could never be withdrawn due to lack of water infrastructure (storage reservoirs and irrigation network). This is the inbuilt weakness of the Accord to maintain trust among the riparian provinces.

The IBIS is essentially a 19th and 20th century system designed at the cropping intensity of 60 %, which has now increased to over 130%. To meet the increasing food demands, cropping intensity is very likely to increase further. Also, the cropping pattern on which the water demands and withdrawals were worked out did not include the high delta crops like rice and sugarcane. The situation is worst in the KPK and Balochistan provinces which cannot use their accord allocations due to inadequate irrigation infrastructure. Hence, the accord contains inherent shortages due to inbuilt hydrological and physical limitations, which make difficult to exactly realize the accord allocations until storage capacity and other irrigation infrastructure is significantly improved.



Data Source: IRSA *Figure 9: Probability of western river inflows and canal diversions during Post-Tarbela period*

3.3.3. Opacity in Sharing of Shortages

Water disputes are usually aggravated during periods of water scarcity and the greatest source of dispute on water distribution is the initial conditions for sharing the shortages. The accord declares pro rata sharing of shortages based on ten-daily average uses, system-wise and seasonally adjusted figures (clause 14.a) provided by the provinces. However, Punjab wants sharing of shortages as per clause 14.b (historical formula based on average actual uses during 1977-82), which was meant to provide guidelines for determining the future regulation pattern of the ten-daily uses to correspond to the indicated seasonal allocations of different canal systems. The other three provinces demand water allocations as per accord and due to this disagreement, IRSA accustomed water sharing on ad hoc basis and has currently adopted the three-tier modus operandi that works in practice, but not without disagreements and disputes. The three-tier system depends on whether the predicted amount of the seasonal water falls under a low, medium, or high availability scenario, all of which dictate different percentages for water allocation among the provinces. In the low-availability scenario, where water availability is less than the historical uses, water is distributed as per clause 14.b of the accord. In the medium-availability scenario, where water availability is greater than the historical uses but less than clause 2 of the accord, historic uses are protected as per clause 14.b with the balance distributed as per clause 2. In the high-availability scenario, where water availability is greater than clause 2, which has never happened so far, the allocations are made as per clause 2 and any excesses are distributed as per clause 4 of the accord.

Table 4 presents the volumes and percentages of water each province has received during the post-accord era and their due share according to the accord allocations, whereas Table 5 indicates the provincial shares as per low- and medium-availability scenarios of the three-tier system. It is quite evident from the figures that the percentages of provincial water shares are different. Punjab gains little over 2% in actual water use from that of the accord allocations, whereas Sindh, KPK and Balochistan provinces have faced proportionate shortage of 0.86, 0.44 and 0.81%, respectively. The three-tier system is in practice since 2003 but it seems that it is ineffective as KPK and Balochistan have received more allocations than their share defined in the three-tier formulae. But then in practice KPK and Balochistan are exempted from sharing the shortages, the question arises whether any water sharing formula works in practice or not – may be things in theory and practice are different. Further Punjab also did not receive more than the allocations under the three tier system.

	Accord Allocations (Clause 2) (114.35 MAF)				Post-Accord Actual Uses (Average 97.84 MAF)			
	Punjab	**Sindh**	**KPK**	**Balochistan**	**Punjab**	**Sindh**	**KPK**	**Balochistan**
MAF	55.94	48.76	5.78	3.87	49.94	40.88	4.51	2.51
%	*48.92*	*42.64*	*5.05*	*3.38*	*51.04*	*41.78*	*4.61*	*2.57*
(+/-%)					*(+2.12)*	*(-0.86)*	*(-0.44)*	*(-0.81)*

Data Source: IRSA

Table 4: Comparative analysis of accord allocations and post-accord uses

There are two distinct schools of thoughts. One school of thought considers that the right to own water and right to use water should be taken differently. Both the KPK and Balochistan have right to own water. As most of the Indus basin irrigation system is developed with the support of the federal government, one can argue that the state deprived these two provinces of using their full right of water. Therefore they feel that KPK and Balochistan may be allowed to auction their unused allocations of river water to any other province. The other school of thought refers to clause 14.e of the Accord, which clearly declares that any surpluses may be used by another province, but this would not establish any rights to such uses. Nevertheless, there are apprehensions that continued non-use by KPK and Balochistan provinces may eventually lead to concerns and questions about their rights to that water[64]. Therefore, there is an urgent need to discuss this issue within IRSA to formulate a mechanism for allowing KPK and Balochistan to auction their unused waters by developing and endorsing an addendum to the Accord.

	Low-Availability Scenario (Historical Use) (less than 102.74 MAF)				Medium-Availability Scenario (102.74 – 114.35 MAF)			
	Punjab	**Sindh**	**KPK**	**Balochistan**	**Punjab**	**Sindh**	**KPK**	**Balochistan**
MAF	54.51	43.54	3.06	1.63	60.19	48.49	3.65	2.02
%	*53.06*	*42.38*	*2.98*	*1.59*	*52.64*	*42.41*	*3.19*	*1.77*

Data Source: IRSA

Table 5: Low- and medium-availability scenarios of the three-tier formulae

3.3.4. Institutional Constraints

Pakistan as a nation is one of the most water inefficient countries in the world. The low irrigation efficiency is a strong indication that the current water scarcity is largely institutional rather than absolute. The nation's increasing water insecurity is due mainly to poor water governance and lack of integrity and transparency. Consequently, the question of whether water shortages and inequities in its distribution will lead to violence or threats to socio-economic security becomes contingent on how water management institutions perform.

[64] *WSTF-FODP (2012), "A Productive and Water-Secure Pakistan: Infrastructure – Institutions – Strategy", the Report of the Water Sector Task Force (WSTF), The Friends of Democratic Pakistan.*

Issues in accord implementation

The primary purpose of establishing IRSA was to address the concerns of the provinces to institutionalize the water apportionment process in an equitable, transparent and universally acceptable manner to secure the consensus among provinces on building additional storages and setting their operating rules. However, due to a variety of reasons, IRSA is partially successful in the true implementation of the accord as interprovincial water contention is still recurring. The institutional issues and technical constraints are the two overarching limitations of IRSA to strictly implement the accord.

Accurate water accounting and regular water audit to systematically identify, recognize, quantify, and report information about water use in compliance with specified allocations is the key to equitable and universally accepted water distribution[65]. Such an initiative will support public confidence in the process of water allocation and plays a central role in mitigating mistrust. Ideally, IRSA was instituted as an autonomous and impartial body under the federal jurisdiction to regulate and monitor the development and distribution of Indus waters amongst the provinces in accordance with the accord. However, it is seriously challenged by the lack of power, authority and resources to fully execute and ensure its mandate. Discharge measurements are recorded by the provinces, but the head-discharge relationship is generally out-dated leading to inaccurate measurements and inequity in water distribution. In order to maintain an accurate water account, the high-tech telemetry system for automatic flow measurements at the main barrages and control structures containing about 2500 sensors was installed during 2001-2004. The purpose of the telemetric system was to equip IRSA with a means of verifying flows through the barrages using methods that are independent of the operators of the barrages. This system was a historic step in the transition from an outdated manual system to a state-of-the-art technology in the monitoring of water distribution. However, an appraisal conducted by the World Bank in 2007-2008 deemed that the telemetric system was not able to adequately provide flow data mainly due to tampered and non-calibrated devices. While the calibration of the devices could be easily resolved by training of operators but the broken or tampered telemetric gauges is a serious and more complex issue. The failure to effectively operate the telemetry system has further fueled the mistrust and powered the belief that the lack of transparency in the system is being manipulated for nefarious purposes.

IRSA allocates water to the provinces based on their demand and the predicted water available in the system in a given season. The current method of prediction adopted by IRSA is not only inaccurate but also contains conflict of interest as IRSA, WAPDA, and the provinces provide input towards the decision. The method also does not use state-of-the-art weather forecasting technology taking in to account variability. This blemished process naturally undermines trust in IRSA as a neutral predictor, arbiter, and deliverer of water to the provinces. Moreover, growing conveyance losses from the Indus River System are also a major concern. The exact source of these losses is not yet identified, but during periods of shortages provinces accuse each other of water theft or illegal abstraction. The use of substandard methods to estimate river losses may be another reason for inaccuracy. Furthermore, the current composition of IRSA consists of one member each from all the four provinces and a fifth member nominated by the federal government, all on three-year tenure. One among the five members serves as chairman on a rotational basis for a period of one year. Frequent and severe provincial clashes and conflicts of interests over accord interpretation and each other's data coupled with deficiencies in water governance mechanisms and practices within IRSA make it difficult to work as an independent and impartial body thereby fuelling the interprovincial mistrust. In fact IRSA has demonstrated itself as a weak enforcing institute as the accord has never been strictly implemented. Despite clear decisions of CCI and Federal Law Division regarding interpretation of clause 14.b, IRSA could not implement the accord rather imposed arbitrary decision of ad hoc arrangement for water distribution.

[65] *Imam, M. & A. Lohani (2012), Beyond Water Conflict in the Indus Basin: Building Interprovincial Trust, Second Year Policy Analysis, March 2012, submitted in fulfillment of the requirement for the degree of Master of Public Administration in International Development, John F. Kennedy School of Government, Harvard University.*

This is the one side issue looking at the views of the lower riparian. In fact all the provinces are equally responsible for the enforcement of accord by IRSA as every province get the turn after every 12th year to be Chairman of IRSA. This is a clear indication that all the provinces should share the blame of less effective operations by IRSA.

Issues in conflict resolution

The 1991 water accord was signed without elaborating an adequate conflict resolution mechanism. For settlement of any interprovincial disputes, the accord completely relies on the CCI, which is a constitutional body to resolve interprovincial issues including development and distribution of shared water resources. However, due to absolute political nature and structure of the CCI, small provinces having little representation are often reluctant to refer the disputed matters to the CCI. Moreover, history reveals that constitution in Pakistan has often been suspended due to frequent military dictatorships. Under such circumstances, IRSA is absolutely empowered to resolve the issues regarding implementation of the accord through democratic way of casting the votes by the members and if needed by the chairman. All the decision makers (members) in IRSA are actually nominees and representatives of the provinces and ethically bound to protect the rights of their native province. Their ethnic background also influences their position on the disputed matters. Hence, the historical animosities, the current issues and rivalries, and bargaining for the future significantly influence the decisions of IRSA. If the stance of any province does not prevail, they object the decision but in reality provinces are fully responsible for all the decisions made in IRSA.

Inadequate legal cover

At the time of signing the accord in 1991, the recently evolved customary international law and protocols on shared waters were simply not available. Therefore, the emerging concepts of equitable and reasonable utilization, no significant harm, prior appropriation, benefit sharing, cooperation and information exchange, protection of the aquatic environments, pollution control, climate change, water trading, and trans-boundary aquifers are inadequately considered. The matter is compounded by vaguely defined water laws and absence of an adequate legal framework covering water rights, entitlements, trading, conservation, or polluter penalties in Pakistan. This is the view of the school of thought that ignores that water issues in the Indus basin have to be resolved within the provisions of the Accord of 1991 and between India and Pakistan as per the Indus Water Treaty 1960. International Water Law cannot be considered because Pakistan has adequate legislation for handling inter-provincial issues. If additional aspects have to be included in the accord these have to be agreed through consensus as an addendum to the Accord.

3.3.5. Future Water Infrastructure and Operation of Existing Reservoirs and Link Canals

Agriculture is recognized as an engine of sustainable economic growth in Pakistan, but its growth is severely constrained by insufficient irrigation infrastructure. The arid to semi-arid climate of Pakistan coupled with highly variable river inflows is absolutely dependent on large storage reservoirs to regulate and ensure year-round freshwater supplies for irrigation. Mangla and Tarbela dam projects were envisioned to be only the beginning of a vast array of storages on the Indus River System. However, new water infrastructure projects are overwhelmingly contested by provinces and further water resources development seems to be a distant dream. The devastating controversy is mainly driven by the contentious views on the availability of river inflows for the future developmental projects and diversion of stored water. WAPDA invested lots of efforts and resources to undertake the Kalabagh dam project, which could not proceed ahead of the planning stage due to opposition of three provinces excluding Punjab.

WAPDA invested lots of efforts and resources to undertake the Kalabagh dam project, which could not proceed ahead of the planning stage due to opposition of three provinces excluding Punjab. Thus, it is clear that unless the provincial grievances in relation to water entitlements, distribution, and governance are addressed in a comprehensive and equitable manner, dams or even other large scale water infrastructure projects may not go ahead. Importantly, carryover dams above Tarbela dam are seemingly less contentious but one important physical limitation of the Indus basin must be kept in mind that the variable surplus flows are largely generated from monsoon precipitation outside the Gilgit-Baltistan. Hence, carryover dams will be more effective in the monsoon range of Indus river system and seemingly less controversial alternatives like Diamer-Basha, Akhori, Kurram Tangi, and Munda dams for the construction of carry-over dams to address water shortages and generate low-cost hydropower may be attractive options. It is imperative to pick the low hanging fruits first and not let the best to become the enemy of the good and proceed with the projects where conditions are propitious and where controversies and disputes are less.

Furthermore, the filling criteria of the two reservoirs Mangla/Tarbela and operation rules of Indus link canals are constantly contested due to absence of standard and agreed operating rules. Surprisingly, WAPDA or IRSA have not prescribed or laid down such standards since their commissioning. Instead, these dams and link canals are operated on an ad hoc basis. The lower riparian provinces demand no storage in the reservoirs until provincial indents are fully met. They also object to the extended operation of the Indus river link canals. In fact, the real issue is that provincial water allocations should be met based on the needs of the provinces and the operational rules for reservoirs are developed in a professional, transparent and just manner. The provincial stances may not be against the transparent and just operational rules of the reservoirs and link canals. The provinces reserve the right to ensuring their water entitlements, instead of spending time in indulging in issues of operation of the link canals and dams, if they are operated in a transparent manner.

3.3.6. Environmental Flows and Disposal of Pollutants

Environmental flows describe the quantity, quality and timing of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems[66]. The below Kotri outflows are influenced by reduction and extreme natural variability of the river inflows and upstream water developments. The Post-Tarbela below Kotri outflows at 50% probability remained 26.9 MAF against the average outflows of 30.44 with maximum of 91.8 MAF in 1994-95 and minimum of 0.3 MAF in 2004-05 (Figure 10). These downstream flows are however highly erratic and unregulated as most of the flows are released during water surplus monsoon period of three months from July to September.

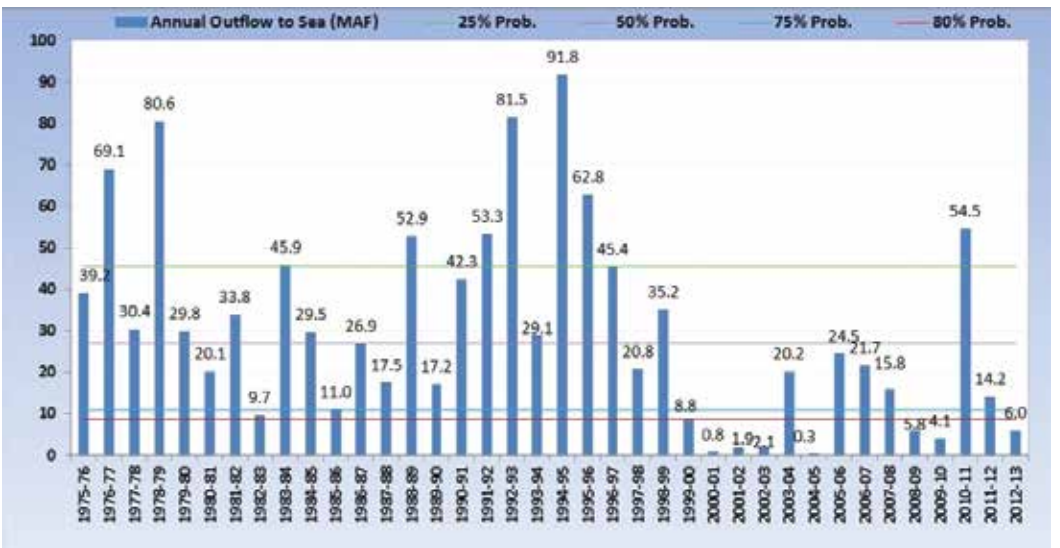
While the downstream Sindh province is a strong proponent of environmental flows, the other three provinces largely consider it as wastage. The 1991 water accord did recognize the need for environmental flows and provisionally allocated 10 MAF for downstream Kotri to maintain the mangroves and fisheries of the delta and to limit saline intrusion until minimum flows are determined through separate studies. These studies have finally been conducted by the local consultants and reviewed by a fully independent International Panel of Experts (IPOE) hired by WAPDA in 2005. These studies recommended a perennial flow of 5,000 cfs throughout the year (3.62 MAF/year) below Kotri Barrage to check seawater intrusion, accommodate the needs for fisheries, environmental sustainability, and to maintain the river channel. The studies further recognized the need for sediment supply to maintain a stable coastline, sustain mangrove vegetation and preserve river morphology and recommended additional volume of 25 MAF in any 5 years period (an annual equivalent volume of 5 MAF) to be released in a concentrated way as flood flow during Kharif season[67]. Notably, these e-flows are not going to have lasting impacts until

[66] *Dyson M, Bergkamp G, Scanlon J (eds) (2003) Flow. The Essential of Environmental Flows. IUCN, Gland, Switzerland and Cambridge, UK.*

[67] *Gonzalez, F.J., T. Basson, B. Schultz (2005), Final Report of the IPOE for Review of Studies on Water Escapages below Kotri Barrage, Delft, the Netherlands.*

the other agents of degradation are controlled. There are increasing evidences that disposal of highly polluted urban and industrial effluents, indiscriminate cutting of mangrove forests and uncontrolled fish catching are equally responsible for growing degradation of Indus delta and coastal zone. Moreover, there is a lack of clarity regarding how these e-flows are to be shared by the provinces. Sindh province demands that these should be taken from overall total flows before allocation to provinces are made whereas other provinces particularly Punjab advocate it from Sindh's share. However, IRSA has been including environmental flows from "off the top" while calculating the allocations for the provinces in each ten-day period. Although the minimum environmental flows have finally been determined, no official response from any of the provinces over the recommended volume has appeared so far. Also, it is not clear who will ensure these flows as it appears that establishing such volume is not meant to be provided as environmental flows are the first to be compromised when there is insufficient supply in the system, especially by Sindh. How IRSA will ensure that e-flows are fully utilized for the Indus delta below Kotri and the allocated water is fully utilized.

The Figure 10 clearly illustrates that out of 38 years data of post-Tarbela, there are only 7 years when the flows below Kotri were less than 10 MAF. There are only four years when the flows are less than 3.62 MAF representing the minimum e-flows. Thus there are less than 11% years, when the flows are less than 3.62 MAF. The other positive side is that two-in-every-three years the flows below Kotri are more than 20 MAF.



Data Source: IRSA *Figure 10. Extent and probability of below Kotri outflows during Post-Tarbela period*

The proposed Master Drainage Plan, which aims to develop an environmentally safe National Surface Drainage System for evacuating the saline drainage surplus and polluted industrial and municipal effluents from the entire Indus Basin irrigated areas by a system of interconnected federally owned and operated outfall drains to the Arabian sea[68], is another potential issue for interprovincial contention as the downstream Sindh province bitterly opposes this initiative considering it disastrous for the productive agricultural lands of the province. Since the existing water accord has no provision for such an evacuation of polluted effluents, WAPDA looks inclined to make way for a possible Interprovincial Drainage Accord. As far as the pollution of river flows is concerned no province is an exception. Industries are not implementing the EPA rules and regulations and there are no polluter penalties enforced by EPAs.

[68]*Scheumann, W. and M.Y. Memon (2003), "Reforming Governance Systems for Drainage in Pakistan: Toward an Interdisciplinary and Integrated Approach to Agricultural Drainage," Agriculture & Rural Development Working Paper 11, The World Bank.*

Even the irrigation department cannot enforce any such provisions laid down in the Canal and Drainage Acts. In fact there is a need that all the provinces take the pollution of rivers water seriously and develop and enforce mechanisms effectively. Political will is essential in implementing such a decision. One of the schools of thought is of the opinion that degradation of mangroves is largely a function of overcutting and clearing of land for urban and agricultural uses, pollutants being added by the industry in Karachi and other human activities. If these actions are continued, even the enhanced flows below Kotri will not help to manage and sustain the downstream ecosystems.

3.4. Options for Promoting Inter-Provincial Water Cooperation

3.4.1. Trust Building

There is an urgent need to bridge the gulf among the provinces to meet the challenges of water, energy and food securities. Encouragingly, Punjab releases its share to Sindh province during the early Kharif season when water storage in the Tarbela reservoir and river flows in the Indus and Kabul Rivers are insufficient to meet the early Kharif requirements of Sindh and Balochistan provinces and gets it back when it needs during the remaining Kharif season. These kinds of cooperative actions need to be continued and broadened leading towards promoting interprovincial trust building. Once an adequate level of trust is build, efforts to enhance its level are essential. This will automatically resolve majority of the issues. It is believed that trust continues to build over time and a multitude of actions and measures is required to build and enhance the stakeholder confidence. The following measures are advocated with the intent of building trust and promoting both intra- and interprovincial water cooperation to offset the negative hydro-politics in Pakistan.

Establishment of independent water forums: The mandate and capacity of the public sector water management organizations in Pakistan largely lack in the important aspects of cooperative water management. There is need to identify the key network partners to engage them in cooperative water management activities through multi-stakeholder dialogue taking into account a variety of issues and structural differences at multiple levels. Once the process of multi-stakeholder dialogue is started, special attention would be required to the interactions between the social researchers, water reformers and policy makers to discuss and explore new insights and opportunities for mainstreaming cooperative water management. The beginning can be made by creating independent Provincial Water Forums, where forward-looking experts and visionaries join hands together to initiate actions for trust building at two levels as a way out for water resources development. Firstly, within the province where issues of provincial water management can be analyzed and options are given to the provincial decision makers. Secondly, they initiate the process of promoting trust building measures between provinces for managing shared waters to benefit the society in the Indus basin through minimizing the differences of opinions. Similarly, a Pakistan Water Forum at the federal level is needed which provide support and assist the Provincial Water Forums and based on the deliberations of the provincial Water Forums the commonalities can be developed for the trust building measures.

Cooperative management: Appreciating the source and severity of the problems, the provinces need to cooperate on joint research, management and fact-finding for managing water scarcity, developing water infrastructure, improving water productivity and averting environmental issues. This would help build trust and confidence and come up with solutions on River Basin Management, rather than harping on the provisions in the accord. Once the fundamental problem of water stress is taken care of through joint efforts, the problems associated with the provisions in the accord will become immaterial. Cooperative management considers different perspectives and interests to reveal new management options and win-win solutions. It will provide forums for joint negotiations, thus ensuring that all existing and potentially conflicting interests are taken into account.

Rational decision-making: Consensus is difficult to achieve because provincial representatives view negotiations and decisions as a zero-sum game, one province wins and other loses. Unilateral decisions will only add to the already growing mistrust. The beginning can be made by generating useful information, which can help the decision makers at all levels to enter in rational decision making rather than consensus. Consensus is not even possible within the province. Therefore, one of the roles of the Provincial Water Forums will be to synthesize the available information and knowledge on water and provide to the provincial decision makers so that efficient, equitable and reliable water management processes can be initiated first at the provincial level. The most interesting example would be building trust between Irrigation and Drainage Authorities and Irrigation Departments and then with Agriculture Departments and civil society organizations within the province.

True implementation of the accord: Encouragingly, despite all the misgivings and deficiencies in its implementation, the accord is widely believed to be a sacrosanct and no one is in favor of its abrogation. Obviously, strict implementation of the accord ensuring all provinces get their fair share of water will greatly appease the mounting interprovincial distrust. However, when riparian states share trans-boundary waters, the usual presumption is that there is a fixed amount of water to divide among them, often in the face of ever-increasing demand and uncertain variability. Such assumptions lead to a zero-sum mindset, with absolute winners and losers. On the other hand, when parties understand that water is a flexible resource, they use processes and mechanisms to focus on building and enhancing trust. The crux of the matter is that everyone has to show flexibility and play an active role to find a way to have win-win situation for everyone. Need for developing information and knowledge for effective implementation of the accord is a pre-requisite. IRSA desperately needs capacity building and institutional restructuring to make it a high performance institution.

Maximizing benefit sharing: While success of the water accord is well-recognized, the provincial rigidities and positional stances have become an impediment to modernizing future cooperation on managing water resources among all the stakeholders in Pakistan. A much needed response to meet the present needs is a new framework of collaboration that is consultative, adaptive, flexible, and is based on sharing benefits from the rivers instead of dividing their waters. Basin communities are usually not interested in the water itself, but rather in the economic opportunities and ecosystem services that can be obtained from access to that water. For example, determination of an equitable hydropower revenue-sharing mechanism which goes beyond benefiting only the province where the power turbines are situated will compensate the other entities in the catchment boundaries of the basin. Similarly, integrated watershed management, ecotourism, aquaculture, biodiversity habitat, and other livelihood opportunities are the additional non-consumptive incentives that a well-managed basin can offer for increased benefit sharing. The best option is to initiate awareness and develop legal and institutional frameworks in support of civil society. This would require systematic research and planning for developing options where benefits are shared by everyone instead of merely distributing water and resisting on few selected stances. This process is new in Pakistan and once initiated it will certainly support the trust building measures and the rational decision making. Currently, IRSA does not have any capacity to initiate this process. It appears that we have to depend more on the independent water forums along with building capacity of the IRSA.

Compensating the damages: Water resources development is often accompanied with some unavoidable infrastructural, environmental and livelihood consequences at both upstream and downstream ends. The experiences from Mangla, Tarbela and Ghazi-Brohta projects reveal that some of the affectees were not compensated properly thereby shaking peoples' confidence and adversely affecting the possibilities for future development. The environmental impact assessments normally focus the surrounding areas of the project but neglect the up- and down-stream areas. Moreover, such assessments are not comprehensively conducted and their effective implementation has also been lacking. Currently, the compensation process has been initiated for the Diamir-Basha dam project.

This is the time that we learn from the past experiences of compensation and resettlement and perform better and effectively. It is really a big contribution of the affectees of Chilas and other surrounding areas who will leave their livelihoods and living places for the sake of the national interest. There is no compensation for the loss of livelihoods because it takes centuries for the people to settle in their hometowns.

Transparency in data collection and information exchange: Water resources related data is mainly collected by WAPDA and to some extent by the provinces. Apprehensions over reliability and sharing of that data have been voiced from different quarters. Ideally, IRSA shall take over the control of measurement, monitoring, accounting and auditing of water resources data in the Indus river system. The Hydrology and Water Measurement Division of WAPDA need to be transferred to IRSA so that the body which is responsible for distribution of water among the provinces is directly involved in collection of data. But at the same time the integrity and transparency of data collection whether it is part of WAPDA or IRSA have to be maintained at all costs. Moreover, there is an emerging need to take appropriate steps to make sure that the data and information is easily available to each stakeholder. Online data availability will be an admirable step for transparency and promoting trust among stakeholders. The experience shows that public-sector institutions are slow in updating the data, therefore some efficient mechanisms be developed for sharing the on-line data.

Recognition of environmental integrity: Scientists, policy makers, and civil society in Pakistan need to better apprehend, assess, and act on the links between water resources development and management, environmental conservation, sustainable socio-economic development, peace and social welfare in order to meet the challenges of water, energy and food securities. The need for protection of aquatic environments is now well recognized globally. Therefore, it is in the best interest of all the stakeholders to understand and recognize upstream downstream linkages and each other's needs and problems and take steps in the best interest of the basin and country as a whole. Strict sanctions for pollutant disposals needs to be followed. As a first step, development of information for creating knowledge-based awareness to sustain the health of downstream ecosystems can be initiated. Similar priority shall be assigned to upstream areas for integrated watershed management to fully accomplish the sustainability of Indus river ecosystem.

3.4.2. Strengthening and Empowering of IRSA

In March 1991, Chief Ministerial meeting and subsequent IRSA act 1992 instituted the IRSA and accorded it the mandate to allocate water among the provinces, yet they did not offer it the absolute power, authority and resources to fully execute and ensure this mandate. It cannot counter check the allocated canal water withdrawals by the provinces and is not authorized to take any punitive actions towards provinces that do not comply with the decisions of the Authority. Thus, even when provinces self-report wrong withdrawal amounts, they face no consequences in terms of fines, reduction in future water allocations, etc. This complete lack of punitive action makes unauthorized over-withdrawal of water an attractive option, thereby de-legitimizing the very existence of IRSA. As per accord, the reservoirs are operated with priority for irrigation uses of the provinces and IRSA is not authorized to modify the operation plan during the peculiar conditions of natural disasters like floods and droughts or hydropower generation during acute energy shortages. Moreover, the current composition of IRSA seems ineffective in the resolution of growing interprovincial conflicts.

IRSA is also lacking in all the fundamental requirements for equitable and universally accepted distribution of shared waters as per water accord. Similar accords, the Colorado Compact in the US and the Murray Darling Agreement in Australia, have proved that in the presence of a clear agreement the accord is governed by three fundamental implementation requirements[69].

[69] *Briscoe, J., and U. Qamar, eds. (2006), Pakistan's Water Economy: Running Dry, Washington, DC: World Bank.*

First, a rigorous calibrated system for measuring water inflows, storages, and outflows is put in place. Second, the measurement system is audited by a party which is scrupulously independent, impartial and above all acceptable to all the stakeholders. Third, reporting is totally transparent and available in real time for all parties to scrutinize. Unfortunately, limited capacity of IRSA in maintaining an accurate water account (discharge measurement and monitoring), analyzing water demands, forecasting water availability, and estimating system losses is adversely affecting the performance and reputation of IRSA as an independent and impartial entity. Its heavy reliance on provinces and WAPDA regarding these technical matters allows interprovincial conflicts of interests and provides undue space to the stakeholders to play with the data they provide and influence the autonomy and neutrality of the IRSA. Consequently, the provincial interests are paramount as each stakeholder tries to push decision in its favor instead of supporting decisions that would be the best for the country.

Therefore, it is strongly felt that the institutional as well as technical capacity of IRSA needs to be strengthened. It urgently needs more autonomy, power, resources and technology to ensure equitable water distribution and fully implement the water accord. It is suggested that IRSA should take control of all the discharge measurement activities at the canal heads and let provinces to check and verify the measurements. For this purpose, IRSA needs to be equipped with the state-of-the-art water measurement, water availability forecasting, and river system losses estimation technologies. Water demand and indents provided by all the provinces need to be counterchecked and verified by IRSA. It also should take serious note of the increasing losses along the course of rivers and come up with modern methods to estimate system losses. The Hydrology and Water Management Division and Flood Forecasting Division of WAPDA need to be transferred to IRSA so that the body which is responsible for distribution of water among the provinces is directly involved in flow monitoring and prediction of seasonal water availability. IRSA shall also develop close linkages with Pakistan Commission for Indus Waters to ensure synergy and consistency with the major policy positions. This will significantly improve the capacity of IRSA resulting in smooth implementation of the accord.

3.4.3. Harmonizing the Accord

Agreements on the shared water resources are usually difficult everywhere because of the legitimate but contending views of different and more often competitive stakeholders. Agreements over shared water resources not only motivate the riparian states to work together but can also be a source of promoting peace and cooperation among stakeholders. However, the validity and effectiveness of such agreements depends on the mutual interest of all the stakeholders, strength of their relationship, level of interdependency and cooperation. Good agreements are stable, predictable, and have the flexibility to make voluntary and contemporary adjustments over time[70].

The 1991 accord has served an important moderating function in the interprovincial hydro-politics in Pakistan and is widely believed to be sacrosanct. The growing contest and resultant conflicts among the provinces further recognize and emphasize the need for the 1991 accord to be more stable, predictable and flexible enough to adjust the future changes. Many of the important water laws, international protocols and customary rules were not available at the time of signing the accord. The emerging concerns regarding climate change, water trading and trans-boundary aquifers need to be adhered and incorporated in the accord.

Therefore, the current settings of the accord need to be adhered, improved and strengthened by harmonizing the accord with the current issues related to water cooperation, climatic variability, climate change and consensus on future water developments.

[70] *Ibid 1.*

Hence there is an emerging need for developing consensus-based addendums and supplements as a way out to plan and implement the water resources development projects, optimally manage the shared water resources while securing and ensuring water rights and entitlements of each province within the existing ambit. However, such a harmonization requires strong political will and support of all the stakeholders. It is contingent upon significant improvements in interprovincial cooperation and trust building, without which further development and distribution of water resources is very difficult if not impossible.

3.4.4. Effective Conflict Resolution Mechanism

The existing conflict resolution mechanism has proved to be highly ineffective due to politicized nature of the governing bodies. As such the renegotiation and settlement of emerging disputes is more difficult and time consuming. Therefore, there is an urgent need for developing and evolving an effective and universally recognized conflict resolution mechanism at the federal level on practical and sustainable basis. For this purpose, the IRSA may be restructured and strengthened to facilitate the provinces on routine matters in a more effective and transparent manner. Representatives from Gilgit-Baltistan and AJK shall be inducted as full time members. The decision making body may be assisted by a technical committee comprising highly reputed professionals in the fields of water law, conflict management, and inter-provincial water management. Each issue must be technically evaluated and unanimously approved by this committee before going for an ultimate decision by the voting members. Similarly, the CCI may also be restructured with a blend of professionals and politicians to effectively play its active role in developing consensus among the provinces.

3.4.5. Legal Framework

A sound legal framework is essential for stable and reliable water cooperation. Pakistan does not have a comprehensive legal cover that defines water rights, allocations, uses, values, pricing, subsidies, conservation, or polluter penalties. Instead, the concepts of rights and entitlements are dominated by a disproportionate emphasis on and preoccupation with water distribution among provinces, currently modulated by the 1991 water accord. The water accord emphasizes avoidance of wastages but is completely silent on the legal aspects of water rights. It is recognized that legislation at appropriate levels is the key to successful implementation of water rights. Over two dozens of provincial acts and ordinances passed from time to time to covering the various aspects of water need to be integrated, updated and extended in a comprehensive manner to clearly define water rights supported by adequate legal cover based on the ground realities. This would make the water-related laws concise and more-readily understandable and less susceptible to misinterpretations thereby ensuring the equitable distribution of water resources among all the stakeholders. There is an emerging need for a comprehensive legal framework regarding well-defined water rights to meet the challenges of contemporary equitable and productive water resources management in a mutually beneficial and cooperative manner

4. Water for Nature in the Downstream Areas of Indus Basin of Pakistan

4.1. Preamble

Availability of clean, fresh water is one of the most pressing issues facing humanity today. Freshwater is a basic requirement for social and economic development of human societies. Furthermore, access to water is a human right as it is the most basic element of life. Environmental Flows (e-flows) describes the quantity, quality and timing of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems[71]. E-flows refer to water provided within a river or wetland to maintain ecosystems and the benefits they provide for people (IUCN). Other definitions and terms regarding environmental flows do exist. These include minimum, in stream and ecological flow.

From the turn of the 20th century through the 1960s, water management in developed nations focused largely on maximizing flood protection, water supplies, and hydropower generation. During the 1970s, the ecological and economic effects of these projects prompted scientists to seek ways to modify dam operations to maintain certain fish species. The initial focus was on determining the minimum flow necessary to preserve an individual species, such as trout, in a river. By the 1990s, scientists came to realize that the biological and social systems supported by rivers are too complicated to be summarized by a single minimum flow requirement. Since the 1990s, restoring and maintaining more comprehensive environmental flows has gained increasing support. A useful and simple way of thinking about e-flows is that of 'ecological water demand'. Environmental flows are effectively a balance between water resources development and the need to protect freshwater-dependent ecosystems.

The analysis of river flows and canal diversions indicated that in an average year 74% of the Indus River flows are abstracted to Indus basin irrigation system and it reaches to 88% in the driest year and reduces to 50% in the wettest year. These are the hydrological and physical limitations which one has to keep in mind while evaluating the water for nature in the downstream areas. As a result of upstream water abstractions, mainly for irrigation, by the time the Indus reaches the Kotri barrage, there is inadequate flow to maintain the natural ecosystems of the Indus delta in the dry years and too much water in the wet years. The average annual flow reaching the delta before the 1994 was less than 35 MAF, and average quantities of silt discharged to the delta are estimated as 100 million tons/year. At this level the amount of freshwater reaching the delta was argued by the lower riparian to be insufficient to maintain healthy natural ecosystems, and had resulted in saltwater intrusion and salinization. The lower riparian views this situation in the context of pre-Kotri and pre-Tarbela periods, which is now a history, as Tarbela dam was constructed 38 years ago. Now the flows below Kotri in the post-Tarbela context need to be assessed. The serious concern is in those years when the flows below Kotri are less than 10 MAF as per Pakistan Water Apportionment Accord.

Mighty Indus discharges into the Indus delta (typical fan-shaped delta) large quantities of silt washed down from upland and mountainous areas. The delta covers an area of about 41,440 km^2 (16,000 miles^2), and is approximately 210 km across where it meets the sea. The active part of the delta is 6,000 km^2 in area. It is characterized by 17 major creeks and innumerable minor creeks, mud flats and fringing mangroves (Figure 11).

[71] *Dyson M, Bergkamp G, Scanlon J (eds) (2003), Flows: The Essential of Environmental Flows. IUCN, Gland, Swizerland and Cambridge, UK. & Brisbane Declaration, (2007). Delegates to the 10th International River symposium and International Environmental Flows Conference, held in Brisbane, Australia, on 3-6 September 2007*

The climate is arid as average annual rainfall varies between 250 and 500 mm. The delta provides habitat for the largest arid mangrove forests in the world, as well as many birds, fish and the Indus Dolphin. The fan-shaped delta is the sixth largest in the world and supports a population of over 130,000 people, whose livelihoods are directly or indirectly dependent on the Indus River. The mangrove ecosystem (Figure 12) provides habitat for fish and shrimp and, together with the tidal mudflats, supports a rich variety of flora and fauna which are particularly important as resting and feeding grounds for migratory birds. From a biodiversity perspective too, the delta is important, as it is home to ten species of mammals, 143 species of birds, 22 species of reptiles, over 200 species of fish, many invertebrate species, including 15 species of shrimp. Many former settlements in the delta have been abandoned as a result of lack of water in the Indus and the encroaching Arabian Sea.

Figures 11 and 12: Extent of Indus delta and Mangrove forests along the delta

The Indus delta was a sustainable ecosystem before the construction of Kotri barrage. The flows to Indus delta were reduced after the construction of Kotri barrage and then further reduction was observed after the construction of Guddu barrage and other barrages in the upper Indus basin. Further reduction in flows occurs due to Tarbela and Mangla dams. This affects the health of the delta ecosystem along with enhanced population and indiscriminate cutting of mangroves and clearing of land for infrastructure and other purposes. In the post Tarbela period the flows to Indus delta are stabilized within the annual and seasonal variability which is an in-built character of the Indus river system. The information available in relation to the health of ecosystem is confusing as different studies have taken different baseline for the analysis. The ground reality is that analysis has to be made for the period of post-Tarbela so that a meaningful analysis is done and appropriate actions can be taken. It is not possible to close down the Kotri, Guddu and other barrages constructed in Punjab and KPK, or the dams. Further, it is difficult to separate the impacts of reduced flows from the degradation caused by the indiscriminate cutting of mangroves and clearing of land for infrastructure and other purposes. The flora and fauna are badly affected due to the increasing inflow of domestic and industrial effluents from the industry in Karachi and Hyderabad. The conflicting analysis of the current condition of the delta resulted in conflicts among the upper and lower riparian. This conflict prevents consensus among the provinces on further development of water in the Indus basin.

The environmental degradation has manifested itself by waterlogging and salinity, increasing pollution, disappearing mangroves and wetland desiccation[72].

[72]*World Bank (2005), Pakistan's water economy: Running dry. The World Bank in Pakistan. http://www.worldbank.org*

There has for some time been a high level of controversy surrounding the allocation of the waters of the Indus River, in particular between competing uses in different provinces. Recurrent disputes over water usage led the government to set in place the Indus Water Accord in 1991, which apportioned the use of the river's water amongst the four provinces. It also recognized – for the first time – the need to allow freshwater discharge into the delta to safeguard the ecosystem, specifying provisional flow of 10 MAF until actual environmental flows are assessed through comprehensive studies.

Because of the development drive to meet human needs, decision-makers or experts have little understanding of the value of aquatic ecosystems and the need for environmental flows. Those who understand overemphasize but fail to assign value to the ecosystems. Until the decision makers understand the realistic valuation of the ecosystem, they will not assign priority to it.

While recognizing the sensitivity of the matter, the present study emphasizes the need for evaluating the necessary environmental flows to sustain delta ecosystem. Therefore, the drivers of the current water discourse in Pakistan are explored to analyze water availability, water entitlements, water utilization and below Kotri environmental flow. The report reviews the contemporary international water laws regarding environmental flows and evaluates the flows below Kotri.

4.2. Surface Water Resources and Availability

River inflows

The historical river inflows of the four western rivers (Kabul, Indus, Jhelum and Chenab) have very high temporal (annual as well as seasonal) variability. The highest annual flows are almost double the lowest flows. The annual influx from these four rivers ranges from 93.1 MAF to 187.7 MAF during pre-Terbela and 91.2 MAF to 161.6 MAF during post-Terbela periods (excluding 3 MAF of canal diversions upstream of rim stations).

River flows are limited in the Rabi season because of limited glacier- and snow-melt and low rainfall. Availability of flows from western rivers in an average year (50% probability) of 139.8 MAF in Pre-Terbela period compared to 130.5 MAF Post-Terbela periods (Table 6 & 7) are around 7% less than the pre-storage period. Summer season (Kharif) flows from western rivers were reduced from 117.7 MAF to 107.2 MAF (9%) from pre to post-Terbela periods at 50% probability. Contrary to Kharif, winter season (Rabi) river flows are increased from 21.3 MAF to 22.4 MAF (5%) from pre to post-Terbela periods in an average year (50% probability). The reduction is basically due to the extreme variability in river flows, higher uses in the upstream including diversions in areas above rim stations and storages constructed by India and other permitted uses as per the Indus Water Treaty.

The eastern rivers contribution has been reduced from 19.6 MAF to 5.9 MAF (70%) in an average year from pre to post-Terbela periods of which more than 80% are in the kharif season. Contribution of eastern rivers has been reduced from pre to post-Terbela periods of 2.6 to 1.0 MAF (89%) in dry period of the year. This reduction is largely due to the Indus Water Treaty. The time is fast approaching when the contribution from eastern rivers, at least in the Rabi season will have to be excluded to accurately assess water resources in the Indus basin. The total mean annual flows both from western and eastern rivers at 50% probability have declined by 14% from post-Terbela (157.2 MAF) to pre-Terbela (134.7 MAF) periods (Tables 6 and 7). This reduction is largely due to the reduced contribution of eastern rivers around 14 MAF and the rest due to enhanced uses in upstream of western rivers and climatic variability. It's too early to relate it with climate change.

Probability of Exceedence (%)	Western Rivers			Eastern Rivers			Total
	Kharif	*Rabi*	Annual	*Kharif*	*Rabi*	Annual	
Minimum	156.1	33.0	187.7	31.8	14.7	36.0	207.7
10	135.1	26.4	161.0	26.1	7.0	30.8	187.2
25	125.4	23.9	146.6	21.3	3.8	25.7	173.8
50	117.7	21.3	139.8	16.5	2.6	19.6	157.2
75	108.2	19.1	130.9	12.8	1.6	14.4	149.4
80	105.7	19.0	125.4	11.5	1.5	14.2	147.7
Maximum	76.2	15.5	93.1	3.1	0.8	4.3	107.5

Data Source: IRSA

Table 6: Probability of Indus River system in flows of pre-Tarbela (1937-74) period

Probability of Exceedence (%)	Western Rivers			Eastern Rivers			Total
	Kharif	*Rabi*	Annual	*Kharif*	*Rabi*	Annual	
Minimum	134.9	30.7	161.6	16.8	6.3	20.0	170.1
10	128.5	28.4	152.9	13.8	3.5	16.6	166.3
25	119.8	25.5	141.8	7.6	2.0	9.5	155.5
50	**107.2**	**22.4**	**130.5**	**4.2**	**1.0**	**5.9**	**134.7**
75	97.0	20.3	117.7	1.9	0.4	2.6	121.3
80	93.0	20.0	117.0	1.2	0.4	1.6	118.6
Maximum	75.7	13.9	91.2	0.1	0.2	0.3	92.6

Data Source: IRSA

Table 7: Probability of Indus River system inflows for post-Tarbela (1975-2013) period

Canal water withdrawals

There is a high seasonal as well as annual variability in canal diversions. The variability between the highest and lowest post-Tarbela canal diversions was 23.92% (73.15 and 55.65 MAF) and 52.04% (40.74 and 19.54 MAF) during Kharif and Rabi seasons, respectively. The variability in annual canal diversions was around 31.43% (111.13 and 76.20 MAF) largely due to stochastic nature of river flows (Table 8). This is largely because of hydrological and physical limitations of the Indus basin system.

Probability of Exceedence (%)	Canal Water Withdrawals		
	Kharif	*Rabi*	Annual
Minimum	73.15	40.74	111.13
10	72.79	38.85	109.19
25	69.59	38.15	105.09
50	**66.57**	**35.97**	**101.84**
75	61.68	31.38	95.57
80	60.86	29.94	94.02
Maximum	55.65	19.54	76.20

Data Source: IRSA,2013

Table 8: Probability of post-Tarbela canal water withdrawals

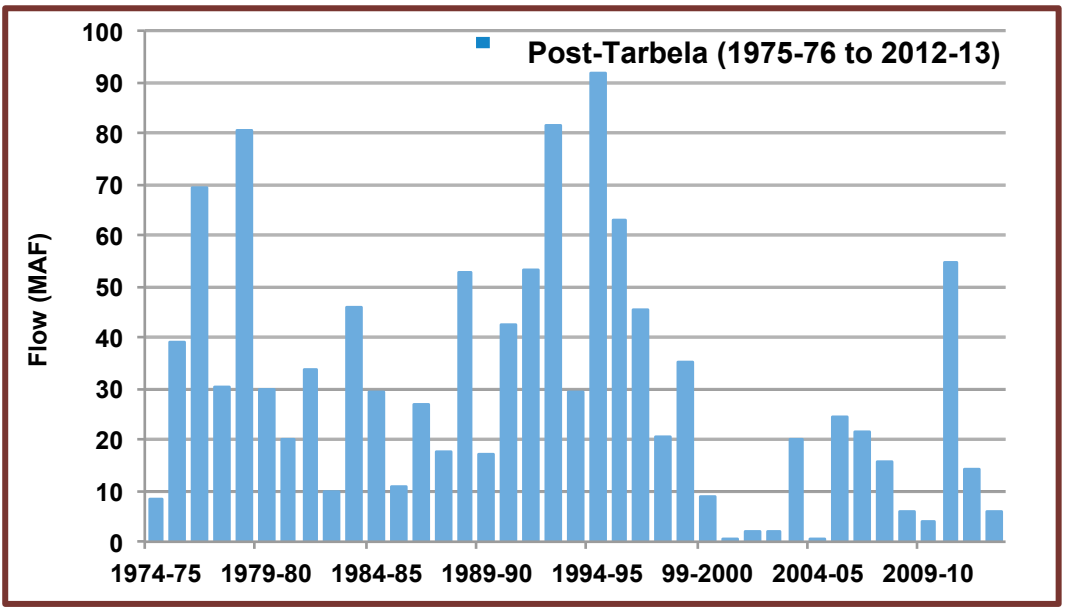
4.3. Flows below Kotri Barrage

Historical distribution of flows

Historical river flows below Kotri barrage were influenced both by seasons and extreme variability of the river flows. The average annual flows were 30.2 MAF during post-Terbela (1975-2013) period. There is reduction of 31 MAF in average annual flow from pre (1937-1974) to post-Terbela (1975-2013), which was primarily due to irrigation developments, Indus Water Treaty and the temporal variability.

The historical flows below Kotri are significantly influenced by extreme natural variability of the Indus river flows from 91.8 MAF in 1994-95 and only 0.3 MAF in 2004-05 (Figure 13). There were 8 out of 37 (22%) occasions when below Kotri flows were 50 MAF or higher during the post-Terbela period.

Likewise, there was 9 out of 37 (24%) years during post-Terbela period when flows were less than 10 MAF. In the post-Tarbela period (1975-2013), the average Rabi flows below Kotri were 1.5 MAF, 67% less than pre-Terbela average of 5.2 MAF. Zero MAF flows were experienced for 1 out of 37 (2.7%) and less than 1 MAF for 21 out of 37 (56%) years.

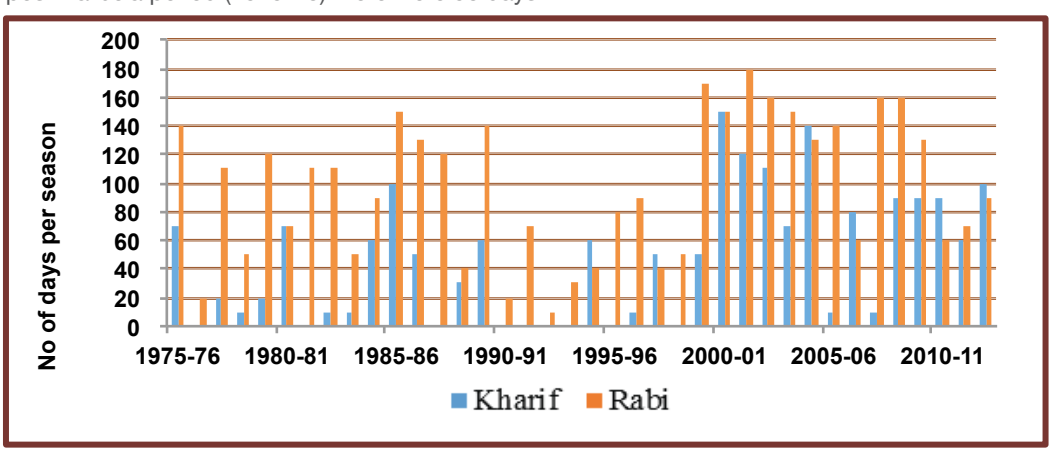


Data Source: IRSA

Figure 13. Annual outflow from Korti barrage (1975-2013)

Distribution of days with zero flows per season

A clearer picture emerges when looking at the extreme events when there was no flow below Kotri. An analysis was made of the number of days per season when flows downstream of Kotri barrage were zero (Figure 14). Zero flow days occurred in 28 years (73%) in the kharif season and 38 years (100%) in the Rabi season in the post-Tarbela period (1975-13). In fact, the frequency of zero flow days in the Rabi season has a direct impact on the downstream system. The highest number of zero flow days recorded in post-Tarbela period (1975-2013) was 180 (Figure 14). In the post Mangla periods (1965-75) there were on average 123 days with zero flows in the Rabi season; and in the post-Tarbela period (1975-13) there were 96 days.



Data Source: IRSA

Figure 14: No of days per season with zero flow below Kotri barrage

The number of zero flow days reached to 300 in 2000-01 and 2001-02, means water was available only for 65 days in a year, there was even no flow during Rabi season, as these are the driest years. River below Kotri remained dry for 200 or more days 5 out of 20 (25%) in pre-Terbela[73] and 9 out of 37 (24%) years during post-Terbela periods. One of the main reasons for escalating of zero flow days in post-Terbela is the worst drought in the Indus Basin during 1999-2004. This necessitates the water resources development and its regulation during drought and low flow periods.

Variability in flow distribution below Kotri

The annual variability of flows distribution downstream of Kotri barrage has been very high and is presented in Table 9. The flows below Kotri during the Post-Tarbela (1975-2013) period are recorded as 26.9 MAF at 50% probability, 11 MAF at 75% probability and only 8.8 MAF at 80% probability. The corresponding reduction in annual flows in extremely dry years (>80% probability) was higher than the average years.

Probability of Excedence (%)	Flow Downstream Kotri barrage (MAF) in post-Terbela (1975-2013)		
	Kharif	***Rabi***	***Annual***
Minimum	88.2	12.3	91.8
10	64.1	5.0	69.1
25	43.8	2.6	45.4
50	**26.7**	**0.7**	**26.9**
75	10.9	0.1	11.0
80	8.7	0.1	8.8
Maximum	0.2	0.0	0.3

Table 9: Annual variability of flows downstream Kotri barrage in post-Tarbela scenarios

The post-Tarbela periods (1975-13) flows below Kotri of kharif season are witnessed as 26.7 MAF at 50% probability, 10.9 MAF at 75% probability and 8.7 MAF at 80% probability while these are 43.8 MAF to 64.1 MAF at 25 & 10% probabilities respectively. Post-Tarbela Rabi season flows are experienced as 0.7 MAF at 50% probability, 0.1 MAF at 75% probability and 0.1 MAF at 80% probability while these were 2.6 MAF to 5.0 MAF at 25 & 10% probabilities, respectively. These downstream flows are however highly erratic and unregulated as most of the flows are released during water surplus monsoon period of three months from July to September. While the downstream Sindh province is a strong proponent of environmental flows, the other three provinces largely consider it as per assessment of minimum e-flows, which is around 3.64 MAF.

4.4. Drivers to Low Flows below Kotri

Flows abstractions of Eastern Rivers by India

There is a considerable decline in eastern & western rivers inflow due to major construction in the Indian part of the Indus Basin. About 17.24 MAF (73%) reductions in flows of Ravi and Sutlej Rivers (Table 10) have been observed for pre-Terbela (1976-2013) from Pre Indus Water Treaty.

Periods	***Kharif***	***Rabi***	Annual	Change (%)
Pre-IWT (1937-60)	19.80	4.13	23.94	
Pre-Terbela (1961-75)	13.42	2.17	15.59	-35%
Post-Terbela (1976-2013)	5.19	1.43	6.70	-57%

Table 10: Eastern Rivers (Ravi & Sutlej) flow reduction after IWT in 1960

[73] *WCD. 2000. Tarbela dam and related aspects of the Indus River basin, Pakistan. Final draft report. WCD Case Studies. World Commission on Dams, Cape Town, South Africa*

Irrigation network development

With the completion of irrigation infrastructure after the Indus Water Treaty in 1960 and improved irrigation management efforts, the canal diversion in the Indus Basin mounted from 62.89 MAF (Pre-Independence, 1937-47) to 96.87 MAF (post-Terbela, 1976-2013) with an average increase of 33.98 MAF (54%). The increase in canal water diversions has been observed 25 MAF during post-Indus Water Treaty, which in turn curtailed below Kotri escapages (Table 11). Consequently, with the expansion of irrigation infrastructure, the total cropped area in Pakistan increased from 11.6 to 23 Mha from 1947 to 2008 while irrigated area amplified by more than double from 8.5 to 19.27 Mha.

Period	*Kharif*	*Rabi*	Annual	Change (%)
Pre-Independence 1937-47	44.39	18.49	62.89	
Pre-Treaty 1947-60	48.58	23.24	71.82	+8.93 (14%)
Pre-Mangla 1960-67	57.11	25.85	82.97	+11.15 (16%)
Pre-Tarbela 1967-76	61.68	28.20	89.88	+6.91 (8%)
Post Tarbela 1976-2013	63.89	32.97	96.87	+6.99 (8%)
Increase from 1937 to 2013				+33.98 (54%)

Table 11: Increase in canal water diversions after Independence

Unimpeded population growth

Due to rampant population growth, industrialization and urbanization, the demand for domestic and industrial abstractions amounted to 12.38 MAF/year (industrial, 4.02 MAF; municipal, 6.9 MAF; environmental use, 1.46 MAF) against 2.5 MAF/year in the early 1975s (FAO STAT) with 400% increase (0.27 MAF/year) which will further aggravate to 17 MAF by 2025. The unbridled population growth in Pakistan will cause severe water shortages for the future generations.

Extreme events

The Indus Basin depends heavily on the glaciers which act as a reservoir, capturing snow and rain, holding the water and releasing it into the rivers which feed the plains. Increased frequency of extreme weather events like torrential rains, prolonged heat waves, frequent tropical cyclones, recurring flooding and persistent drought are the phenomenal changes experienced by this deltaic region. Pakistan was hit by extreme events especially floods in 2010, 2011 and 2012 and severe drought in 1999-2003 which severely impacted on Indus delta. This recent drought reduced rivers flows considerably and severely impacted downstream deltaic life and communities.

It is anticipated that these sorts of extreme events are likely to be repeated more frequently and cause even more severe problems. By the end of the century, temperature in the deltaic region could increase by 40 C, affecting weather in the Indus and over the Arabian Sea with serious implications[74].

4.5. Minimum Environmental Flows (e-flows)

The Water Apportionment Accord established water entitlements based on historic water rights, including the expected future storages of 10 MAF. The accord also included the need for escapages below Kotri to check seawater intrusion and other environmental considerations to maintain the mangroves and fisheries. The provinces held different views about the necessary flows; it was decided that further studies would be undertaken to establish the minimal escapages needed below Kotri barrage, the main regulating structure on the lower Indus River put an interim limit of 10 MAF outflow.

[74] *Rasul, G., A. Mahmood, A. Sadiq, S. I. K. (2012). "Vulnerability of the Indus Delta to Climate Change in Pakistan" Pakistan Journal of Meteorology Vol. 8, Issue 16: Jan 2012*

Three studies were agreed and commissioned to reach consensus on the minimum required escapages below Kotri barrage, which is the main outstanding item of the Water Apportionment Accord after intense negotiation among the provinces. The first study determined the minimum flow below Kotri barrage to control seawater intrusion into the delta. The second study addressed environmental impacts from river water and sediment flows and their seasonal distribution below Kotri barrage. The third study addressed environmental concerns about a wide range of issues related to the management of water resources upstream of Kotri barrage. These reports were then assessed by an International Panel of Experts.

In order to have an independent external review of the studies an International Panel of Experts was appointed. The Panel took good note of the historical developments and the Accord, especially of para 7 on the need for certain minimum escapages to the sea, below Kotri, to check sea intrusion. The Panel reviewed the studies, had in depth discussions with government staff at the federal and provincial levels, as well as with the consultants, and analyzed international experiences and practices.

The Panel recommended "an escapage at Kotri barrage of 5,000 cubic feet per second throughout the year (3.6 MAF) to check seawater intrusion, accommodate the needs for fisheries and environmental sustainability, and to maintain the river channel. It is recommended that a total volume of 25 MAF in any five-year period (an annual equivalent amount of 5 MAF) be released in a concentrated way as flood flow (Kharif period) to be adjusted according to the ruling storage in the reservoirs and the volume discharged in the four previous years to maintain sediment supply to the mangroves and coastal zone".

Based on the post Tarbela flow data the above recommendations would result in a required additional release downstream of Kotri barrage during low flow months of 1.26 MAF in an average year and 2.20 MAF in a typical dry year. This will require additional storage capacity to prevent a reduction of water availability for irrigated agriculture. Environmental flows would as and when appropriate be routed via upper rivers before release downstream of Kotri barrage.

The accord did not specify how these environmental flows would be accommodated within the allocations. Would they come "off the top" (thus reducing allocations to all provinces) or would they come out of the allocations to Sindh, the province in which the delta is located? However, IRSA has been including environmental flows from "off the top" while calculating the allocations for the provinces in each ten-day period. The accord also did not assign responsibility for delivering and monitoring these flows. The recommendations of the Panel study, however, could not be materialized, so far due to unknown reasons. Increasing zero flow days indicate that Panel recommendation of 5000 cfs per day is not being exercised. The amount of freshwater reaching the delta was argued to be insufficient to maintain healthy natural ecosystems, and had resulted in severe saltwater intrusion and salinisation[75]. With the existing reduction in flow, downstream Sindh province already claims it is short of the minimum of 10 MAF of water needed to maintain the Delta.

Although the minimum environmental flows have finally been determined but no official response from any of the province over the recommended volume has been appeared so far. Also it not clear who will ensure these flows as it appears that establishing such volume is not meant to be provided as environmental flows are the first to be compromised when there is insufficient supply in the system.

In the absence of implementation of the Panel's recommendation which is based on detailed studies and analysis of reputed international experts as per decision of the Accord, controversy of minimum environmental flows persists. Resolving the environmental flows has been further

[75]*Champion, H.G., Seth, and Khattak, G.M. (1965). Forest Types of Pakistan. Pakistan Forest Institute Peshawar, 87-95*

aggravated and it does not appear likely that in the near future the issue of allocation to the delta will receive greater attention than the other major issues with the accord.

4.6. Issues of Degradation of Delta below KOTRI

Sufficient e-flows are not going to have enduring impacts until the other agents of degradation are controlled. There are increasing evidences that disposal of highly polluted urban and industrial effluents, indiscriminate cutting of mangrove forests and uncontrolled fish catching are equally responsible for the growing degradation of the Indus delta and coastal zone. As far as the pollution of river flows is concerned no province is an exception. Industries are not implementing the EPA rules and regulations and there are no polluter penalties enforced by EPAs. Even the irrigation department cannot enforce any such provisions laid down in the Canal and Drainage Acts. In fact there is a need for all the provinces to take the pollution of rivers water seriously and develop and enforce mechanisms effectively. Political will is essential in implementing such a decision.

Indiscriminate Cutting of Mangroves

There has been a significant reduction in the area of mangroves in the Indus Delta over the last 30 years, 0.4 million ha in 1965, 0.2495 million[76] ha in 1983, 0.207 million[77] ha in 1990, 0.158 million[78] ha in 2001. There is a wide variation in estimates of recent mangrove cover, especially in the early 1990s, and in 2005. Reasons for the decline of mangrove area include:

Figures 15: Indiscriminate harvesting of mangroves and clearing of land

- Over-harvesting of mangroves for fuelwood, as people living near the mangrove stands harvest about 18,000 tons per year[79].
- Timber Mafias are indulged in merciless chopping of mangroves trees which is mainly used as fuel into boilers
- Encroachment into mangrove areas for urbanization by land mafia for commercial purposes, industry and development of salt pans
- Earth filling projects by cutting of mangroves. News and reports show many housing schemes have been constructed by clearing mangroves
- Grazing by camels and fodder collection
- Highest concentrations of industrial and municipal untreated effluents
- Meandering of creeks and rivers, and erosion of creek banks
- Lack of focus by the research and development agencies (national and international)

[76] *Saenger, P., Hegerl, E.J. and Davie, J.D.S. (1983). Global Status of Mangrove Ecosystems. Commission on Ecology Papers No. 3, Gland, Switzerland, World Conservation Union (IUCN). The Environmentalist, Vol. 3, Supplement No. 3*

[77] *Government of Pakistan (1992). Forestry Sector Master Plan. National Perspective Ried, Collins and Associates, Canada and Silviconsult Ltd. Sweden. Ministry of Food and Agriculture, Islamabad, Pakistan.*

[78] *Pakistan Forest Institute (2004). National Forest and Rangeland Resource Assessment Study. Final Report, Peshawar. Pakistan (Unpublished manuscript).*

[79] *ADB. (200)5. Pakistan Sindh coastal and Inland Community Development Project, Technical assistance Consultant's report, ADB Ta 4525-Pak. Asian Development Bank.*

Instead of addressing the real issue of degradation of mangroves, the agencies are busy planting mangroves which amounts to not more than a fraction in the total potential area of mangroves. The efforts made are not cost-effective as the cost of plantation of mangroves varies from Rs. 10000 to 2000 per plant. This effort can never be up-scaled until it is cost-effective. This is evident from the fact that despite efforts by the public-sector and NGOs in the country in the past 67 years to plant trees, tree coverage has only reduced

Enhanced Catch of Fish using Smaller Nets

The centuries-old fishing practices of the indigenous fishermen communities were sustainable. However, with the entry of non-fishermen and non-Sindhi population into fisheries, including those with the pure motive of moneymaking, the traditional sustainable fishing methods were replaced by many unsustainable methods. Some of such methods include fishing for longer hours, fishing using harmful and smaller gauge nets, fishing everywhere, fishing the areas considered as breeding grounds for juvenile fish, and over-fishing with trawlers and mechanical means. Extensive use of small gauge nets further depletes the fish stock. The unregulated fishing on the coast of Sindh has in fact wiped out several important fish species of commercial value.

Industrial and Urban Pollutants Disposal at Coast

It is estimated that about 450 to 472 million gallons per day of sewage is generated in Karachi and adjacent areas from domestic and industrial sources about 60 % industrial effluents and 40% domestic discharges. The industrial waste-water and sewage are discharged into the two seasonal rivers: the Lyari River and the Malir River of Karachi which act as main open sewers for liquid waste disposal from the city. The Lyari and Malir Rivers are thus contributing about 59% and 25% of the total pollution load of Karachi City respectively, while 15% of the pollution load is directly discharged into the adjacent open seacoast or discharged via Gizri, Korangi and Gharo Creek.

There are currently over 6000 big and small registered industrial units operating in Karachi located in Sindh Industrial Trading Estate (SITE), Landhi, Korangi, Malir and the Port Qasim Authority area with more than 65 categories of industrial plants. Three sewage treatment facilities in Karachi under Karachi Water and Sewerage Board are only treating about 30% of the wastewater and sewage; the rest goes into the sea without any preliminary and primary treatment through natural drains or nullahs which adversely affects marine or aquatic environment[80].

This waste has begun to pose a serious threat to the marine environment, as the channel water is contaminated not only with bacteria but also with toxic chemicals. High concentrations of Mg, Fe, Mn, Cu, Ni, Zn, Cr, Pb, Co and Cd have been reported in the surface and tide pools seawater of Nathia Gali coast of Karachi11. The high concentrations of various metals in seawater of coastal areas are also due to harbor activities such as dredging and cargo handling, the dumping of ship waste and other coastal activities which are highly dangerous for marine life and aquaculture.

Figure 16: Karachi municipal and industrial effluents going into the sea

[80] *Rashida, Q. and Sardar A. S. (2008). Heavy metal pollution in coastal sea water of NathiaGali, Karachi (Pakistan). Journal of Environmental Research and Development Vol. 3 No. 1*

BOD and COD is a Major Concern at the Coast

Various studies tested a wide range of pollutants at Orangi Nala and Lyari River waters, revealed that area was moderate to highly contaminated due to excessive concentrations of water quality parameters like TSS, COD, BOD, DO and SAR. The results in comparison with National Environmental Quality Standards (NEQS) limits suggest that TSS, COD, BOD are higher than NEQS limits, whereas TDS, DO and SAR also fall under moderate to high category. Analysis revealed significant effect of BOD, COD, TSS, cyanide, zinc, cadmium, iron, chromium, phenol, phosphate and copper due to effluents from different industrial and municipal sources which have serious implications on the marine life including the mangroves and aquaculture. The most frustrating part is that the globally known Orangi Pilot Project, where participatory sanitation system was developed at a large scale, is also disposing all the sewage in to the streams leading to the coast. This project is an excellent example of changing the place of the problem by shifting the place of sewage from the street to the coast.

4.7. Way Forward

a. The International Panel of Experts recommendation is based on the review and analysis of detailed studies conducted by experts and these must be enforced as per the decision of the Accord. Further, realizing the ecological significance of the lower riparian ecosystems, the Indus delta rehabilitation programme ensuring regular environmental flows below Kotri must be envisaged. Such programme must deliberate on the revival of lost species and protection of mangrove forests.

b. There are major, ongoing controversies over measuring flows. Telemetric system was installed to automate the measurement and reporting process, but it has not worked. Some viable, transparent system must be explored, placed and practiced. Also enhance cooperation on data sharing and information exchange to improve governance and overcome trust deficit.

c. Initiate a comprehensive study to assess the damage already done to mangroves, fisheries, livestock and other manifestations of bio-diversity in the Indus delta. Also include the up-stream and downstream communities as the beneficiaries of large projects developed in the Indus basin, as a whole. The watershed communities are equally worth considering as upper riparian.

d. More than 60% of municipal and industrial sewage is being discharged into the sea untreated, which not only pollutes but also severely impacts marine life and deltaic ecosystem. Ensure effective enforcement of National Environmental Quality Standards for municipal and industrial effluents. Introduce a progressive environmental or green tax on large industries in accordance with the concept of “polluter pays principle”. Also enforce regulations for the control of illicit cutting of mangrove and riverine forest from land and timber mafias.

e. Develop a reliable system of data collection, storage and information as a pre-requisite for planning and implementation of water and environmental projects in the Indus Delta. Also initiate studies for ecosystem characterization and their valuation.

Create mass awareness among civil society in general and those at the helm of affairs in particular, of the benefits and services provided by the ecosystems to human beings and the society, and of its protection. The ultimate goal must be to protect the existing plantations and then reinforced new plantations using cost-effective interventions. The current interventions being undertaken by all the institutions are on a small scale and add little to addressing the present scale of the problem.

Acronyms

AJK	Azad Jammu and Kashmir
BS	Basic Scale
CoA	Court of Arbitration
Cumecs	Cubic meters per second
HEC	Higher Education Commission
HEP	Hydro Electric Power
HKH	Himalaya Hindu Kush
IUCN	International Union for Conservation of Nature
IWT	Indus Waters Treaty
KG	Kishanganga
KHEP	Kishanganga Hydro Electric Project
Km	Kilometre
MAF	Million Acre Feet
MIT	Massachusetts Institute of Technology
MP	Management Professional
MW	Megawatt
NARC	National Agricultural Research Centre
NASA	National Aeronautics and Space Administration
NE	Neutral Expert
NESPAK	National Engineering Services of Pakistan
NGO	Non-Government Organization
NOVIB	Nederlandse Organisatie Voor Internationale Bijstand
OXFAM	Oxford Committee for Famine Relief
PARC	Pakistan Agricultural Research Council
PCIW	Pakistan Commission for Indus Waters
RoR	Run of River
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organization
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America
USAID	United States Agency for International Development
USGS	United States Geological Survey

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