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IRRIGATION POTENTIAL IN PAKISTAN:

WATER AVAILABILITIY AND DEMANDS

As water is the foremost required ingredient of life, the insufficient and less developed limited water resources caused water disputes among the nations from time to time in the history of the world. The upper riparians exploit their geographical position against the lower riparians on the issue of water sharing whether these are sovereign states or the units of such sovereign states. Pakistan is a federation comprising of four units. The economy of all units is agriculture based and Indus River System is shared by all the provinces to draw water for irrigation. Most of the time, the provinces met with a crucial situation during water distribution. The upper riparians fulminate the lower riparians on wastage and mismanagement of water and vice versa. Any discord or disunity among the provinces is harmful for Pakistan's survival and national security. This paper will discuss the utmost available quantity of water in the country and the historical division of the available water among the provinces of Pakistan.

IRRIGATION POTENTIAL IN PAKISTAN: WATER AVAILABILITIY AND DEMANDS

Naseer-ud-din Mehmood

Introduction

The world's ancient civilizations had been the gift of mighty river basins of the world. Mostly the economy of these civilizations had been reliable on agriculture, and agriculture had remained as a primary occupation for human being because human resources were not developed well in the past time. This made agriculture a linchpin among all the natural resources in economic sector. As water is the foremost required ingredient of agriculture, the insufficient and less developed limited water resources caused water disputes among the nations from time to time in the history of the world. This gave birth the exploitation of lower riparian by the upper riparian for centuries at intra-national as well as international level till the primal comprehensive code of river water law that had emerged out of years debate, is that the user at the upper side of a flowing stream (which is legally known as upper riparian) has no right to pull out or divert water from the sharing river if it is against the interest to a party at the lower side (which is commonly known as lower riparian).

> Prof: H.A. Smith's famous work "Economic Uses of International Rivers", which examines treaties between the states since 1785, states that all these treaties proceed with principle that works executed in the territory of one state, require the consent of another, if they injuriously affect the interests of the latter.[1]

A country may have sufficient natural resources according its physical features and geographical location such as cultivable lands, suitable climatic conditions, mineral resources, water resources and trained manpower. It may get maximum output from all these resources only in the presence of congenial and salubrious political environment otherwise all these factors of exploitation become insignificant. Empirical evidences show that economic development and political stability correlate to each other. Disagreements and distrust among the societies arise when they differ in their socio-economic status. In such environment, one enjoys its status while the other is depressed. Unfortunately, this took place between the provinces of Pakistan when the units differed in their social and economic status whether it caused of less natural resources or mismanagement. Evidences show that less water resources

is not dispute but mismanagement of water reserves has become pivotal issue which has to deal at preferential basis to minimize the conflict among the provinces. It is severely needed to rationalize water rights of provinces by adopting a rationalized approach. In this modern world, natural resources, especially water have got much importance in the economy of any country. The question of possession over these natural resources makes the rival states at loggerhead with each other.

> Mostly the world conflicts arouse on the possession of natural resources among the civilizations, countries and communities. In this modern world, the diplomatic relations among the nations are developed or violated on the base of exploitation of those natural resources found there.[2]

So, it is clear these are resources which determine the bilateral relations between different societies and countries because of the advancement in the scientific field. Many natural resources have been made renewable from their natural non-renewable nature.

Water is amongst those renewable resources which is all likely to result into a conflict between the neighboring nations in sense of cross border water sharing as well as within the same nation on the part of water division issues.

Conflicts Rise Mechanism

Conflict is a social interaction in which the trust of the actors decreases and distrust developed which becomes the main reason of conflict. This trustless behavior may be due to the misperception and misinterpretation among the stakeholders. The conflicts are intensified when it adversely affects fundamental values of the peoples and disagreements commonly appear on limited resources. Therefore, conflicts commonly emerge when different co-sharers perceive grudges due to the action of others.

Fresh water is amongst the foremost requirements of societies for human survival and its consumption is increasing with its higher demand. So, one of the reasons of discordance over fresh water resources is more and more demand of usable water while the supply side looks more and more susceptible. The only solution of this scarcity is the careful use and construction of new dams, reservoirs and barrages at present time. This activity of building new reserves of water may cause eruption of conflict either within the state or among the states that share the same water resources. When such conflicts rise among the nations or within the nations, it not only sweeps away decades of development efforts but also socio-economic and political status of that particular society, “Water scarcity is a major source of conflict all over the world because of increase in global water demands”.[3]

This increase in water demand incites the water users to solve the dispute in their own way and such self-centered behaviours lead to the conflicts among the nations. This conflict might be at regional level as well as at international level. Many hydrologists accept that this amplifying trend of water scarcity will bring the people to contend over fight to hold maximum water resources. Water as a renewable resource will be a major source of conflict in 21st century. According to Dixing cited by Allouche (2005) "The renewable resource mostly likely to stimulate interstate war is river water. Disputes between states over water bring about regional tensions delay economic development and activate the risks of causing more conflicts".[4]

More water conflicts may develop more distrust among the states which may cause fragile poor relations among the co-sharers. Pakistan confronts the same situation over water division between its federating units. Competition for both quality and quantity over shared water at regional level create crevices among the relations of the provinces at the issue of water management. Water disputes are not the product of recent political and economic scenario but have always been sprouted throughout the history of human beings. Water distribution is not an issue when it is available in abundance and every co-sharer gets its due share but it becomes a problem when its availability becomes short and demand is more. In such situation water becomes a source of conflict among shareholders.

> When a dispute arises over water resources, peace cannot be achieved without resolving the question of water right. The upper riparian usually took advantage and want to use maximum quantity of the available water, while the lower riparian wants equitable distribution of water for the development of its areas.[5]

Now a day's multipurpose use of fresh water makes the issue of water distribution more perplexing within the boundary as well as beyond the boundaries of the country. Besides agriculture and domestic sectors, water is also being used in industry at a large scale to produce daily use items.

> Production of different commodities requires the consumption of water also. The scale of water consumption for producing different commodities at present time is very high, for example to produce one litter of petroleum, one cane of vegetables, one kilogram of paper and one ton of woolen cloth, it is necessary to consume ten liters, forty liters, hundred liters and six hundred liters of water, respectively.[6]

The swelling flux of population, the rapid growth of industrialization and the increasing trend of urbanization are the big water consumption sectors other than agriculture.

These tendencies of modern age had shrunk the limited water resources which once a time were being used only for agriculture. Moreover, global climatic changes have disturbed the water cycle unanticipated and causing unforeseen droughts and floods. These unexpected and abrupt droughts and floods directly hit the economic status of countries and the constituting states. This irreparable money spinning loss is intolerable to the provinces and they entangle with one another on the issue of water apportionment.

Significance of Resolving Inter-Provincial Water Issues

Pakistan is a federation comprising of four units. The economy of all the units is agriculture base and Indus River System is shared by all the provinces to draw water for irrigation. At many times, the provinces met with a crucial situation during water distribution. The upper riparians fulminate the lower riparians on wastage and mismanagement of water and vice versa. Any discord or disunity among the provinces can be detrimental for Pakistan's survival and national security. However, such issues on water roped up frequently in the past and are chasing even today. Sindh and Punjab came on a collision at many occasions and the cause for clash was of water distribution between the two provinces during the period of water shortage. Similarly, Baluchistan accuses Sindh for not releasing its due share at Guddu and Sukkur Barrages. KPK have its own concerns over the running and proposed water projects. Many attempts had been made in past to resolve the water issues on permanent basis through different formulas but unfortunately were rejected by either side on different grounds. Although the matter has been settled for the time being but there is a vigor chance for it may crop up again. Thus, here is dire need to develop a mechanism for equitable distribution of water. This disharmony among the provinces is also a big cause of delay in the progress of river water resources and implementation of hydro-power projects.

Irrigation Capability of Pakistan

Water is an essential element of life and plays a pivotal role in the economy of an agriculture based country like Pakistan. It is an assessment that about 88% of fresh water is being used in various sectors such as industry, agricultural commerce and public health. This wide and excessive use of water highly influenced the quality and quantity of the available fresh water. In Pakistan agriculture is the largest consuming sector of available water. It is a single largest sector to support Pakistan's economy and account 48.4% of the total workforce as employees. Pakistan's population is mostly featured with rural areas with the figure of 68%

which is directly or indirectly dependent on agriculture for its economy. Water is the mainstay of agriculture because about 70% of our exports rely upon agriculture sector. Geographically Pakistan consists of an area of 196 million acres (MAc) out of which 77 M.Ac is qualified for agriculture. Among this area of cultivable land about 54.5 million acres is already being cultivated either by irrigation or through rain. The remaining 22.5 MAc of land which makes 29% of the total area suitable for agriculture can be brought under cultivation if water is made available for the irrigation of this huge area. It means that a little less than 1/3rd of agriculture potential of Pakistan is not subjected to tapping because of lack of water resources and associated poor infrastructure.

Pakistan has the largest canal irrigation system in the world with a capacity of 145 million acre feet (MAF) annual average of surface water. This largest contiguous irrigation system offers about 90% of the country's food and fiber production. Out of this total 145 MAF quantity, 75 MAF is being used for agriculture, 35 MAF is being mismanaged and another 35 MAF is being wasted into the sea during the rainy season every year.[7]

Present available water quantity consistently decreased from the day of independence once which was in surplus after to meet the water needs in the field of agriculture and the others. Before the partition of sub-continent there was 168.3 MAF water available in the IRS because of absence of any remarkable water carrying canal system up to the rim station in North-Western province of Pakistan. Indus was sharing 89.5 MAF at Kalabagh, river Jhelum was contributing 22.6 MAF at Mangla, 23.5 MAF from Chenab at Marala, 6.4 MAF from Ravi at Madhupur while Bias and Sutlej were sharing 12.7 MAF and 13.5 MAF at Mandi Plain and Rupar head works respectively.

Major Water Resources

The major exploitable water resources of Pakistan being used are conventional in their nature. The evaluation of availability of these water resources is location-specific. Amongst these are

i- Surface water resources

a) Rivers
b) Rainfall
c) Glaciers

ii- Groundwater resources

a) Useable groundwater aquifers
b) Useable layers overlying saline water

i- Surface Water Resources

a) Rivers

Surface water sources of Pakistan mostly comprising on its rivers namely Indus, Jhelum, Chenab, Ravi, Bias and Sutlej in the east and Kabul, Sawat, Gomal and Kurrum rivers in the west.

These surface water resources offer about 145 MAF water per year out of which only 105 MAF is being used in agriculture and for other purposes, the rest of it is wasted at the cost of mismanagement or disposed into the sea.

Indus River System (IRS)

The Indus River System has number of tributaries including Jhelum, Chenab, Ravi, Sutlej and Kabul rivers and is the 21st largest river of the world in terms of river flow. Indus River constitutes the largest irrigation network of the world with the following configuration factors;

Major storage reservoirs (12.16 MAF)	3
Barrages	19
Siphons	2
Link canals	12
Main canals	45
Other dams >15m height (3 MAF)	82

The Indus rises in the Greater Himalaya through the valleys of Mount Everest-World's highest peak from Lake of Mansarover in China. It enters to Pakistan after flowing through Ladakh and Kashmir near Sakardu. After covering 1000 miles from its origin it comes out from the hilly terrain at Kalabagh and debouches the plains of Punjab which is called upper Indus plain. It covers another 1000 miles length through the plains of Punjab and Sindh. Then it drops below 16000 feet from its origin to fall into Arabian Sea to the south east of Karachi.

Jhelum is a river of Pir Punjal mountain range situated in the South-eastern part of Indian held Kashmir. The Kishanganga (Neelam in AJK) joins it at Domal near

Muzaffarabad as its largest tributary. Another remarkable tributary is River Kunhar of the Kaghan Valley joins it near to Muzaffarabad, and then it is joined by the Ponch River and falls into Mangla Dam reservoir near Mirpur District. Mangla Dam is an opening of river Jhelum to Punjab Province 8 Km east to Jhelum Town. Ultimately it converges to Chenab Rivers at Trimmu Headwork in district Jhelum.

Chenab is the third eastern tributary of Indus. Its source lies in Himachal Pradesh state of India east to Kashmir. Chandana and Bhaga are the main feeding streams of Chenab River in Himalayas and run parallel to the Jhelum stream through the hills of Lesser Himalayas and then Shiwalik before emerging to the plain areas of Punjab at Marala near Sialkot. At Trimmu it joins Chenab River after covering about 974 km from its origin and proceeds to south, till its joins to river Sutlej at Punjnad headwork district Rajanpur.

The Ravi is the shortest tributary amongst all eastern tributaries of the Indus River. It also originates in the state of Himachal Pardesh, India. The river enters the plains of Madhupur in Indian Punjab after leaving the Himalaya range at Baseeli. After passing through Gurdaspur, it enters to Pakistan at Shakargarh. After that it runs along the Pak-India border and then enters Pakistan a short above Ravi siphon to the north-east of Lahore and finally joins the river Chenab below Sidhnai headwork of Qasur District.

River Bias like Ravi is also a small tributary of Indus River. It rises from the mountains of an Indian Himachal Pardesh and at Harike it joins river Sutlej in Indian Punjab.

River Sutlej and Indus have same origin of Lake Mansarover in China after crossing the hilly terrain of Kailash and Himalaya range it proceeds towards south-west till it confluence with Bias river at Harike headwork in India above Ferozpur. After entering from India it runs along the border of Qasur and Pakpatan districts and flows deep to Southern Punjab from Sulemanki Barrage district Bahawalnagar. All of the five eastern tributaries combine one by one to form a single river at Punjnad and ultimately joins the river Indus at Mithankot (District Rajanpur) of Punjab. Thereafter the river Indus passes through Sindh province by covering an area of 600 Miles unto its mouth on the Arabian Sea near Thatta. It is estimated that the aggregate length of all the eastern tributaries of Indus river exceeds 2500 Miles (4480 Km).

The other feeding tributaries arrive from the west of river Indus namely Kabul, Sawat, Kurrum and Gomal rivers. River Kabul originates from the territory of Afghanistan and it enters to Pakistan from Khyber agency above Warsak dam in Peshawar and it drops into the river Indus above Attock Bridge into the Punjab. Kabul River is fed by Sawat River which

joins Kabul from the north above the town of Mardan. Kurram and Gomal rivers are two small tributaries of Indus and join Indus from the west below Kalabagh at Chashma and D.I.Khan respectively. The western tributaries of Indus are about 600 miles in their total length. "The total area of the Indus Basin counts 213674 square miles of which 204300 square miles constitutes the catchment of Indus river system and the rest lies in the desert areas of Sindh, Bahawalpur, and Rann of Kutch."[8]

Mikran Coastal Basin

Mikran Coastal Basin is comprising of coastal ranges of Mikran of Baluchistan It stretches over an area of 122,400 sq. km with a small number of tributaries of Hub, Porali, Hingol, Malir, Nai, Dasht, Kud, Mashhai, Nihing and Kech which flow southward into the Arabian sea. The main source of water is rainfall which provides 3.0 MAF annually.

Endorheic (Interior) River System

This river system coming out of Raskoh and Chaghi ranges in the south-western Baluchistan and fall into lakes of Hamon Mashkhel and Hamon Lora instead of Arabian Sea. Its main rivers are Rakhshan, Baddo, Lora and Mashkhel. This river system is spreading over an area of 120,100 square km. This river system is mostly fed by the water of rainfall and approximate snow melt of Quetta Valley. This system provides about 0.8 MAF of water annually.

Table: 1 Annual Water Flows of the Three River Systems

River system	Average annual flow
Indus River System (Western Tributaries including Kabul, Jhelum, Chenab)	143.18 MAF
Indus River System (Eastern Tributaries including Ravi, Sutlej, Beas)	8.40
Mikran Coastal Basin	3.0 MAF
Endorheic River System	0.8 MAF
The River System Losses	10 MAF
Total Water Available from IBIS	145.38 MAF

Source: Danish, M., Majeed and N. Natelie.2013. Understanding Pakistan,s Water-Security Nexus, United States Institute of Peace, USA

The historical figures show the fluctuating behavior of river flows during the few past years. During 2004-05 the flows of Indus along with its five major tributaries including Jhelum, Chenab, Ravi, Sutlej and Kabul were about 118.90 MAF during Kharif season, it dropped to its minimum of 80.226 MAF in Rabi season in the same year. The average flows of six rivers for five years from 2002 to 2007 were recorded 101.9 MAF as maximum and 9.1 MAF as minimum during the same years. This swinging behavior of rivers flow cause floods or water shortages in the country. It makes difficult to handle the water sharing management among the provinces in both the cases.

b) Rainfall

Pakistan generally lies in an arid and semi-arid climatic region and is one of the most dry and arid countries of the world which receives an average rainfall of 240 mm per year. The amount of rainfall varies from season to season and area to area. Mostly the winter season is placed in a most dry category except the ending month of winter season which receive few amounts of rain during February and March due to western low-pressure disturbances. Most of the rainfall occurs during monsoon season because during summer, low pressure prevails in the country due to immense high temperature. Meanwhile high rate of evaporation starts in the Arabian Sea near to the Bay of Bengal which causes reasonable rainfall in Bangladesh, India and Pakistan. "The annual rainfall in the Indus plain averages about 26 MAF, out of which only 6 MAF is used in irrigated area."[9]

Another source of rainwater is the hill torrents which flow for a short period of monsoon but bring high damages because of their immense flux and speed. These hill torrents offer total development potential of 17 MAF of which 5 MAF has already been conserved through the construction of more than 500 structural interventions in the form of delay action dams, lakes, dispersion structures, retaining walls etc. "Annual rainfall in the upper catchment is less than 800mm, gradually tapering down to just 125 mm in the southern parts of Sindh."[10]

Mean annual rainfall in upper and lower Indus plains vary as,

Upper Indus Plain > 750mm

Lower Indus Plain <100mm

Average Seasonal Rainfall in Pakistan.

Kharif Season = 212mm

Rabi Season = 53mm

This fluctuating figure of rainfall directly affects the surface and ground water resources. Surface water resources includes rivers have their individual flow characteristics. The flows reach to its minimum capacity during winter i.e. November February. The mean flows in a month reach to about one tenth ($1/10^{th}$) of those in summer. Except the main rivers there are number of small water courses and streams which are periodic in their flow and only flow during rainy days otherwise they provide nominal flow or get dry during winter season. This big rainfall difference in the water sheds of Indus river can be assessed by passing through the past 77 years old record of seasonal inflows in western rivers from 1959-2000.

c) Glaciers

Glaciers are the main feeding source of Indus Basin. Pakistan possesses more glacial areas than any other part of the world except the Polar Regions lying on North and South Poles.

> The glacier area of Pakistan is about 13,680 sq. km and on the average, is 3 percent of mountainous region of upper Indus Basin and accounts for most of the river turnoff in summer. Pakistan has greatest mass and collection of glaciers on the earth. In Karakoram Range, the total length of glaciers is 160 km. About 37 percent of the Karakoram area is under its glacier, Himalaya has17 percent and European Alps has 22 percent.[11]

There are seven glacial areas situated in the Indus catchment area namely Siachin, Baltoro, Batoora, Hispar, Biafo, Barpo and Hopper. The big glacial areas of Pakistan are;

i) Siachin Glacier about 78km long in Karakorum Range

ii) Baltoro Glacier about 62km in length also situated in Karakorum Range.

iii) Batoora Glacier as the third large glacier of Pakistan with 57km length in Hunza Valley. Apart from three big glaciers there are at least 20 small glaciers having more than 20 kilometer length also present in Northern Areas of Pakistan. This glacial area is the third largest frozen region in the world outside the polar regions of having total length more than 2250 sq.km. These are great frigid water reserves and dams without any cost which supply water for the whole year to the Indus river system (IRS) and are proving as a life line for the economy of an agriculture base country, Pakistan.

> "It is necessary to commend that about 65% of the total river flows is provided alone by the river Indus while Jhelum River contributes about 17% and Chenab Shares 19% of the total flow."[12]

During July to September which is the third quarter of the year is commonly known as monsoon low pressure winds period in the sub-continent, the flow of rivers oscillates at its peak and even sometimes cause heavy floods in the Indus basin during this seasonal crop viz. Kharif crop flows reach up to 84%. Kharif crop is followed by Rabi crop which is winter season crop during which low pressure of winds diminished and the river flow decreases up to 16%. This abrupt fall down in river flows during Rabi crop is the most irritating fact and makes alarms to store more water during the high flow period i.e. monsoon season for the use during Rabi crop which is counted as a low water flow period. Under such circumstances storage reservoirs become obligatory and inevitable in the country for the availability of water during the stressed period of water shortage, because this access and dearth of water flow ultimately cause the inter-provincial water conflicts which is an unhealthy ominous to such a federating government like Pakistan.

Table: 2. Maximum and Minimum Inflows Record in Western Rivers

	Kharif (MAF)	Rabi (MAF)	Total (MAF)
Maximum flow (year)	154.7 (1959-1960)	35.1 (1999-91)	186.8 (1959-60)
Minimum flow (year)	71.5 (1999-2000)	15.7 (1971-72)	97.7 (1971-72)
Mean flow (77 year)	115.9	22.8	138.7

Source: WAPDA and IRSA reports.Water-Resoureces situation in Pakistan: Challenges and Future Strategies by Muhammad Akram Kahlown, Chairman Pakistan Council of Research in Water Resources, P-35).

ii- Groundwater

Groundwater is another important source of irrigation which consists 99% of freshwater in the Indus basin system except the surface water and is being used as a supplemental source of irrigation water. It is underlain by an unlimited aquifer tracing about 15 million acres in surface area and now supplying about 45% of crop water

> requirements in the country. In the Indus Basin, the groundwater table is not much deep; it is about 40 feet in Lower Indus Plain and 100 feet in depth in the Upper Indus Plain areas. Most of the groundwater resources are exploited in Punjab and Sindh provinces with an underlain area about 79% and 28% respectively because here water table is not much deep.

Indus River along with its eastern and western tributaries offers about 240 MAF of water which is available to us during a year. Also about 56 MAF of freshwater is contributed through groundwater resources which are recharged by the Indus basin irrigation system. About 2.5 million farmers are extracting groundwater through their own tube wells or rely on their neighbor's tube wells.

> The aggregate groundwater potential after full development of surface water resources is estimated to be approximately 56 MAF of which 42 MAF is being currently used annually through more than 70'000 tube wells installed and operated by the farmers themselves, and about 5'000public sector operating tube wells.[13]

For the last 25 to 30 years the ground water is being utilized for irrigation purposes in place of canal water where the groundwater is good in its quality. The usage of this resource has increased from 3-40% of the total water available at the farm gate due surface water shortages in the last three decades. This over exploitation of fresh groundwater causes many threats such as deepening of water table, salinity, high cost of crops and soil erosion etc.

Water Apportionment Efforts

Indus basin waters are being used by all the provinces for irrigation purposes through an extensive canal network and they exaggerate their water requirements by insisting more water share. They are not ready to compromise over water issue most of the time and multi political party system also made it more complex. Most of the political parties play their politics at provincial level and no one party scores its mandate throughout the country and could not be able to develop a consensus on this sensitive issue of water division. Political instability, non-serious attitude of politician, parochialism, political unconsciousness and irrational mind approach are the factors involved keeping the water issue unresolved for the century. Some external factors also responsible of complicate the issue such as Indian hostile attitude, frequent martial laws, Kashmir issue and global environmental changes.

On April 01, 1948 India stopped the water of canals off-taking from rivers Sutlej, Bias and Ravi at the headwork constructed in its territory. This gave an irreparable loss to

Pakistan's economy because it was the end of Rabi Crop. This stoppage of water sowed first water dispute between India and Pakistan. Ultimately, with the arbitration of World Bank these issues reached to its end through signing Indus Water Treaty (IWT) in 1960.

A number of commissions and committees were constituted to defuse the tension over water issues among the provinces before the partition such as the Tripartite Agreement 1921, the Indus Discharge Committee 1921, Sutlej Valley Project(SVP) Inquiry Committee 1932, Anderson Commission 1937 and Rao Commission 1945and after the partition, Akhtar Hussain Commission 1968, Fazle Akbar Committee 1970, Chief Justices Commission 1977,Justice Haleem Commission 1983 were constituted which ultimately resolved in 1991 by signing the Water Apportion Accord by all the provinces of Pakistan to some extent.

Ayub khan tried to resolve the issue in his own way without consultation with the provinces. Zulfiqar Ali Bhutto's political government did not take the risk of starting the solution of water issue with a fear to lose his vote bank and his government carried on water allotments on ad hoc basis every year without keeping into account its strikes on future claims from any corner of the country. Zia Government felt the sensitivity of the issue and constituted many committees to resolve the issue on permanent basis as apportionment of water on ad hoc basis was uncertain and unsatisfactory.

For many years since the completion of Terbela Dam in 1976 no new water reservoir was built. Land reforms were introduced time to time by Bhutto and Zia regimes and new lands were brought under cultivation. It needs more irrigation water along with urban and industrial use of water. The future governments had to face the issue of water shortage. The exploration for new water reserves was the foremost need of the time and it was a call in question for the new democratic regimes after the end of Zia's military rule. In 1991 Nawaz Sharif became the Prime Minister of Pakistan he was deep interested to resolve water apportionment as well as to construct mega dams like Kalabagh dam. Shareef government succeeded to resolve the issue of water distribution by signing an accord in 1991 in the form of Water Apportionment Accord 1991 which all the provinces unanimously agreed. Under this accord small provinces had given more water than its due share on the firm understanding given to the then prime minister. WAA 1991 was also approved by CCI. After a long time perplex of water distribution was successfully solved to some extant but not in complete.

Table: 3 Water Allocations According to WAA-1991 is as under

Province	Water shares (MAF)		Total (MAF)	Balance Supply Shares (%)*
	Kharif	Rabi		
Punjab	37.07	18.87	55.94	37
Sindh	33.94	14.82	48.76	37
KPK	3.48	2.30	5.78	14
Baluchistan	2.85	1.02	3.87	12
Civil** Canals	1.80	1.20	3.00	-
Total	77.34	37.01	114.35	100

*Including flood flows and future storage.

**Ungauged civil canals in KPK.

Source: Save Water Save Pakistan by B.A Malik.

Pakistan; A Water Stressed Country

Pakistan water resources are continuously shrinking and annual availability of water per person is falling to an alarming figure. According to a Swedish hydrologist Falkenmark Indicator, a person requires 1700 cubic meters of water annually. In Pakistan, per person required quantity of water reduces to 1000 cubic meter which was about 1234m^3 in the year 2009. According to the appraisements of Water and Power Development Authority (WAPDA), this will be reduced to 885 cubic meters per person till 2020. This prevailing declining situation requires urgent counter measures to enhance water availability in Pakistan in the shape of constructing new water reserves to exploit the available surface and ground water resources in full. As agriculture is the largest employee consuming and revenue generating sector for Pakistan and it gives to water sector a status of an industry and this industry is considered as a lifeline for the whole country, "Water sector industry of Pakistan is the largest enterprise accounting for approximately US $300 billion of infrastructural investment and contributing about US $16 billion annually to the GDP of the country."[14]

Table: 4 Water Barrier Differentiation Proposed by Falkenmark (1989)

Index (m^3per capita)	Category/Condition

>2,500	Ok
2,500-1,700	Water Vulnerability
1,700-1,000	Water Stress
1,000-500	Water Scarcity
<500	Absolute Scarcity

Water vision of 2025 is a serious attempt to raise water availability for the future generation. Unexpected floods and shortage of water during seasonal crops, especially during the Rabi Crop is now compelling the provinces of Pakistan to raise water sharing issue at the national as well as international levels.

Under the water vision of 2025, the Government of Pakistan has initiated number of projects with the cooperation of Water and Power Development Authority to build new small and big dams and other types of water reservoirs in the next fifty years in order to meet the increasing demand of water. But unfortunately, the provinces had shown their own grievances on the validity and effectiveness of these projects which rather increasing day by day. Moreover, these issues are being raised on political basis by different small regional political groups. They are dispraising each other without knowing the real and technical facts of these projects. Such selfish political groups seduce their illiterate voters and supporters and use it as a shelter to connive over real issues of education and health sector.

Effect of Increasing Population and Emerging Spectrum of Water Challenges

Pakistan was considered as water abundant country in the 1950 as more than 5000 m^3 water was available per capita but recent water surveys indicate that Pakistan will be a water scarce country by 2017 with 1000 m^3 per capita water availability. "According to the benchmark water scarcity indicator (the Faulkenmark Indicator, a Swedish hydrologist), Pakistan's estimated current per capita water availability places it in the "high water stress" category."[15]

The following table shows the comparison between population and water availability per capita through our history.

Table: 5 Populations against per Capita Water Availability

Year	Population (Million)	Per Capita Water Availability (m^3)
1951	34	5260
1961	46	3888
1971	65	2751
1981	84	2129
1991	115	1565
2002	139.5	1282
2010	167.7	1066
2020	195.5	915
2025	208.4	858

Source: Economic Survey of Pakistan 2009-2010.

There is a reverse proportion between population and water availability. Now Pakistan's population has five times increased as per 1951 population but per capita availability of water has also decreased with some ratio and reduced from 5260 to 1000 m^3 per person. It is obvious that we had not developed new reservoirs to meet the demand of increasing population of the country after 1960 water accord IWT two dams were commissioned to feed the long reaches of the eastern rivers but the variability in annual river flows altered and reduced canal diversions and compelled the provinces to share water shortages. IRS claims for every four out of five years, yearly available flows are around 123.59MAF. Supper floods are observed approximately once a time in five years. "This may increase the average to respectable 137.27MAF per year but in the remaining four years availability of water is 123.59 MAF only."[16]

Most of the water reservoirs have been built on river Indus itself and its Easter tributaries. There are few Western tributaries which also feed river Indus but their water not preferably framework that some technocrats suggest that river Kabul should be tapped to address flow uncertainty and Pakistan should establish its water rights on the Kabul flows.[17]

Pakistan and India both share the Indus River System and the population of both countries increases rapidly but our neighbouring country started to develop its water storage capacity consistently through building of new water reservoirs at the different rivers passing through its territory. On the other side Pakistan could not developed consensus among its provinces over the construction of new dams which was the need of time. In this way, it could not keep the balance between the availability and demand of water for agriculture and other uses.

Table: 6 Developments of Water Resources in India and Pakistan, A Comparison

Particular	**Pakistan**	**India**	**Ratio**
Population (1998)	140 million	1016 million	1:7
Irrigated Area through Canals and Tube wells	42 million Acres	221 million Acres	1:3
Large Dams	68 number	4192 number	1:62
Hydropower Capacity	5009 MW	21891 MW	1:4
Canals Diversion	104 MAF	460 MAF	1:4

Source: Pakistan's Dams and Development by World Commission on Dams (Nov 2000).

Current and Projected Water Availability and Demand in Pakistan

In 2002 a study was arranged by the ministry of Water and Power under the title of "Pakistan National Water Resource Strategy" and worked out that about 109.3 MAF water was available at farm gate including surface, underground and rainfall resources. Under this study it had also been calculated that development potential under water vision 2025 can be enhanced to 139 MAF at farm gate from the available same resources. This development potential is given in this table.

Table: 7 Development Potential under Vision-2025

Water availability in 2002				Water Vision-2025				Potential
Surface water	Ground water	Rainfall	Total	Surface water	Ground water	Rainfall	Total	

62.3 MAF	42 MAF	5 MAF	109.3 MAF	75.3 MAF	55.7 MAF	8 MAF	139 MAF	29.7 MAF

Source: Water Vision-2025

This table shows that we may able to develop our water resources and have a potential to recover 29.7 MAF more water through an effective and in time planning but our water requirements would be near to 145 MAF in 2025 which is an alarming figure for Pakistan. Kalabagh and Bhasha dams were there part of this potential which could not be constructed after passing fourteen years of this survey.

Future Challenges and Options

To the past record, the balance between water availability and requirement is seemed to be reverse in proportion as the targets in agriculture irrigation water requirements estimated for the years 2000, 2013 and the water vision 2025.

Table: 8 Water Demand and Availability

Year	2000	2013	2025
Population (in millions)	148	207	267
Water Requirements (MAF)			
Irrigation	143.1	206.4	-
Non-irrigation	5.9	8.7	-
Total Requirements	149.0	215.1	277.4*
Water Availability**			
Total Surface and	108.7	107.3	126.6
Groundwater	-	-	-
Shortfall	40.3	107.8	150.8

*Extrapolated

**At Watercourse head

Source: Mulk, Shamsul, and Khalid Mohtadullah (1991) Water Resources Management Policies in Pakistan. Paper presented in International Workshop on Water Resource Management. Washington, D. C.: USA.

In 2025 our irrigation water requirements will increase to 277.4 MAF which is almost double of availability for that time which is 126.6 MAF (in case of completion of 3 big dams namely Kalabagh, Bhasha and Dassu). These figures would reveal a very disastrous scenario of water shortage if we would not be able to construct new big water reservoirs in the present future. In such circumstances, inter-provincial water conflicts may be escalating in full vigor.

Strategy for Addressing Various Issues and Active Conflict Resolution Mechanism

Pakistan observes water shortages every year and it will continue to do so, except in the wet season of monsoon. These wet months offer surplus water and these surpluses can be utilized in a timely and effective manner only when all the provinces come to terms of consensus on water conservation and development schemes in prevailing misunderstandings. Despite the constitutional provision which address the role of "Council of Common Interest" there is a lack of an effective conflict resolution mechanism among the provinces. We need to evolve such a mechanism on practical and sustainable basis which is acceptable for all the units.

There are two possible ways to do this.

a) Activation of Council of Common Interest (CCI)

Articles 153 to 155 of the Constitution of Pakistan relate to the appointment and function of CCI. Especially article 155 narrates about the water related complaints of the Federal government or the provincial governments. But this CCI sometimes also failed to develop a consensus over water issues among the provinces because CCI itself became controversial in its configuration. We should feel the sanctity of this institution and it should be allowed to play its role without any type of political pressure in resolving inter provincial conflicts and disputes by developing consensus on such resolution.

b) The Rightful Role of Parliament and Parliamentary Committees

The Parliament is the most reliable and sacrosanct forum to discuss and to hold debates over national issues and resultantly develop consensus among the provinces over such issues. Pakistan parliament is bi-cameral in its nature and both the floors i.e. the Senate and the National assembly should take initiatives to discuss the water related issues and develop consensus over such national issues to minimize the confrontation among the federating units. Moreover, the standing committees of the parliament must show their interest and responsibilities on water and power to work out on water relating issues and takes up the issue before the full parliament session for resolution. The committees should also consult the water experts to collect the real facts and should hold public hearings in open for discussion and such hearings must be propagated without any discrimination for creating public awareness. We get more loss by trying to keep the issues in the shell. Open discussions should be hold even at gross root level. No doubt such discussions in the beginning seen to be chaotic but ultimately, we are going to the development of national consensus. It is rather unfortunate that such committees are formed out of way but not taking both houses of parliament in confidence and are resolved on personal likes and dislikes of the government.

The elected representatives must realize their powers and duties to develop durable and sustainable consensus at national level on confrontational and complex issues by convincing the mob with the devotion of national integrity as the successful examples of declaration of 1991 Accord and the framing of the comprehensive constitution of Pakistan 1973 demonstrated in the history. In short parliamentarians should be the most ardent agent in the question for a national consensus.

End Notes

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