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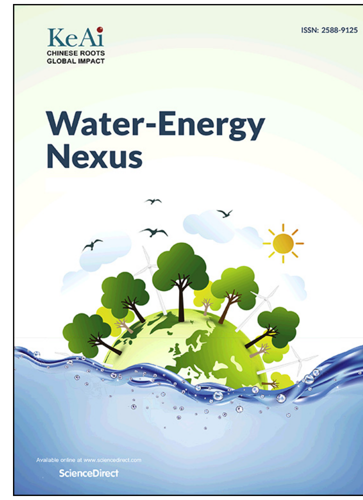

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Water, Energy and Food Nexus of Indus Water Treaty: Water Governance

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Water, Energy and Food Nexus of Indus Water Treaty: Water Governance

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Abstract: Water, energy and food nexus of Indus Water Treaty (IWT) is presented in the light of water governance. The water governance doctrine refers to social, economic, administrative and political systems influencing the transboundary water use and management. Water governance means who gets what water, when and how much, and who has the right to water related benefits. Indus water treaty is cited to be one of the few successful settlements of boundary water basin conflicts that has stood the test of times since last six decades. Riparian states have opportunities of harvesting water, power and agriculture by compliance to accords in letter and spirit. IWT restrains both (India) and lower (Pakistan) riparian from pulling out of accord from fear of deadly consequences. IWT is founded on World Bank's professionally prepared comprehensive terms and conditions keeping in mind future regional developments. This treaty has given control of three eastern rivers (Ravi, Beas and Sutlej) to India and three western rivers (Indus, Jhelum and Chenab) to Pakistan. IWT gives both countries genuine share of eastern/western waters for domestic use, agriculture and electricity generation using run-of-river plants, subject to observing minimum level of water flow into lower riparian at Head Marala Barrage. Water, energy and food nexus of this treaty bonds upper and lower riparian to comply with water governance principles. Upper riparian diverted 34 million acre feet (MAF) water out of eastern rivers before entering into Pakistan and launched run-of-river power plants spree on western rivers in last two decades. Restricting water flow to lower riparian in the name of pond filling needs attention. Unrestricted use of water in run-of-river power plants is pointed out to be a limiting factor in Indus Water Treaty. Continuum of cooperation has room for collaboration under Indus Water Treaty. India and Pakistan can sort out disputes by dialogue, in light of rights and needs, rather Harmon Doctrine.

Keywords: Water, Power, Energy, Agriculture, Dams, Climate Change, Run-of-River Plants

Contents

1. Introduction

Water sustain the life on planet. Water connects soul with body, as oil connects engine to car. Lao said “Nothing is softer or more flexible than water, yet nothing can resist it.” All living species - plants, animals and humans - thrive on water. Human body and earth’s surface consist of about 71% water. Animals live on plants and water connects their natural ecology (Kamran, Aijaz, & Shivakoti, 2017). Rampant rise in water, energy and food consumption is implicitly driven by population growth rate (N. Abas, Kalair, & Khan, 2015). There is acute scarcity of water, energy and food supplies and demand is likely to increase 40-50% by 2050 due to population rise (Shivakoti, Pradhan, & Helmi, 2017; Ward, 2003). Food production and supply chain use 30% of the total energy. Water, energy and food are issues are related to population. Scaled down water (1000km^2), food (billion tons), energy (1000TWh), population (billions) and reservoir capacities (1000x10^{9}m^3) are shown in Fig.1

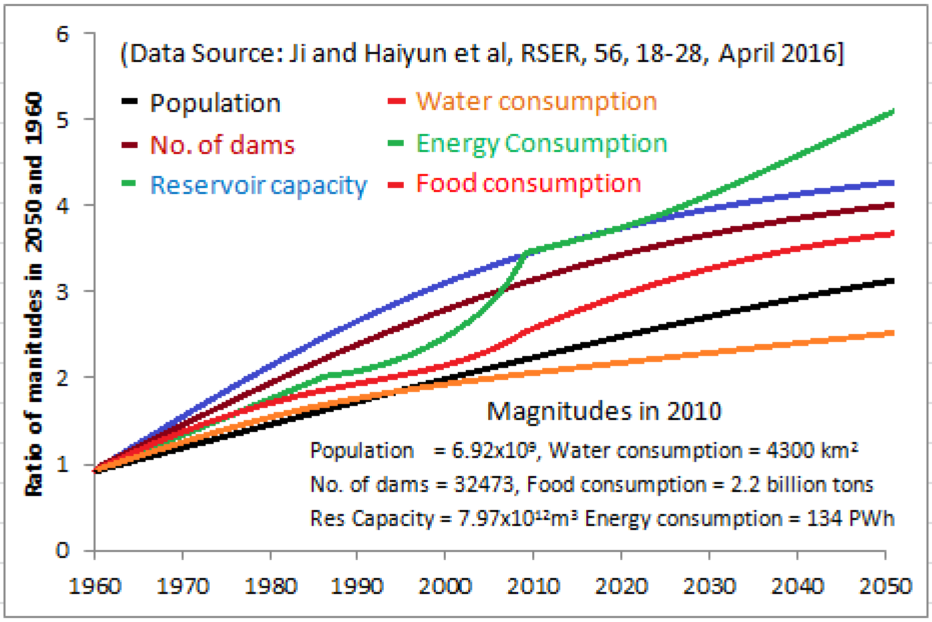

Fig.1 Ratio of magnitudes in 2050 to 1960 to plot six variables on same scale
Example (population in 2050/1960 = 9.55/3.03 = 3.16) (*Hydropower Status Report shows record rise in clean electricity*, 2018)

Fresh air, clean water, nutrient food and energy have been included in the goals of UN SDG-17 program (Grigg et al., 2018). Climate change is reminiscent of water variability as shortage of water causes droughts, abundance of water causes floods, evaporation of water causes rains, freezing of water forms glaciers and melting of water causes sea level rise (Naeem Abas, Saleem, Kalair, & Khan, 2019). Plants need water to absorb carbon dioxide and produce oxygen in photosynthesis process. Plants convert sunlight into chemical energy, which is ground zero of natural food supply chain pyramid (Irfan, Abas, & Saleem, 2018). Planet has fixed fresh water resources, which might be enough today and insufficient for future generations. First water war is reported between Lagash and Ummah cities in Mesopotamia 4500 years ago. Today water is perceived to be unifying agent rather than being cause of war (Emma, 2014). However, severe water scarcity in future due to rising population may create different situation (Ahmed, 2017). Water alone, is not issue, our food and hydropower systems also depend on natural freshwaters. Hydropower is 17% of world total electricity and 71% of global renewable energy. Global installed hydropower capacity is 1.267TW that produced 4.185PWh electricity in 2017 (Shaheen, 2018). Agrarian economies especially depend on natural waters for food and energy ("Transboundary Waters," 2018). Water resources played a significant role in human civilization. History of water disputes in Mesopotamia goes back as early as 4500 years ago.

Ancient hunter-gatherers started settling in riverine and coastal regions for agriculture 10,000 years ago in Indus Valley Civilization. Mehrgarh, Kot Diji, Harappa and Mohenjo Daro used to be large populated regions 4500 years ago. Thar Desert used be dense forest that was buried in subsurface to become coal today. A long, 200 years, hiatus inflicted dry spell in Egypt, Greece, Mesopotamia and Indus Valley Civilization (IVC) about 4200 years ago (Smajgl, Ward, &

Pluschke, 2016). Water shortages forced IVC to move from Baluchistan and Sindh (Mohenjo Daro) to Harappa and Kalibangan in South, Ganges in East and Northern areas in Himalayan range. Foreign invaders have long been ruling this agricultural region since ancient times. British Empire built world's largest irrigation canal system in 19th century to increase agricultural productivity. End of British Empire led to division of lands, mountains, rivers, barrages and canals between India and Pakistan in 1947. Pakistan is situated on geographical location that once used to be center of Indus Valley Civilization (IVC). India and Pakistan get fresh water from monsoon rains and Himalayan glacier melts. Water conflicts started in 1948 as all major Pakistani rivers pass though India. Pakistan is located on a place that was galaxy of rivers, waterfalls and monsoon rain streams. Water shortage fears are encoded in genes of Indus basin people as dry spells affect to lower riparian. Pakistan, India and World Bank agreed on Indus Water Treaty (IWT) in 1960. IWT controls boundary river waters flowing from India into Pakistan. Indus water basin had 170 million acre feet (MAF) water out of which 34MAF used to come from eastern rivers and 136 MAF through western rivers. The Indus river basin area 1.12×10^6 km^2 and 170MAF water is distributed among Pakistan (47%), India (39%), China (8%) and Afghanistan (6%). Pakistan uses 95MAF water for irrigation and stores 13.86MAF in Tarbela, Mangla and Chashma. Annual water flow varies from 97 to 186MAF (average 137MAF) out of which 80% water flows in 100 days from June to September every year (C. Zhang, Chen, Li, Ding, & Fu, 2018). Pakistan has increased storage of Mangla by +39% but storage capacities of Tarbela and Chashma have decreased by -36% and -61% respectively. Pakistan has 50MAF groundwater out of which 40% is not useful for irrigation. Pakistan is highly dependent on natural river flows being dammed and diverted by India.

River basins sustain food, water, and energy security in the region (Helmstedt, Stokes-Draut, Larsen, & Potts, 2018). According to UN Food and Agriculture Organization (FAO), boundary waters consist of more than 263 watersheds and 300 aquifers cross the borders of two or more countries. International river basins covering 45.3 percent of the earth's land surface, account for 80 percent of global river flows, and may affect 40 percent of the world's population. There have been signed 150 treaties out of which 37 acute boundary water disputes were noted in last 50 years. However, 60% (150) of world's 263 transboundary river basins still lack framework for cooperative control of shared water sources (Kaddoura & El Khatib, 2017). The rationale for integrated water resources management, instead of water management technologies, involves water, food and power policies to adapt to climate change. Water, energy and food nexus is a new paradigm shift in water policy (Cai, Wallington, Shafiee-Jood, & Marston, 2018). Concepts, theoretical models, experimental methods and international frameworks for the water-food-energy nexus are reported in literature (Amorim et al., 2018; Karatayev et al., 2017; Martinez-Hernandez, Leach, & Yang, 2017; Saladini et al., 2018; Taniguchi, Masuhara, & Burnett, 2015). The nexus between water, energy and food security is important in the light of looming global risks like climate change (Susnik, 2018). The water-food-energy nexus has opportunities as well as challenges. Water, energy and food indicators reveal the degree of possible sustainable development. Water, energy and food security are recognized common concerns of Asian, Middle Eastern and Western countries (Bidoglio, Vanham, Bouraoui, & Barchiesi, 2018; Karan, Asadi, Mohtar, & Baawain, 2018; X. Zhang et al., 2018). However, quantification of sustainability of water-food-energy nexus needs big data analysis due to wide variety of parameters (Shannak, Mabrey, & Vittorio, 2018). Optimization of water-food-energy nexus requires stochastic methods to evaluate the sustainability (J. Zhang et al., 2017). Water, energy and food ecosystems, in the presence of climate change, can affect the hydropower (Bieber et al., 2018; "Editor, Weird 'wind drought' means Britain's turbines are at a standstill," 2918). It is time to study the theoretical models and practical practices to forecast the long term sustainability (Hanes, Gopalakrishnan, & Bakshi, 2018), especial agriculture during water (Pahl-Wostl, 2017) and energy during wind droughts (Al-Saidi & Hefny, 2018). Awareness among the masses can be created through education and training (Yasmin, Naseem, & Masso, 2019; Yasmin, Naseem, & Raza, 2018; Yasmin & Sohail, 2018; YASMIN & SOHAIL, 2018). Sustainable development of water-food-energy nexus requires policies incorporating nature that keeps on shifting its equilibrium to maintain continuity (Abbott, Bazilian, Egel, & Willis, 2017; Dinar, Katz, De Stefano, & Blankespoor, 2015).

Governance of water-food-energy nexus is an ideal solution (Rausching, 1983), the cooperative control and regional water treaties have good success record (Swain, 2015). Examination of existing water-energy-food nexus shows that cooperative control of boundary water resources need sincere heartfelt policies prove more successful than ingenious ruses for hydro hegemony tactics (Wellington, 2018; Wolf, 2018). Water experts think the future wars will be fought on water. History shows the shared waters cause either conflict or more engagement. Treaties are good at start but become bone of contention later, when older terms and conditions do not meet rising water demands due to climate change and population growth (Kamran et al., 2017). Idea of invoking human rights to water can let the United Nations interfere to mitigate regional boundary water conflicts. Water governance may focus to achieve equity, efficiency, resilience, security, and sustainability (Akhter, 2015). Water is an ethical issue as all human and ecosystem activities rely of sustainable water supply. Transboundary waters often cause tensions more to lower riparian than upper riparian. In the presence of international laws and treaties even the hostile nations do not fight on water. Natural decline of water may trigger water war the solution lies in mitigation of causes inflicting water shortages. Water variability is forecast to affect hydro-political balance nations in future (Yang, Brown, Yu, Wescoat, & Ringler, 2014). International water conflicts can be solved by treaties, cooperation and transformation (Wescoat, 1991). Water governance is good idea, especially, for IWT, between two hostile states. Hydro political cold war by upper riparian to establish hydro hegemony may escalate cold war into hot war (Barquet, Lujala, & Rød, 2014; Fischhendler & Katz, 2013). India used to get 3MAF from eastern rivers before 1960 that increased to 33MAF after IWT yet she eyes on the western rivers. Water governance and adaptation to climate change is the only option to uphold the IWT (Mccaffrey, 1996; Wolf, 2009). Impact of climate change on transboundary river basins may change water flows. Increase and decrease of water may cause violations of treaties and agreements causing armed conflicts. India and Israel are accused of violating the water treaties and agreements (Ahmad, 2009; P. Woodhouse & Muller, 2017). Water experts believe in water flow monitoring using telemetry techniques for satisfaction of upper and lower riparian states . Water governance can improve bilateral relationship and ingenious tactics lead to end of agreements and start of disputes between water sharing countries. Upstream riparian states invoke Harmon Doctrine that is already dead today (Hatami & Gleick, 1994), by associating rights with place where water falls, whereas downstream riparian claim absolute integrity (Bingham, Wolf, & Wohlegenant., 1994). Indo-Pak issue is basically upper and lower riparian issue that can be sorted out through dialogue. Indus basin has complicated origin in multiple countries. Indus basin consist of Indus River and six contributory rivers, The Indus rive originates from Chinese controlled Tibet and flows through Jammu & Kashmir. The Sutlej river originates from Tibet and flows through India to fall into Chenab in Pakistan. The Chenab originates from India Himachal Pradesh and flows through Jammu & Kashmir. The Jhelum river originates from Kashmir and falls into Chenab in Pakistan. The beas and Ravi rivers originate from Himachal Pradesh India and fall into Chenab in Pakistan. River Kabul originates from Amu Darya and falls into Indus River in Pakistan. The Indus and the Chenab Rivers are biggest rivers in Pakistan. Indian run-of-river plants spree on Jhelum and Chenab has created fear of Indian mindset to strangulate agriculture in Pakistan (Naff & Matson, 1984).

2. Water Governance

Water governance refers to social, economic, administrative and political systems influencing transboundary water's use and management. Water governance means who gets water, when and how much, and who has the right to water and related benefits such as electricity and food crops. Water governance can minimize water conflicts and enhance concurs between upper and lower riparian states. Water governance is the lexis nexus for global development (Dinar et al., 2015). Water conflict is a term describing a conflict between countries, states, or groups over an access to water resources. The United Nations recognizes that water disputes result from opposing interests of water users, public or private (M. Woodhouse & Zeitoun, 2008). Water conflicts for punishment have been happening throughout human history at least since 3000BC (Noah's Deluge), 1200BC (Moses, Egypt), 2001 (Israel-Palestine), 2007-2018 (India-Pakistan) [51-53]. Water governance theory may integrate communities if applied in letter and spirit. In the wake of climate change, water governance performs better than treaties. Earlier water treaties and accords, like Indus Water Treaty, had no sub-clause of climate change. Water variability due to climate change requires needs cooperation continuum rather than treaties (Nunzio, 2013). The cooperation continuum from dispute to integration consists of unilateral action, coordination, collaboration and joint actions.

No war has ever been reported alone due to water, but the water might be one of the drivers. History shows the Rwandan genocide and Darfur wars were linked to water conflicts. Water disputes arise due to resources such as territories and strategic advantages. Typical water related advantages may include fishing, agriculture, industry, recreation, tourism and navigation. History of violence incidents over water goes back to 4500 years. Water conflicts not only arise for fresh water but also salty waters. There are 200 shared basins in 148 countries. Water treaties help cooperative control of transboundary water resources. There are 783 million (11%) people on earth which yet have no access to clean water. There were recorded 1831 water conflicts over transboundary basins in 50 years from 1950 to 2000. Annual frequency of water conflicts is 36.62. Notable water conflicts include Euphrates-Tigris dispute between Turkey, Syria and Iraq (Nunzio, 2013), Jordon River conflict between Israel, Lebanon, Jordon and Palestine (Olivera, 2004), Nile River conflicts between Egypt, Ethiopia and Sudan, Aral Sea conflict between Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan and Kyrgyzstan and seven US states and Mexico.The Nile River has had a major impact on the interstate politics of the region through the years, as it is the only reliable source for renewable water supplies in the area (Ahmed, 2017).Cochabamba, water war in Bolivia, is the only conflict resulting in death of one person. This war was ignited by privatization of water after other utilities (Keskinen et al., 2016). There is no chance of water conflict in Europe, least risk in Americas and high risk in South Asia and Middle East. Water conflicts are signs of regional maturity. Earlier we recognize each other's natural water needs the better it will be. River Danube passes through several European states who have never threatened one another of water wars. River Danube Treaty is a good starting point to make new agreements. IWT has stood the test of time, which has room to further improve using terms and conditions of other more enduring water agreements.

Ancient people used to store water in underground ditches for long term use and modern civilization builds dams for water, agriculture and electricity. Chinese three gorges dam has water storage capacity of 31.9MAF, capable of producing 30,000MW electricity, which equals to annual flow of water in Chenab and Jhelum rivers. We are losing Rs.196 billion resources by opposing Kalabagh dam. If few leaders of 35% population oppose 65% population then dam cannot be built. Supreme Court is interested in using corruption money in building Bhasha (GB) andMunda (Mohmand) (KPK) and KBD (Punjab) dams to protect KPK against floods and Sindh against drought. Eastern dams feeding to south Punjab were sold by KPK (Aub Khan) and Sindh (Zulfqar Ali Bhutto) under IWT not Punjabi leaders. We have many people in Pakistan each of them can build and donate one dam to Pakistan. Using corruption money to sponsor dam construction and manpower in jails to clean silt of existing dams is also not a bad idea, China has demonstrated its implementation long ago. HKH plateaus are source of water for half of the world population. Planet earth remained ice ball for long time. Ice Age' snow on Himalayas began melting with rise of temperature with start of Holocene period 10,000 years ago. Ten large river basins emanate from HKH region in western (Amu Darya), south western (Indus), Southern

(Ganges), South eastern (Brahmaputra, Irrawaddy, Salween and Mekong), eastern (Yellow and Yangtze) and northern (Tarim) directions as shown in Fig.2

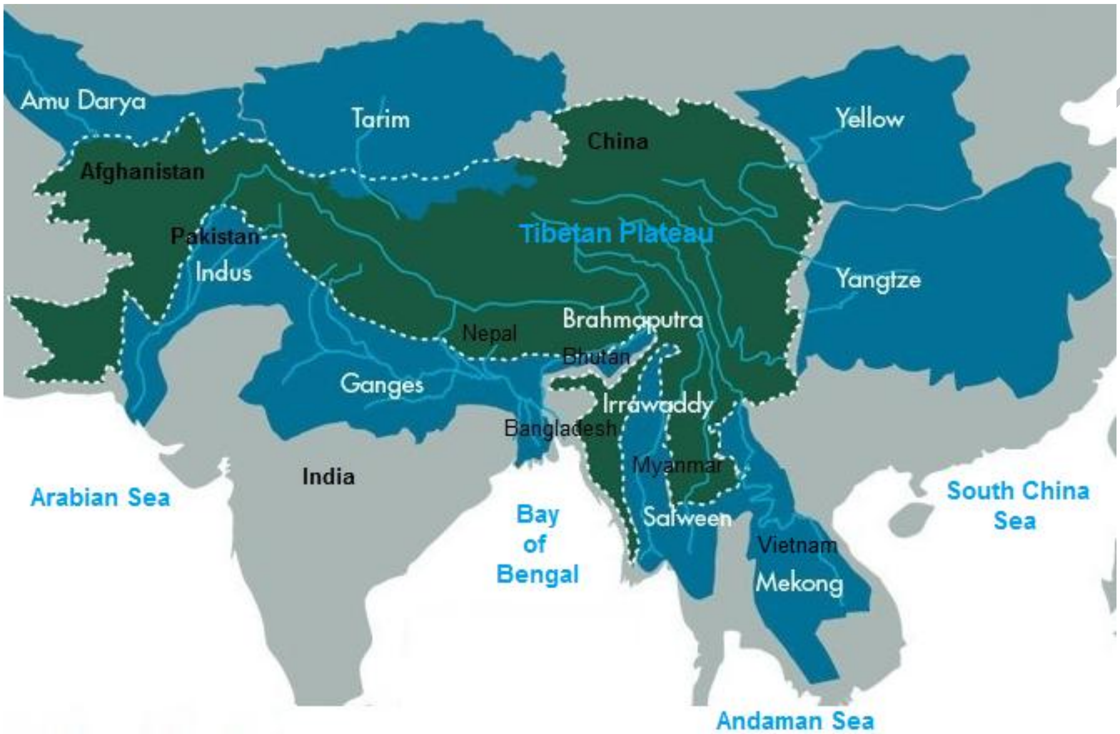

Fig.2 HKH Ten Large River Basins

Himalayan mountains supply freshwater to areas from Karachi to Beijing and even beyond. Amu Darya basin supplies water to central Asian states, Indus to Pakistan, Ganges to India, Brahmaputra to Bhutan, India and Bangladesh, Irrawaddy, Salween and Mekong basins to China and Myanmar and beyond, Tarim, Yellow and Yangtze basins to China. Six river basins pass through China which is the reason behind its large hydroelectricity generation capacity. Large rivers pass through several countries before falling into oceans that is the reason of water conflicts between involved countries. We have marked the borders ourselves the nature treats us all alike. Boundary treaties and interstate agreements are the ultimate solution of water sharing and distribution issues. Wars and waters are typical examples which mandate existence of Unite Nations forum. Treaty of Zonhoven 1833 on Scheldt and Meuse Rivers between Netherland and Belgium is historic example of sharing the boundary river. The Halibut Treaty 1923 between Canada and America is an agreement concerning fishing rights in the northern Pacific Ocean. American and Canadian Boundary Water Treaty 1909 played model role in sharing river waters for power generation and flood control. Columbia River Treaty 1964 allowed Canada and America share 1250MW electricity and $64.4 million flood control benefits of Mica, Libby, Duncan and Keenleyside dams. Typical examples of other water agreements include interstate Rio Grande Compact 1938 between Colorado, New Mexico and Texas, the International Commission for the Protection of the Danube River (ICPDR) 1994 between 15 European states. In the absence of any formal agreement Turkey, Iraq and Syria are always disputing on water control in Euphrates-Tigris basin since 1960, when India and Pakistan signed IWT.There is no academic solution for transboundary water conflicts; however, United Nations, World Bank and World Trade Organizations have powers to mediate treaties between the rival countries.A typical success story of boundary water sharing is IWT, 1960, that is viewed as a role model for sorting out water conflicts on transboundary river basins ("Indus Water Treaty," 1960).

Indus River has a total length 3,180 km from Tibetan plateau to Arabian Sea. It runs 404 km in China and 395 km in Ladakh. Jhelum River flows through Kashmir and Pakistan. It is a tributary of the Chenab River and has a total length of about 480 miles (774 km). The river Jhelum rises from a spring at Verinag situated at the foot of the PirPanjal in the south-eastern part of the valley of Indian held Kashmir. It flows through Srinagar and the Wular Lake before entering Pakistan through a deep narrow gorge. The Kishenganga (Neelum) River, the largest tributary of the Jhelum, joins it at Domel Muzaffarabad, as does the next largest, the Kunhar River of the Kaghanvalley. The Chenab Riveris a major river that flows in India and Pakistan. It originates from upper Himalayas in the Lahaul and Spiti district of Himachal Pradesh, India, and flows through the Kishtwardistrictin Jammu and Kashmir into the plains of the Punjab, in Pakistan. Chenab is960 km (597 mi)long and its average annual flow is estimated to be around 33 Million Acres Feet (MAF) out of total 145MAF water capacity of Pakistan. The break-up of 145 MAF is as follows. Indus (including river Kabul) provides 89.58 MAF annually (61.89% of total annual river flows), Jhelum, 22.69 MAF annually (15.67% of total annual river flows), Chenab 25.45 MAF (17.58 % of total annual river flows), and other unaccounted for diversions, post rim station of the rivers to Kotri barrage plus eastern rivers comprise of 7.0 MAF (4.83% of the total annual river flows). The total varies from 137 to 145 MAF annually. Out of this, on average, 102 MAF is diverted for the irrigation system. System losses (evaporation, seepage, conveyance) equal to 12 MAF annually. Surface water going to the sea is 31MAF annually, 8MAF desired to stop sea erosion. Pakistan's total costal length is 1100 Km, shared by Balochistan (750km) and Sindh (350 Km) respectively, is facing severe threat of land erosion due to sea intrusion. An international panel of experts conducted a study in 2004-05 and suggested an annual release of 8.86 MAF of water downstream Kotri to stop the sea intrusion as well as protection against environmental hazards. Downstream water storage barrages and control gates of eastern and western rivers are shown in Fig.3

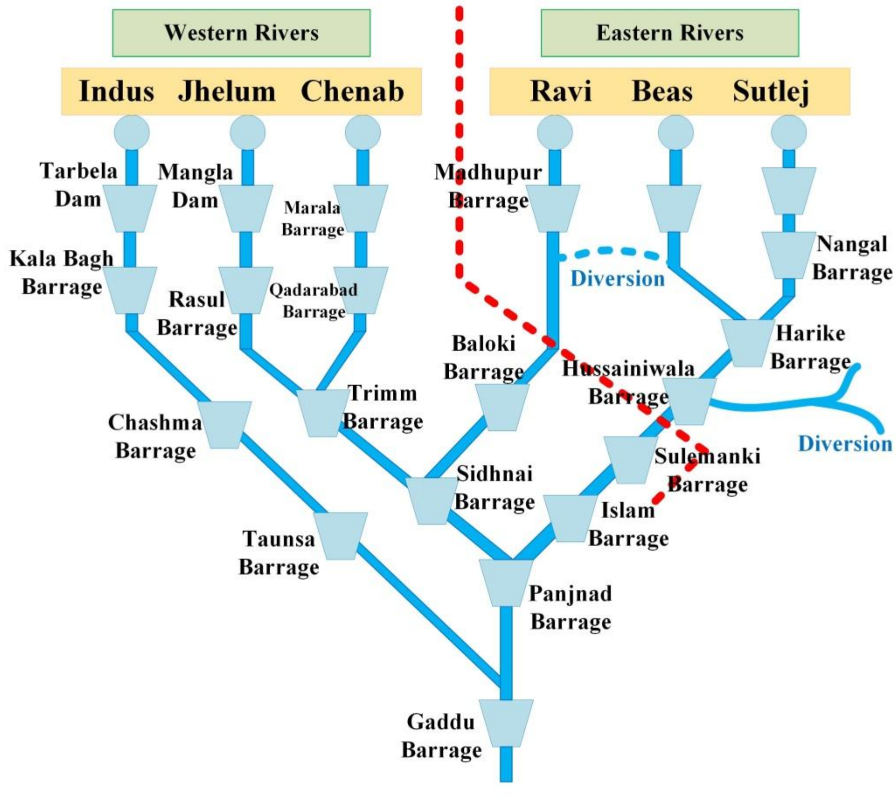

Fig.3 Water dams, storage barrages and control gates of rivers.

June and July months are usually considered monsoon rain months. Glaciers melt fast to increase water in rivers. Despite optimum season the water flow rates in rivers are at dead levels. Tarbela dam reached dead level on 8th July and Mangla is emptying fast to reach dead level in couple of weeks. According to WAPDA water reports the latest flow rates on 10th July 2018 are shown in Table 1.

Table 1 Water flow rates in western rivers and barrages on 10 July 2018

Name	Inflow (cusecs)	Outflow (cusecs)	Location
Indus River*	123,500	122,800	Tarbela
Jhelum River	39,300	55,000	Mangla
Chenab River	68,600	36,200	Marala
Jinah	145,900	140,900	Barrage
Chashma	143,400	180,000	Barrage
Tounsa	193,300	177,300	Barrage
Punjnad	14,960	000,000	Barrage
Gaddu	150,000	110,900	Barrage

*33,200 cusecs from River Kabul coming from Afghanistan

Normal water flow in all the three rivers is 186,000 in summer and 386,000 during monsoon rains. According to Geo.TV on 14 July 2018 theoperating levels of water inTarbela, Mungla and

Chashma were 1405.51, 1050 and 641 feet and their dead levels are 1380, 1050 and 638.15 feet respectively. Tarbela and mangla have total storage capacity of 11.098 MAF and 7.39 MAF all together 18.49 MAF that has declined to 14MAF due to silt in reservoir. Generally available water capacity in June is 1.14MAF that is not enough for coping with drought season. It is insightful to see Jhelum, Chenab, Ravi, Beas and Sutlej rivers are feeding only 14,000 cusecs into Panjnad Barrage (five rivers confluence) which is not filling to discharge water to downstream Gaddu Barrage in paddy cultivation season. India is storing all the monsoon and glacier waters which she will release later if flash flood situation occurs in Pakistan to further worsen the disaster. Timed injection of stored uphill water create havoc in every year in Pakistan. India stops water when we need and floods the lower riparian during rainy seasons. More than 80% water comes for 100 days during monsoon that must be stored for rest of 265 days.

Himalayan glaciers, contributing over 80% water to the Indus river (that feeds more than 65% of the country's agriculture), are receding at alarming rate of 30 to 50 meters/annum. The Himalaya contains the world's third largest ice mass after Antarctica and Greenland. Glacial area in Pakistan's north is spread over an area of 16,933 km^2. The river Indus, which originates from Tibetan Plateaus, flows through India, enters into Pakistan from GilgitBaltistan. In 1950, Pakistan was rated by international agencies as a water abundant country. In 1951, annual water availability in Pakistan per capita stood at 5650 m3 which was more than 3 times the threshold value of 1700 m3/capita/annum. In 1992, the UN Fund for Population stated that Pakistan was a water stressed country with only 1700 m^3/capita/annum of the commodity available. In 2003, Pakistan's per capita availability of water declined from threshold value. Currently Pakistan is a water scarce country with alarmingly reduced availability to 940 m^3/capita/annum, which is critically less than the threshold value. The country's per capita annual water availability is poised to drop further if there is no paradigm shift in the prevalent water infrastructure. The reasons, inter alia, for water scarcity in Pakistan is a simultaneous effect of overpopulation, climate change and more importantly, non-development of major reservoir(s) after Tarbela dam ("The World Bank In India," 2018).

3. Indus Water Treaty

Indus water treaty (IWT) is a transboundary water distribution agreement between India and Pakistan that was mediated by World Bank on 19 September, 1960. Signatory parties were represented by first Indian Prime Minister Pandit Jawaharlal Nehru and first Pakistani General President Ayub Khan. Both parties agreed to give control of three eastern rivers (Ravi, Beas and Sutlej) to India and the three western rivers (Indus, Jhelum and Chenab) to Pakistan. Both parties agreed to use of river waters for domestic needs and power generation such that it does not affect the overall flow of water below a mean level of 55,000 cusecs at Head Merala in Pakistan. IWT articles (I to XII) and annexures (A to H) are available on the World Bank Website and key terms & conditions doccuments shown in Table 2 ("The World Bank In Pakistan," 2018).

Table 2 Articles/Annexures of IWT, 1960

IWT 1960, Articles	IWT 1960, Annexures
Article I Definitions Article II Provisions regarding Eastern Rivers Article III Provisions regarding Western Rivers Article IV Provisions regarding Easter Rivers/Western Rivers Article V Financial Provisions Article VI Exchange of Data Article VII Future Cooperation Article VIII Permanent Indus Commission Article IX Settlement of Differences and Disputes Article X Emergency Provisions Article XI General Provisions Article XII Final Provisions	Annexure A - Exchange of Notes between India and Pakistan Annexure B - Agricultural use by Pakistan from Tributaries of the Ravi Annexure C - Agricultural use by India from the western rivers Annexure D - Generation of Hydro-Power by India on the western rivers Annexure E - Storage of Waters by India on the western rivers Annexure F - Neutral Expert Annexure G - Court of Arbitration Annexure H - Transitional Arrangements Annexure H - Appendix II (Annex II to Annex H above) Baglihar Decision to be released to India and Pakistan On Monday, February 12, 2007 Analysis & Research: http://www.worldbank.org/en/region/sar

IWT documents use technical terms and phrases which are defined here for readers ("The World Bank In Pakistan," 2018).

3.1 Pondage level

Pondage usually refers to the comparably small water storage behind the weir of a run-of-the-river hydroelectric power plant. Such a power plant has considerably less storage than the reservoirs of large dams and conventional hydroelectric stations which can store water for long periods such as a dry season or year. With pondage, water is usually stored during periods of low electricity demand and hours when the power plant is inactive, enabling its use as a peaking power plant in dry seasons and a base load power plant during wet seasons.

3.2 Dead Storage Level

Dead storage refers to water in a reservoir that cannot be drained by gravity through a dam's outlet works, spillway or power plant intake and can only be pumped out. It is the volume in a reservoir below the lowest controllable level. Dead storage capacity is defined as the portion of total storage capacity that is equal to the volume of water below the level of the lowest outlet. Dead Storage Capacity" means that portion of the Reservoir Capacity which is not used for operational purposes, and "Dead Storage" means the corresponding volume of water.

3.3 Operating pool

It is a level above dead storage level and full pondage level. Reservoir Capacity" means the gross volume of water which can be stored in the reservoir. Flood Storage Capacity" means that portion of the Reservoir Capacity which is reserved for the temporary storage of flood waters in order to regulate downstream flows, and "Flood Storage" means the corresponding volume of water. "General Storage Capacity" means the Conservation Storage Capacity excluding Power Storage Capacity, and "General Storage" means the corresponding volume of water.

3.4 Live Storage

Live storage is the portion of the reservoir that can be used for flood control, power production, navigation and downstream releases. In addition, a reservoir's "flood control capacity" is the amount of water it can regulate during flooding. "Conservation Storage Capacity" means the Reservoir Capacity excluding Flood Storage Capacity, Dead Storage Capacity and Surcharge Storage Capacity, and "Conservation Storage" means the corresponding volume of water. "Power Storage Capacity" means that portion of the Conservation Storage Capacity which is designated to be used for generating electric energy, and "Power Storage" means the corresponding volume of water. "Small Tank" means a tank having a Live Storage of less than 700 acre-feet and fed only from a non-perennial small stream: Provided that the Dead Storage does not exceed 50 acre feet.

3.5 Surcharge Storage

Surcharge storage is the storage between the full reservoir level and the maximum water level of a reservoir which may be attained with capacity exceeding the reservoir at full reservoir level to start with.

"Surcharge Storage Capacity" means the Reservoir Capacity between the crest of an uncontrolled spillway or the top of the crest gates in normal close d position and the maximum water elevation above this level for which the dam is designed, and "Surcharge Storage" means the corresponding volume of water.

3.6 Run-of-River Plants

Run-of-River Plant means a hydro-electric plant that develops power without Live Storage as an integral part of the plant, except for Pondage and Surcharge Storage.

Domestic agriculture water use and run of river hydropower station construction details and canal water allocations have been detailed in Annexures A to F as shown in Tables 3 to 5.

Table 3 Storage capacities permitted on western rivers under IWT, 1960 (AnnexE)

Western River systems (Names)	Conservation storage capacity (As per IWT, 1960)*, in Million Acre Feet (MAF)		
	General storage	Power storage	Flood storage

	capacity	capacity	capacity
The Indus Jhelum (Tributary) The Jhelum (main) Chenab (Tributary) The Chenab (main)	0.25 MAF 0.5 MAF Nil 0.50 MAF Nil	0.15 MAF 0.25 MAF Nil 0.60 MAF 0.60 MAF	Nil 0.75 MAF Not divert/hold Nil Nil
Total storage	1.25 MAF	1.60 MAF	0.75 MAF

* Total storage cannot exceed 3.60 MAF that Wikipedia refers to 33 MAF to promote Indian propaganda campaign.

Table 4 Irrigation water withdrawals permitted under IWT, 1960: Annex C

Canals on Chenab (names)	Kharif 15 April -14 October	Rabi 15 October – 14 April
Ranbir Canal Pratab canal	1000 cusecs 400 cusecs	350 cusecs 100 cusecs

New reservoirs on the Indus (1st July to 20 August), the Jhelum (21st June to 20 August) and the Chenab (21st June to 31st August) should be filled at such rates the flow in Chenab above Merala may not be less than 55,000 cusecs.

Table 5 Permitted irrigation areas and annual conservation release under IWT, 1960: Annex C

River System	Max Irrigated Area	ACR	New Lands
Indus Drainage Basin Jhelum Drainage Basin Chenab Drainage Basin Chenab Basin DegNadi	70,000 Acres 400,000 Acres 225,000 Acres* 6,000 Acres (120 cusecs)	… The Jhelum The Chenab …	… 150,000 Acres 75,000 Acres …

* Total 125,000 acresfor Punjab and 100,000 acres for Jammu district. ACR: Annual conservation release may be used to develop new land on condition it should be 0.2 MAF in Jhelum and 0.1/0.2 MAF in Chenab rivers.

IWT violation complaints will be submitted to World Bank, which can mediate itself or appoint a neutral expert to investigate the ground realities as per annex F for which India and Pakistan will the expenses. Under IWT the upper riparian (India) was allowed maintain existing dams on tributaries and continue build the under construction reservoirs. Keeping in mind a few hundred kW size existing power plants Pakistan agreed to allow India build run of river plants on western rivers, in addition to domestic use of water, subject to avoid diversion of river natural route or reduce water flow below certain minimum levels recorded in agreement. Existing and under construction hydropower plants are shown in Table 6

Table 6 Existing or under construction power plants at time of IWT, 1960* (Annex D)

Existing plants	Capacities (kW)	Future Plants	Capacities (kW)
Pahalgam	186	Mahora	12,000
Bandipura	30	Ganderbal	15,000
Dachhigam	40	Kupwara	150
Ranbir Canal	1200	Bhadarwah	600
Udhampur	640	Kishtwar	350
Poonch	160	Rajouri	650
…	…	Chinani	14,000
…	…	Nichalani	600

* It was assumed in IWT that new Run-of-River reservoirs will be same size

Agriculture accounts for 20% of GDP in India and Pakistan. Major crops in Pakistan are wheat, rice, maize, sugarcane, cotton and jowar. We grow wheat on 8.6 million hectares (23.3 million tons), rice on 2.6 (5.4 million tons), maize on 1 (3.1 million tons), sugarcane on 1 (55 million tons), cotton on 3 (13 million tons) and jowar on 0.3 million hectares (0.18 million tons). India and Pakistan heavily depend on natural fresh waters to feed local and international communities. Eastern and western rivers have annual water discharge capacity of 33 MAF and 136 MAF respectively. Due to Kabil River the overall water flow capacity becomes 145 MAF in Pakistan as shown in Table 7

Table 7 Water capacity of western rivers

River System	Water Capacity (MAF)	Percent (%)
The Indus	70.58	48.76%
The Chenab	25.45	17.58%
The Jhelum	22.69	15.67%
The Kabul	19	13.12%
Ravi/Beas/Sutlej	33	Diverted under IWT
Total	137.72 + 33	100%

IWT model was also implemented among provinces according to their needs. A land and population based formula was devised to distribute water. Political leaders have no consensus on Kala Bagh dam and sometime threaten each other to go to World Bank for local distribution agreements. All the rivers pass through Punjab and its soil is more fertile than other provinces. Local distribution of water resources is shown in Table 8

Table 8 Local distribution of water among four provinces

Province	Allocation	Irrigated	Population	Area (km^2)

		Area		
Punjab Sindh KPK Baluchistan	55.94 MAF 48.76 MAF 8.78 MAF 3.87 MAF	77% 14% 5% 4%	110,012,442 47,886,051 35,525,047 12,344,408	1111,345 140,914 347,190 101,741
Total	117.35 MAF	100%	207,774,520	796,096

Pakistan has 59,000 MW hydropower potential out of which hardly 6,600 MW hydropower is produced. India has 84,000 MW hydropower potential out of which 39,500 MW is produced. Nepal and Bhutan have 43,000 and 24,000 MW hydropower potentials out of which meager 700 MW and 1500 MW power is being produced. SAARC countries have overall 210,000 MW hydropower potential as shown in Fig.4.

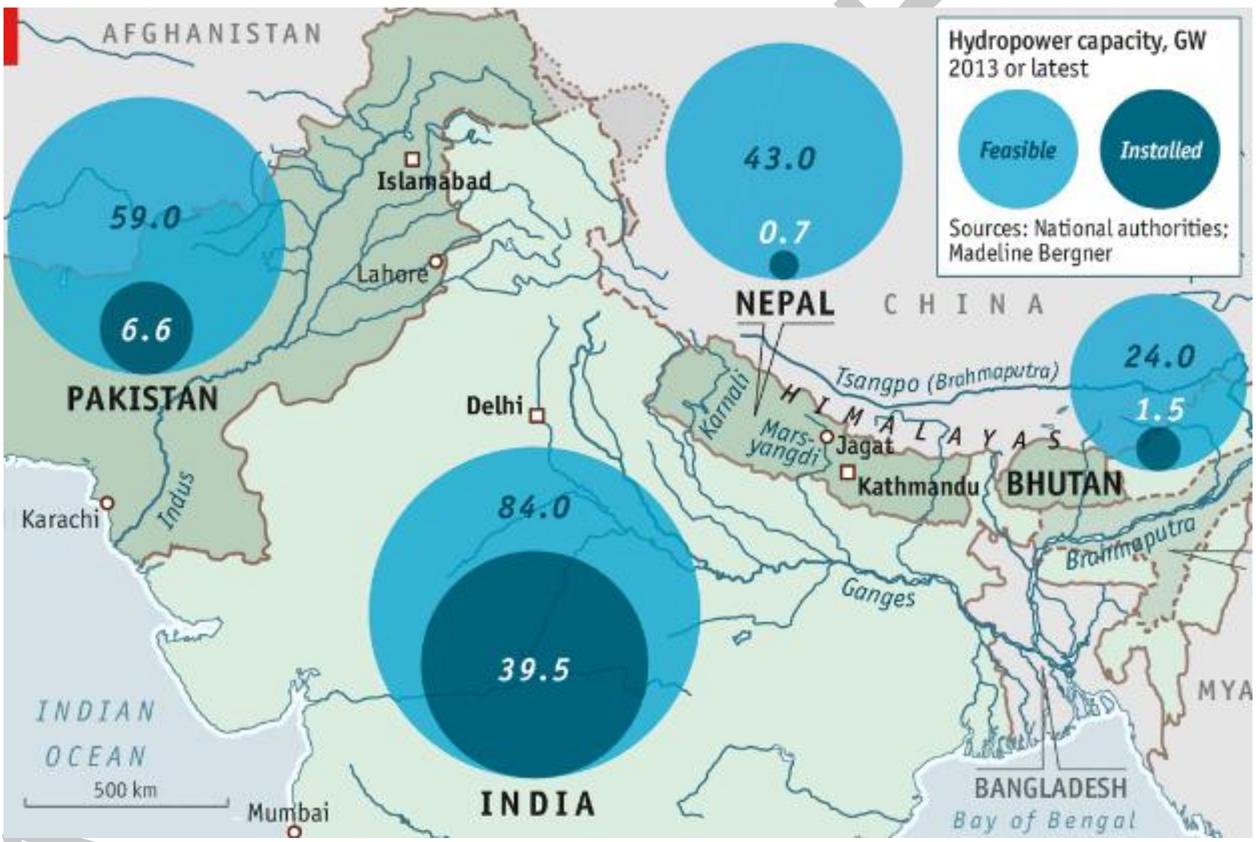

Fig.4 SAARC Hydropower Potential [62]

According biennial freshwater report 1 to 25% Indians, 26 to 50% Pakistani, 51 to 75% Bangladeshi and Nepali, and 76 to 100% Afghans have no access to safe drinking water (Gleick & Heberger, 2012). Himalaya supplies lot of fresh water to Asian countries but many of them waste water due to their poor water management policies. There are total 47,655 dams on planet out of which there are 22,000 in China, 4,291 in India, 71 in Pakistan, 66 in Iran, 46 in Sri

Lanka, 3 in Nepal, 2 in Afghanistan and 1 in Bangladesh. Large dams in Pakistan include Tarbella, Mungla, Warsak and Ghazi Brotha. Warsak is almost filled with silt and runs as a run-of-river plant. Pakistan has huge potential for dams but cannot build large dams due to economic and political reasons. Bhasha, Bunji, Dasu, Munda and Kalabagh dam sites have potential of 17,000 MW and tens MAF water storage capacities.

4. Ingenious Terms and Ingenuous Stances

Water treaties may have very ingenious terms, which may prove nerve heads later. A term unrestricted non consumptive use of water was ignored by Indus Water Commission of Pakistan, which proved problem due to run-of-river dam projects spree later. Indian water commission was well aware of hidden meaning at start which were not well clear to Pakistani water commission. Indian water commission set aside three eastern rivers complete and got right of building run-of-river power plants on western rivers too .Unrestricted non consumptive use of water for power generation was the ingenious gist used to deprive Pakistan from getting full western rivers' water later. A run-of-river plant has little storage, if number of plants increases then it can be used to deprive lower riparian from water in any particular season. Indian reservoir and plant sizes were smaller at the time of IWT-1960, on the basis of which, phrases like unrestricted access to hydropower subject to maintaining minimum level of water flow, were permitted. India started larger reservoirs in last two decades declaring their water war against Pakistan. Indian Prime Minister and senior State Ministers endorsed his mission to deprive Pakistan from waters flowing down from Indian administered Kashmir.

Indus Water Commission of Pakistan viewed run-of-river plants spree an advertent violation of IWT, though it is too stretching over, if not violation completely. If you empty dead level to feed to new lands in off seasons and refill the dead levels every season then most of summer season before monsoon water will not be available to lower riparian which actually owns control of western rivers. Indian dam and power plant sizes were smaller at the time of ITW, 1960, which were increased in subsequent dam projects due to recent technical advances. Under planned to fail IWT, India has planned tens of large hydropower projects on the Chenab, dozens on the Jhelum and Indus. India violated IWT by raising Ravi banks and diverting Neelum Jhelum water into Wular Lake. Sutlej, Beas and Ravi irrigated areas in south Punjab have deserted wide swathes of agriculture lands. Pakistan tried to water Ravi by Link Canal but shortage of water flow in Head Marala did not allow it. Indian Indus water commission strategy is unbeknownst mise-en-scène of embed water war (Allen, Cohen, Abelson, & Miller, 2012).

5. Water Management Challenges

Pakistan faces serious political and technical water management challenges. Water management challenges include building reservoirs, dams, barrages, canal and irrigation systems. Pakistan has upstream water control challenges and downstream distribution challenges. Political leadersare bogged in water rights politics and upper riparian ingenuously uses them to maintain water, power and food shortages in Pakistan. Water distribution, reservoir and efficient use challenges include public opposition from fear of land loss and dislocation. National leaders play their role in preparing public for national sacrifice (Yasmin, Sohail, & Mangrio, 2015). Statesmen do their job and selfish leaders start using controversy for personal gains. Enemy of truth is not always lie, rather myth which politicians use to exploit their scenario. Pakistan Water and Power Development Authority (WAPDA) is no stranger to controversies on reservoir and dam projects. It is easy to complete water reservoirs and dams projects in kingdoms and hard to accomplish in federations.

WAPDA keeps eye on national interests for water and power. Three of four provinces of Pakistan accuse WAPDA for arguing in favor of Kalabagh Dam (KBD) project, which was conceived after shutdown of rivers by India in 1948, in 1953 half decade before the birth of WAPDA in 1958. Preliminary site study was carried out by Tipton & Hill Company in 1953, feasibility by Chas T Main in 1966, water and power study by World Bank in 1967, feasibility report by WAPDA/HARZA in 1972, appraisal by World Bank in 1980. Overall project was designed by a team consisting of Pierre Londe (France), James J Sherard (USA) and Klaus W John (Germany) et al in 1983. KBD hydraulic modeling was done by Prof EF Mosonyl, flood hydrology by Bertie, sedimentation study by K Mahmood and technical study by D King in 1983. Review of civil works by KS Smith, resettlement plan by M Cheema and review of sedimentation and hydraulic studies in light of Cabinet concerns by K Mahmood in 1985. KBD was reviewed by Asghar Ali Abidi, Sheikh Manzoor Ahmed and Shahnawaz khan in 1984.

Detailed design was prepared by KBD consultants in 1985 and tender documents were finalized by KBD consultants in 1988. Engineers were aware of Kotri Ecology in Sindh and Nowshera Valley flooding in KPK. Earlier was taken care and later was reviewed by Dr Ding Lianzhen (China) in 1987. Final review was done by Dr. John F Kennedy (USA), Dr. Khalid Mahmood (USA) and Dr. Rodney White (USA) in 1987. KBD project was carried on by WAPDA, Government of Pakistan and World Bank. Opponents of KBD project divided 90% of WAPDA into small water and power companies in the name of deregulation policy and finally shelved the project in 2008. Pakistan has been facing energy crisis in 1980s, 1990s and 2010s but politicians could not concur on KBD project. Media and energy experts have advised incumbents to first uphill dams to minimize flash flood fear in hearts of KPK leaders and evaporate drought fear from minds of Sindhi leaders. KBD has become a symbol of living disharmony among provinces as 75 percent population favors construction and 75% provinces oppose it. KBD opponents cry loader for electricity than proponents in hot summer at 50°C. Kalabagh dam has become an undead horse that starts running during flash floods and load shedding but lays down numb rest of the time.

Flood waters damaged buildings and swept away everything in range. Army rescued public by air lifts and military boats to safe places. On eastern side four days rain waters from

GilgitBaltistan province, district Kohistan, district Shangla, district Butgram, district Mansehra, Kaghan Valley, district Toregs, district Abbotabad and district Haripur entered Indus and a big tsunami reached Tarbella. The Taarbella dam released about 25% of surplus water that caused historic damages in district Sawabi, Ghazi Batakra, Zardbe, yousfi, Dhok, GaraIkakhail, GaraZiarakhail, Punjab and Sindh provinces. Power grids and crops were lost yet Motorway Bridge tolerated the big tide. The point to be noted is the Indus River (Kabul and Abaseen rivers) waters were flowing freely unrestricted at Kalabagh site yet flash flood waters caused heavy losses to KPK province. If there was a Kalabagh Dam barrier wall then the backflow might have reached Mardan and Peshawar. During flashflood 2010 the Kabul and Abaseen rivers were overflowing in 8 to 10km ranges along their beds. To deal with water, food and power issues it is better to build first uphill dams mentioned above to reduce flash flood risks before constructing Kalabagh dam. The writers and media channels which advocated Kalabagh dam during the flash flood further threw salt on wounds of flood victims who oppose the Kalabagh dam. The best strategy is to stop the waters coming from Hindu Kush, Karakoram and mighty Himalayan Mountains on downhill dams on slopes to decelerate waters. Once the uphill dams are ready nobody will oppose the Kalabagh Dam. KPK will not oppose due to lack of flash flood fears and Sindh will not oppose due to vast storage of uphill waters. China can help Pakistan fund construction of Bhasha, Bunji and Dasu Dams in north east and a few smaller dams in north western mountains to store the flash rain waters during monsoon (Ganter, 2017). Existing, proposed and possible sites of dams from Gilgit Balistan to Kalabagh are shown in Fig.5.

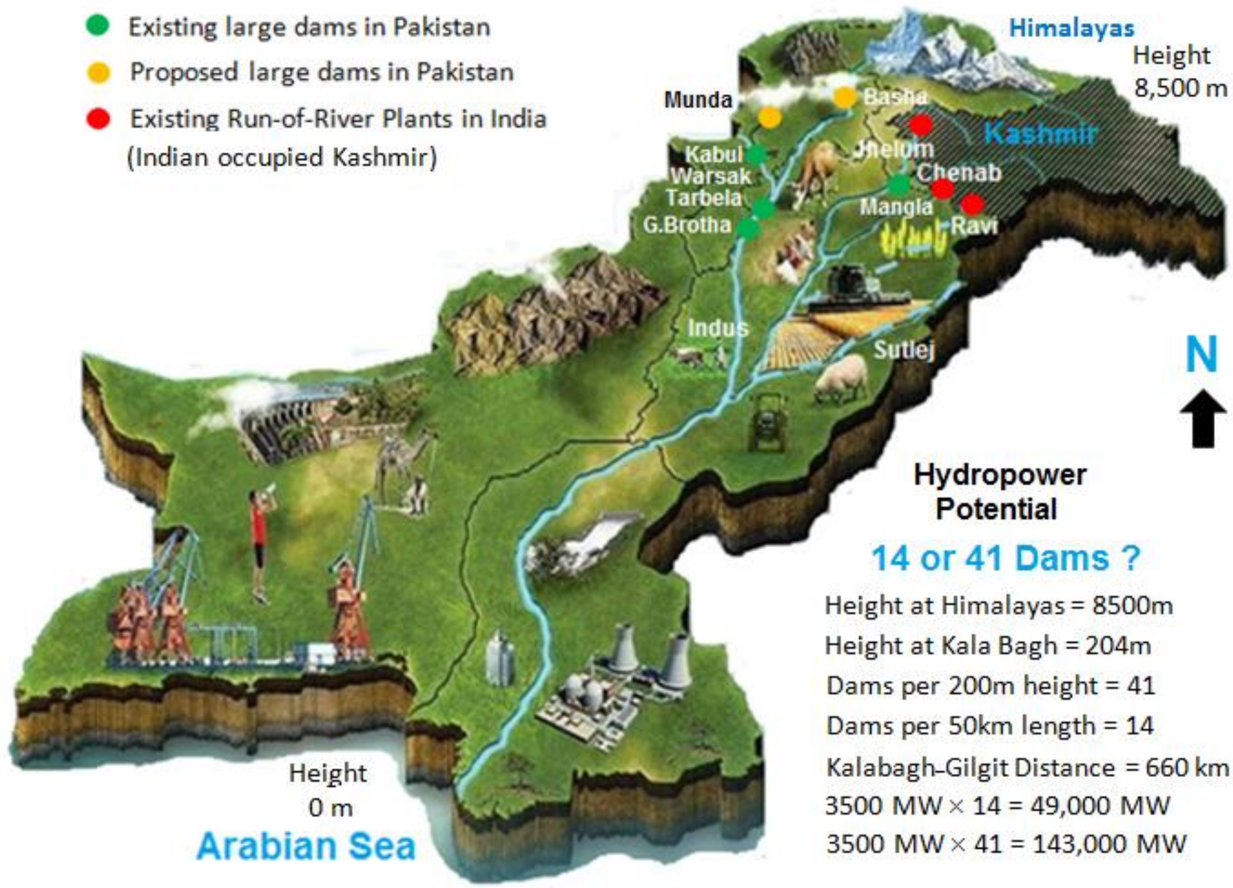

Fig.5 Phase wise construction of dams in Pakistan

Water, energy and food nexus dictates construction of dams from Dia Mir to Kalabagh for agriculture and power generation. Kalabagh Dam is a most debated and most economic project, but stopping uphill dam activities until consensus on KBD is not a wise decision.According to Chairman WAPDA the major objections on KBD come from Sindh Province - Punjab will take away the Indus water -which may be addressed by giving control of KBD to Sindh government. KPK Province has fear of backflow to Noshehra during flash flood that may be addressed by first building BhashaandMunda dams. Bear in mind the water is basic human right and lamb excuses may not be used to delay and derail national progress. In my opinion, population threat is more serious to Pakistan than the water shortage. Shortage of dams becomes more significant in case of water shortage as we let 35MAF rain water fall into sea every year. India has built dams to water for 170 days and our capacity is only 30 days. We have 260,000 tube wells for agriculture which are depleting our ground water. Dams will supply water in canals which will reduce farmers' reliance on underground waters. Water level has dropped to 130 feet in Lahore and more than 250 feet in Islamabad. If waters in monsoon season is diverted and stored then wide swath of Thar region can be cultivated using fertile flood waters. Thar desert used to be land of green forest 4500 years ago, which transformed into desert by evaporation of Ghaggra (India)-Hakra (Pakistan) rivers due to diversion of Ganges [65] and Sutlej [66] or end of monsoon watered Ghaggra-Hakra river passing through Cholistan and Thar deserts as shown in Fig.6

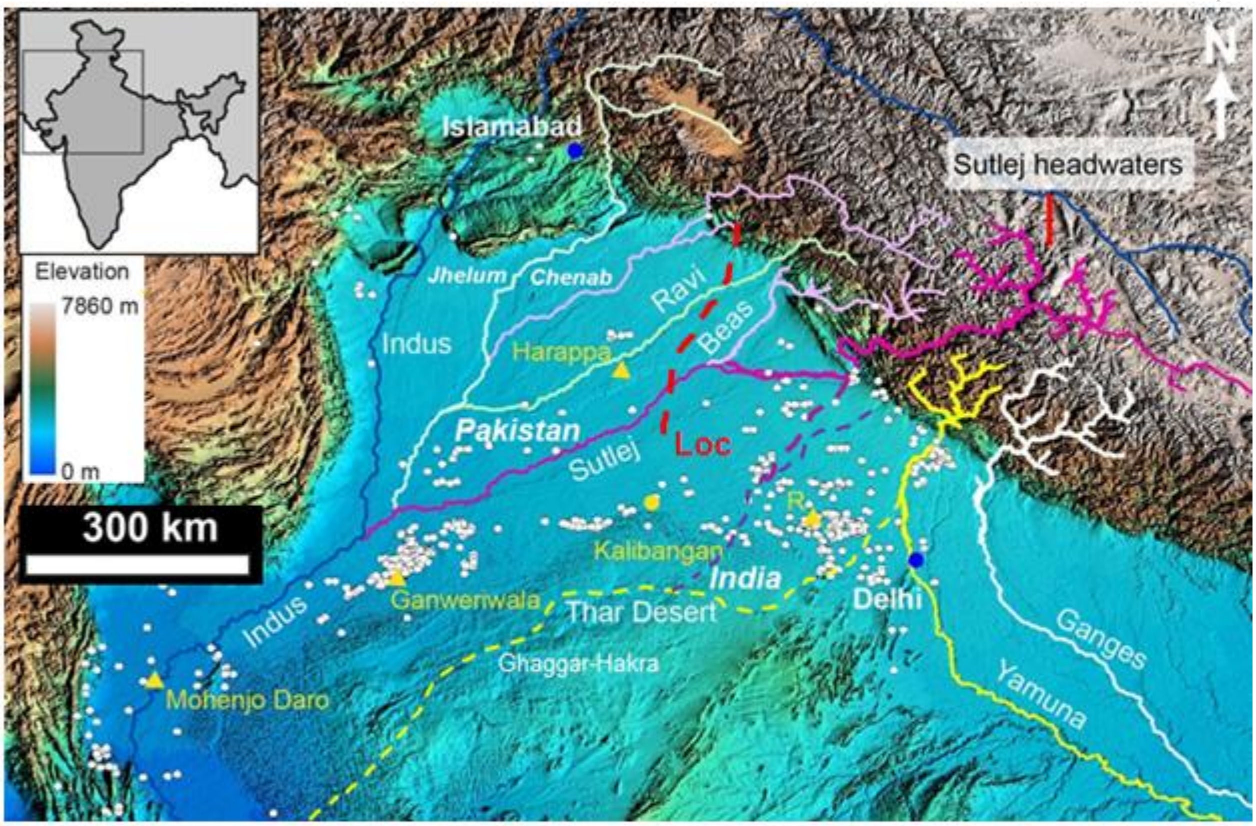

Fig.6 Dried Ghaggar-Hakrariver (dotted) used to originate from Himachal Hills during monsoon and/or fed by Sutlej/Yamana, and diverted to their current courses 10,000 years ago.

KBD is the only location to distribute waters to areas previously fed by eastern rivers. KDB costs only $6.1 billion compared to $1.15 billion Mohmad and $15.66 billion Basha dams projects. Indian run-of-river plants policy has become Pakistan's fate accompli now. They are fighting on trivial issues and ignoring dam spree of upper riparian. Pakistan agreed to water apportionment in 1991, established IRSA in 1992, made national climate change policy in 2012 and reached national water policy on 24 April 2018 ("Indus Water System Authority," 1992; "National Water Policy," 2018). Water storage capacities of Tarbela Dam, Mungla Dam and Chashma Barrage are 6.78 MAF, 4.46 MAF and 0.37 MAF respectively. Naturally 80% of monsoon water is available for only 100 days. Bhasha Dam has water storage and power generation capacity of 6.5MAF and 4500MW respectively. Pakistan gets 80% water from Indus and 20% from Jhelum and Chenab. Chief Justice of Pakistan and Prime Minister has started fund raising campaign to collect $12 to $15 billion to build this Bhasha and Munda dams. Pakistan needs both water and power to replace dirty coal and diesel power plants. UN Climate Change Fund and Paris Accord should sponsor dam construction projects. Sindh faces 80% reduction in rains in 2018 and other provinces might face 25 to 30% reduction in 2025. Egypt has 1000 days water storage capacity, USA for 900 days, India for 220 days and Pakistan only 30 days. Supreme Court has declared it basic human rights issue to build new dams. Bhasha dam site is located in killer Nanaga Parbat mountains one of world's 9th peak. It needs \$2 to \$3 billion alone to build road infrastructure to reach there. It is hard task but you have to take the first step to reach anywhere. Supreme Court and Prime Minister have given call for donations to local and overseas Pakistanis. Call proved effective as billions of rupees reached in first month of call. Malaysia built his dam at his own, China brought industrial revolution and Germany built the system after WW-II at their own. Pakistan produces only 6000MW of hydropower out of total potential of 55,000MW. Satpara and Bunji dams have capacities of 7000MW each. India has 750MAF water potential and 278MAF storage capacity. Pakistan has 145MAF water potential and 12.5MAF storage capacity that 7% which should be at least 20%. Big cities in Pakistan like Islamabad, Karachi and Quetta face water crisis as underground water level has fallen down more than 90% in major cities of Punjab. Quetta and Karachi need 50 and 1000 million gallon water daily which are receiving hardly 32 million and 500 million gallons. Drinking water supplied in Islamabad exceeds WHO limits of hardness (87mg/L), sodium (02mg/) and TDS (227mg/L).

Fecal coliforms and E Coli traces are also present in water. According to third pole analysis 91% of drinking water in Karachi is unfit for health. Water scarce districts of Baluchistan include lasbella, Gaddani Town, Kichhi, Chaghi, Nokundi, Mastong and Dera Bhaghti. Water is supplied at rate of 45 gallons per person in Islamabad, 30 gallons per person in Karachi and Lahore, and 10 to 13 gallons per person in Quetta. Freshwater sources are fast depleting in Lahore, Multan and Vehari districts. Underground water level in most parts of Baluchistan fallen down from 30 to 40 feet in 1951 to 1000 to 1200 feet in 2018. Solar pumped tube wells have extracted most of subsurface water reserve that might take 300 years to replenish. PSDP 2018-19 has kept another 3500 solar water tube wells for Baluchistan. Load shedding is nuisance but Baluch people were happy as tube wells cannot pump water, solar pumps work all the day. Mastong district used to have 350 creases which have gone dry. Natural water charging process needs trees and bushes in fertile valleys and barren mountains. Big dam construction movement started worldwide in 1935 that trend now has shifted to small dams which are easy to manage. Artificial rain technology might be needed in Baluchistan in near future. FWO desalination plant in Gawader will sell 20 million gallon water daily at rate of Rs8.85 per gallon that is annual water business of Rs.6.46 billion. Chinese Oversees Port Holding Company will sell 0.3 to 0.5 million gallon water daily at rate of Rs0.80 per gallon that is annual business of Rs.146 million. Supreme Court of Pakistan has imposed a tax of Rs1/liter on water companies.

6. Climate Change and Water Variability

Water is manifestation of climate change. Water abundance causes floods, water shortage inflicts dry spells, sea level rise causes land erosion and heat waves result in evaporation of glaciers. The climate change is a major test of water sharing agreements (Miralles-Wilhelm, 2017). Climate change triggered water variations can affect transboundary water agreements and treaties (Hejazi et al., 2014). According to UN sustainable development vision the climate change adaptation means water as “Water is the primary medium through which climate change influences the Earth's ecosystems and therefore people’s livelihoods and well-being.” (Rosenzweig & Parry, 1994). Climate change related water variations may bring water sharing nations to conflicts or cooperation policies (Wheeler & von Braun, 2013). Climate change affects water flows (Dowling, 2013), food supply systems (Anel & Fernandez-Gonzalez, 2017), power generation resources and energy consuming systems (Kundzewicz et al., 2018). Climate change impacts natural water resources, affects urban water security and changes irrigation water requirements due to global warming (Li, Yang, & Lam, 2012).

Climate change impacts marine food security, land food chain system, agriculture productivity, crop yields, food prices and ecosystem that needs adaptation (Jaramillo & Nazemi, 2018). Climate change impacts hydroelectricity, power markets, domestic heating/cooling consumptions, generation costs, electric grid capacity, solar and wind energies (Hilden, Huuki, Kivisaari, & Kopsakangas-Savolainen, 2018). Climate change effects economy and air pollution the human health. Think globally and act local as any local level action against GHG emissions effect global climate [96]. Indian leaders vowed in elections to close the western rivers to starve lower riparian by increasing storage capacity for hydroelectricity and diversion of waters for agriculture as their new national policy (Wang, Liu, & Brown, 2017). Indian media ignores Indian water storages and diversions on western rivers and exploits Chinese dams’ spree (S, 2017), although China is not doing to India what she is doing with lower riparian Pakistan. Regarding power generation capacity Tarbela Dam (3,500MW), Guri in Venezuela (10,235MW) and three-Gorges Dam in China (22,500MW) are considered the biggest dams. Tarbela can produce 4,500MW power if water is available that would be possible after construction of Basha and Munda dams.

A huge amount of 3 trillion metric tons of Antarctic ice melted during 1992 and 2017. Ice thaw rate has tripled in last 25 years. Sea level rise might be higher in 2100 than expected earlier. Overwhelming consensus of 80 scientists on 190 feet sea level rise is an existential threat (A. Khan, 2018). Berkeley City Council declared climate emergency more significant than World War II that took life of 60 million people. The population growth is driver of climate change which needs to thin out herd humanly (Gregg, 2018). Citizens are urged to avoid consumerism and narcissism. Pope-Francis said the humanity is at verge of global suicide. Berkeley is likely to become global carbon sink by 2030. Rampant rise of volcanic eruptions and high intensity earthquakes reveals earth’s disturbing thermal equilibrium. Methane belching oceans (N Khan, Kalair, Abas, & Haider, 2017) and dust farting volcanic eruptions are signs of imbalance. Big fleet of vehicles on land, never ending lines of oil tankers on oceans and swarms of airplanes in air inject GHG emissions in heart, lungs and brain of living planet, which responds to rise and fall of GHG emissions. NASA ALMA telescope capture a new born star 300 light years away with baby proplanets orbiting around it. Our milky way seems to be full of carbon crystals (gems) reflecting nearby solar lights. NASA claims to have detected several exoplanets capable of supporting life. Nature has separated planets, stars and galaxies by large distances and composed matters with indivisible particles. Our current state of technology can neither see larger nor smaller objects. We are blinding the planet by plastic pollution, deafening the planet by noise and dumbing the earth by opposing the Paris Climate accord (N. Abas et al., 2018; N. Abas, Kalair, Khan, & Kalair, 2017; N. Abas, Khan, Haider, & Saleem, 2017; Naeem Abas, Khan, Haider, Saleem, & Kalair, 2018; N. Khan, Kalair, Abas, Kalair, & Kalair, 2018; Nasrullah Khan, Dilshad, Khalid, Kalair, & Abas, 2019). Plants, animals and humans are three forms of life on planet none of them can survive without water. Population, construction and industries are disrupting food supply chains, overheating land and choking atmosphere.

NASA's Gravity Recovery and Climate Experiment (GRACE) satellites have been determining trends in total water storage including groundwater, soil moisture, surface waters, snow and ice from 2002 to 2016. Color codes from blue to red show average increases and decreases per year in available fresh water worldwide. The deepest blues indicate areas where flooding has been increasing, the deepest reds indicate areas where water losses have been most severe. Western North America, Eastern South America, Southern Russia, Southern Europe, Middle East, Northern Pakistan, Western China, Central China, Southern China, Myanmar and Arctic and Antarctica regions face rapid water reserve decline. NASA GRACE Satellite map paints a picture of breathtaking limits of both extremes. Half of the planet will be inundated by deluges and half by droughts. Satellites also consume worth several thousand dollars fossil fuels during single launch, but SpinLaunch startup has claimed to catapult satellites by solar electricity in in future (K. Khan, 2006). Robert Frost wondered if the earth would wind up into a world of fire (global warming) or ice (global cooling). NASA's Spitzer Space Telescope discovered a giant gas exoplanet u Andromeda b, 4 billion light years away in constellation of Andromeda, which is both fire and ice due to +1400 to +1650°C temperature on lit side and -20 to -230°C on its dark side. Carnegie Institute of Washington found another exoplanetGliese 436 b, which has burning fire on icy surface due to gravity. Water and fire have implicit connections in nature. Water keeps green wood becoming fuel and rains bring lighting strikes. Simulation studies show earlier climate change killed aliens like dinosaurs 65 million years ago. A day on earth had 18 hours 1.4 billion years ago and 23 hours 65 million years ago, which may exceed 24 hours in future. Nature keeps on adjusting dynamically to maintain its equilibrium and humans might not be part it in future. It is up to South Asian leaders to decide they want clean waters and fresh air or water watts on risk of nuclear suicide. There are many who consider this life to be a simulated reality the real life starts after death of humans.

Agriculture sectors of SAARC countries consist of 20 to 25% of their GDPs and we all cannot afford to import expensive food commodities. World's 40% poor people live in populated

Himalayan valleys. Water conservation includes all the policies, strategies and activities to sustainably manage the natural resource of fresh waterto meet the current and future water demands. India is building series of dams and timber mafia is deforesting our jungles. Ficus and banyan trees used to be symbols of Arhats, gurus, monks and saints in Buddhism, Hinduism, Janis and Islam in South Asia, which are fast disappearing. Weallkill the trees, which give life, food and shelter to every living creature. A tree is symbol of patience and charity on planet that cleans our atmosphere to give us fresh air, flowers and fruits. Air and water molecules keep us spiritually united by passing one's lung and stomach to others. Air and water molecules keep on traversing across borders. We can divide ourselves into borders, the air and water molecules obey no man made border lines. Collapse of Indus Valley civilization occurred due to end of water which forced people to migrate and occupy fresh water sources of Ganges. Control of western rivers will lead to armed conflicts which may escalate into to full-fledged nuclear war. According to Michigan University professors, it takes 100 nuclear bombs to kill global population and world has 15,000 atomic bombs, which are more than enough to destroy the planet. It is time to talk about love and peace rather than nuclear or aqua bombs. Water treaties and nuclear technologies restrain nations from wars. Pakistan is worried about negative impacts of Indian dams as she had already used water weapon in 1948 that forced Pakistan to go for IWT. If no action is taken by global institutions against dam spree then the ground reality may lead both countries to water wars. International Court of Justice (ICJ) in Hague in 2010 and World Bank (WB) in 2016 asked India to freeze construction activities but she continued underground. Change of political camps has changed the mind of international institutions which follow America more than rule of law.

7. The Limits of Two Extremes

Climate change has caused weather extremes at local and global scales. It is very strange the half of same country suffers from drought and rest inundated with floods. There is scorching heat in south and snowfall in north. Nature controls living species to maintain natural equilibrium through wars, diseases and disasters. The best way, in the light of past experiences, is to force every couple to produce two children for the continuity of life on planet. It would be better to opt genitive population growth for a few decades to maintain population at 7 billion. Our technology has failed to feed 7.5 billion people what when we will grow to ten billion? Population peril is an inbuilt time bomb which can explode us inside out (Naeem Abas, Naseem, Kalair, & Saleem, 2018). Exponential growth of population does not reflect any horror at start but whelms over times. To understand effect of doubling, suppose you pay just one cent to any person in first month, two cents in second and 4 in third and so on, then you will pay total \$40.95 in first year, \$167,772.15 in second year and \$687,194,767.35 in third year and \$88 billion in 43rd year. Human population was just 1 billion in 1800 at doubling rate of 300 years. Our population from 1800 to 1927 increased to 2 billion at 127 years doubling rate and then from 1927 to 1974 increased to 4 billion at 47 years doubling rate. Global population from 1974 to 2020 seems to grow to 8 billion at doubling rate of 46 years. In case of business as usual the world population is likely to grow to 10 to 12 billion by 2100.

The people who have died (>100 billion) are 14 to 15 times more than living (7.5 billion) today. More than 9.8 billion persons died in twentieth century with different causes. Communist famines killed 38 to 46 million people from 1921 to 1998. Smallpox killed 500 million people in 20th century. Influenza alone killed 13-29 million in 1918 and 1919. Earlier diseases were plague, tuberculosis, influenza, accidents and diphtheria the major killer diseases today are heart attacks, cancer, noninfectious airways, cerebrovascular diseases, accidents, diabetes and suicides. Melting of ice graveyards in Siberia poses great risk of return of ancient diseases. Earlier people died of famines and modern people die of obesity. A diamond meteorite can enrich Africa and Russia but a wandering asteroid may collide with earth to cause heath death. Super volcano may cause nuclear winter marking end of Holocene with start of another Ice Age. Genetic engineering may create super kids who consider older generation a burden on limited earth resources. They may consider us unnecessary to go ahead. Growing population is occupying deserts, jungles, mountains and oceans. Animals are already loosing habitats and x, y, z generations may be refused fertile lands. Elite classes have already made laws to use poor people's kidneys, hearts, eyes and other useful organs. Rise of health and education expenses will render major proportion of population walking dead extremist zombies (Yasmin, Sarkar, & Sohail, 2016; YASMIN, SOHAIL, SARKAR, & HAFEEZ, 2017). Climate change is the biggest looming threat and superpower denies its existence. Global warming may melt Siberian ice graves to disperse ancient diseases. End of climate change peril may be same as Mayan end of world prophesy, but end of coal plants and oil fired cars will reduce atmospheric pollution killing people and plants. It is time to let rivers run, wind waft and forests foster else look for how to leave the earth ("Humanity has only 100 years left to leave Earth or perish, Stephen Hawking believed," 2017; "List of deaths in wars, genocides and natural hazards," n.d.).

Pakistan WAPDA built 5.88MAF capacity Mangla Dam in 1967, 0.87 MAF capacity Chashma Barrage in 1972 and 11.62MAF capacity Tarbela dam in 1976. According to World Bank data Pakistan WAPDA had planned to build Kalabagh Dam in 1986 and Basha dam in 2010 which could not be built due to lack of political consensus on Kalabagh Dam project. Popular politicians and military generals failed to seek consensus therefore Chief Justice of Pakistan took notice on human grounds to build Basha and Mohmond Dams due to looming climate change threats. Pakistan has Asia's largest irrigation system consisting of two dams, 14 barrages, 6429km long canals, 31214km long distributaries and 58,000 water outlets. This huge irrigation system has 3350km long wide high mud/stone walls to control flood waters. There are 50,000 employees taking care whole system. A big fraction of 65% of funds is consumed in salaries rest 35% on actual repair and maintenance. We have only 30 days water storage capacity and 80% of water comes during 100 monsoon days in summer. Pakistan is losing $21 billion water every year. Out of 796096km area, we have 34 million hectare cultivatable land out of which 16 million hectares is being irrigated and rest 18 million hectares is changing into barrens. Per person water availability used to be 5650m^3 in 1951 that due to Indian water control policies has decreased down to 850m^{3}per person in 2018. South Punjab had waters of three rives (Ravi, Sutlej and Beas) before Indus Treaty who have no more water except few seasonal canals.

8. Conclusions

Rivers follow their natural paths irrespective of manmade boundaries. After partition in 1948, Indian officials closed taps of rivers flowing into Pakistan. US experts pointed out in 1950s that upper riparian (India) can control river water flow into lower riparian (Pakistan). World Bank used its financial muscle to mediate IWT between India and Pakistan in 1960. Three eastern rivers (Sutlej, Beas and Ravi) were given to India and three western rivers (Chenab, Jhelum and Indus) were given to Pakistan. Upper riparian diverted Sutlej, Beas and Ravi waters to south western provinces from 1960s to 1990s and initiated run-of-river dam spree on western rivers from 2000s. India started violation of IWT by declaring construction of a series of dams on western rivers. India announced construction of 500MW run-of-river Buglihar dam in Doda district during 1999-2008, 390MW run of river DulHasti on Chandara river (contributory of Chenab) during 1985-2007 and 850MW run of river Ratle dam in Kishtwar District during 2013-2017 on river Chenab. India has already 690MW Salal dam, NimooBazgo, 180MW Dumkhar, 44MW Chutak, Kirthai dam, 1200MW Sawalkot dam, PakalDul and Bursar dams on river Chenab. India announced to construct 330MW run-of-river Kishnaganga (rock filled 37m high dam to reroute some water to south to affect the Neelum Jehlum dam in Pakistan) during 2007-2018, 480MW Uri dam on de facto line of control in Barmula District during 1998-2014 and recent Rubber Dam on Wullar Barrage in Kashmir during 2016-2018. IWT has granted India 33MAF (100%) water of three eastern rivers and permission to build fair number of run-of-river plants on western rivers. India intends to use run-of-river power plants vouchsafe on western rivers to deprive lower riparian from seasonal waters. India has already diverted eastern rivers and has started diversion of Neelum river waters to Wular barrage, eventually entering river Jhelum. Despite all the lower riparian has failed to build dams to regulate the available water. Annual flow of western rivers, including Kabul River, is 137 MAF bulk (80%) of which comes in 100 days from July to September. Construction of Mohamand (1.29MAF, 800MW) and Basha (6.5MAF, 4500MW) dams will support water-energy-food nexus. Compliance to IWT in letter and spirit seems to be ultimate solution of water conflicts between upper and lower riparian states. Water variability due to climate change may be integrated in Indus Water Treaty keeping in mind rights and needs.

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Highlights

The Indus Water Treaty is cited to be successful settlements of boundary water basin conflict.

Water, food and energy are intimately related in a nexus, and changes in one of these sectors influence the others.

This paper reviews global water conflicts, boundary river treaties and aftermath of Indus Water Treaty in context of water and energy.