

The Dilemma of Dams to Manage Floods in Pakistan: An Analysis from the Landscapes of National Security

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Abstract:

The study aims at exploring the causes of floods, the role of dams to manage floods, the destruction caused by them, ways and means to save surface and groundwater for national security. Due to rapid climatic changes, the phenomenon of floods is likely to increase in the future posing a bigger threat to life and property. This research finds out that due to the non-existence of an effective water strategy, a huge amount of water is allowed to run into the Arabian Sea unused. Findings suggest that due to the worst water management, the country's underground water resources are fast depleting. This study makes the point that due to acute shortage of water reservoirs, in the near future challenges will trap the country into a dilemma of food security, energy security, water security, human security, and above all national security. The research is deductive and has used a qualitative approach to collect the data to assess the shortcomings in the existing infrastructure of reservoir management and interlinks with national security.

Keywords: Pakistan, dams, water management, food security, water security, national security

INTRODUCTION

The panorama of floods has immune the national response because it has almost become a ritual that from June to September floods have to come, people have to suffer, media has to report and the same political rhetoric has to be raised but there will be no moving forward. Since the construction of medium and small dams fall outside political scoring, why should nnt the flood water be harnessed by building medium and small dams? In a country, with a fast-growing population and growing demand for drinking water and irrigation, both the wastage of floodwater draining into the sea is enough reason to study the advantage of building small and medium-sized dams. Pakistan has already been the victim of Indian draconian acts meant to restrict the free flow of water that it had promulgated to bypass the 1960 Indus Waters Treaty (IWT) facilitated by the World Bank. By violating the treaty, India constructed Baglehar Dam over River Chenab in the Doda district of Indian Occupied Kashmir (IOK) in 1999 along with Ratle Dam and Kishan Ganga Dam over Chenab and Neelum-Jhelum rivers, respectively (Qureshi, 2017). Trapped with its legacy, Pakistan's leadership felt convenient to indulge in a blame game with India rather sought alternative routes to ensure water storage on which its agrarian economy was dependent. Out of 57,000 worldwide dams, Pakistan only has 164 dams and all of them are not operational (Shah, 2018).

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Other than mingled with the flood, water is also a lifeline for agricultural security, food security, energy security, human security, and above all national security. As claimed by the Pakistan Meteorological Department (PMD) in its 2012 report that due to climate change and global warming “the water security, the food security and the energy security of the country is under serious threat” (Rasul, Afzal, Zahid, & Bukhari, 2012). In June 2018 Pakistan’s Water and Power Development Authority (WAPDA) warned the national leadership to build more dams in wake of the ever-increasing consumption of water in Pakistan. The warning also brought into the limelight the decreasing capacity of Tarbela Dam that has decreased its water storage capacity by 30 percent (Beham, 2018). According to International Commission on Large Dams, Tarbela is one of the biggest dams in Pakistan. Due to its earth-filled capacity, it stands first in the inventory of international dams with a declining capacity of water storage. Parallel to declining capacity, the dam is still ranked the second biggest reservoir in its structural volume. Mangla is the 7th largest dam in the world, whereas Mirani Dam is considered the largest flood stock dam in the world with a capacity of 588,690 cubic-hectometers. Also in context to flood stock dams, Sabakzai Dam in Baluchistan is too considered the 7th largest water reservoir in the world with a capacity of 23,638 cubic-hectometers (Shah, 2018).

Pakistan is blessed with 164 dams with a minimum of 15 meters of height (49 ft) and above (International Commission on Large Dams, 2018). Reports are adamant to the fact that until 2025 if appropriate measures are not taken on war-footing grounds Pakistan would run out of water (Wasif, , 2016). Moreover, the amount of water that every year passes by our rivers without helping the agrarian nation is something not less than a tragedy. The ill-preparedness to construct medium and small dams to manage the amount of water that overruns Pakistan’s territory is in fact allowed to flood the whole country.

It is difficult to understand that for our leadership the construction of dams somehow threaten the federation of Pakistan or become the doomsday for democracy. It is also important to notice that Pakistan has been on the list of most affected states due to climate change that to the best of its impact had brought floods of enormous magnitudes that caused great damage to crops, land, human life, livestock, and infrastructure. Knowing the fact that in Pakistan only politics defines the interest of the nation, it is not a secret how serious our national leadership had been to address the issue of floods. Flood management had nothing to do with the story of *Kalabagh* Dam since each province was equally affected by the amount of water freely running through the country. Therefore, without compromising the importance of dams and also keeping aside from the phenomenon of political ego, this study has attempted to shed light on the role of medium and small dams to address the issue of floods.

Since our national water consumption is increasing with that of the decreasing capacity of national leadership to address the issue; this article has taken a perspective that the construction of medium and small dams will play a crucial role in flood management in Pakistan, a phenomenon which is going to challenge the agricultural security, food security, energy security, food security, human security, and above all national security of the country. The economic loss which Pakistan has been inflicted with due to floods has had an enormous impact on the national economy. The economic cost is not the only factor that places itself at the high ranks of national security; it is the wastage of valuable water that is continuously being thrown in the Arabian Sea. How can a water-scarce

country afford such a luxury to stay silent on extensive floods along with a massive shortfall of its reservoir capacity?

IMPACT OF FLOODS ON NATIONAL SECURITY

When it comes to natural hazards, floods have proven themselves the most glaring example of natural disasters. Also, it had a manifold impact on the lives of civilians who have been affected along with their properties more than any other natural disasters led by calamity. Floods are a recurring phenomenon and with the change in a global environment, an increase in their frequency and intensity has been predicted by experts (Vinke, et al., 2017). The country that once used to be water-stressed is now transforming into a water-scarce country. Unfortunately, Pakistan is on top of the list of the most vulnerable countries to natural hazards. According to a UK-based think tank report, about 10 million Pakistanis are prone to the threat of floods. Overall 136 million population in the country is exposed to natural hazards which enlist it at the 7th number among the top 10 most affected states of the world (“New study,” 2016). The scenes of submerged crops, stranded humans and livestock, evacuation of people, loaded boats with people and livestock’s in the flood-hit areas have become all too familiar. Water is a basic component for the survival of living things and it is additionally an indispensable factor for economic improvement which expands the development of the civic and agricultural industry.

Since 1947 Pakistan has grasped different calamitous debacles activated by rain-encouraged floods. Most of the major disasters inventory highlights floods in years such as 1950, 1955, 1956, 1957, 1959, 1973, 1975, 1976, 1977, 1978, 1981, 1983, 1984, 1988, 1992, 1994, 1995, 2010, 2011 and 2012. There were almost 38 noteworthy floods that Pakistan encountered between 1950 till 2012 with the pace of one major flood in every third year (Manzoor, Bibi, Manzoor, & Jabeen, 2013). As a result, about 8,887 human lives were lost and almost 109,822 villages were destroyed costing US\$19 billion to the national economy. In nutshell between 1960 till 2012 the flood damages are accounted for 1percent of the Gross Domestic Product (GDP) annually. The 2010 calamity-led-disaster stands alone when it comes to exceptional damage caused by the floods. About US\$10 billion was the estimated economic loss that the country was inflicted with due to this single flood disaster (Memon, 2012).

As explained above Pakistan would run dry in the coming decade until 2025 which the German television DW (*Deutsche Welle*) also highlighted in one of its reports. The report further postured that the water shortage level in Pakistan is alarming (Baloch, 2018). Water crises are about to knock on the door and posing serious threats to national security. When it comes to water consumption Pakistan stands fourth in the world. The report claims that “Pakistan’s water intensity rate—the amount of water, in cubic meters, used per unit of GDP—is the world’s highest” (Baloch, 2018). This brings to the attention that there is no other country in the world except Pakistan which is so water-intensive in terms of its economy. According to an IMF report, “Pakistan’s per capita annual water availability is 1,017 cubic meters—perilously close to the scarcity threshold of 1,000 cubic meters. Back in 2009, Pakistan’s water availability was about 1,500 cubic meters. Today, Pakistan ranks third in the world among countries facing acute water shortage” (Bashir, 2018). In 2016, the bells were even rung by the Pakistan Council of Research in Water Resources (PCRWR) when they published a report and exposed that Pakistan had crossed the water stress line back in 1990 and surpassed the water scarcity level in 2005 (PCRWR, 2016). Furthermore, the

Indus River System Authority (IRSA) provided the figure that each year Pakistan receives 145 million acre-feet (MAF) water, and about 13.7 MAF is saved (Ahmed, 2017). The remaining 131.3 MAF is wasted due to Pakistan's incapacity to save it. IRSA in June 2018 also rang the bell and claimed that Pakistan needs 40 million acre-feet of water for agricultural sector. About 29 million acre-feet flood water is wasted and allowed to run into the Arabian Sea (Shah, 2018).

The benefits of water storage particularly flood-stocking through small and medium dams are enormously significant. In absence of an efficient response mechanism, not only the future of Pakistan's agriculturist economy is at stake but also food security, energy security, water security, human security, and above all national security is about to explode. All the above figures and analysis provide a glaring picture of Pakistan's ill-preparedness and that is only getting impetus due to fewer dams. Abundant water resources are available to the country. Pakistan is blessed with all types of land, ranging from mountain glaciers to hot and dry deserts, with forests and plains in between. Efficient management of flash floods to conserve water and afterward its utilization for agriculture could address the growing issues of water scarcity. Harvesting through flashflood management is the productive way both to boost national economy and also to save issues of regular flooding. Furthermore, sustainable irrigation system is detrimental for economic growth associated with agriculture. Construction of medium and small dams also looks after the hydroelectric needs while mitigating the gaps of water storage.

Floods in Pakistan are a recurring phenomenon. In the wake of global warming and climate change, an increase in the frequency and intensity of floods are inevitable. The country's underground water resources are fast depleting and as mentioned earlier it had already entered the endangered zones of water scarcity and millions of acre-feet are allowed to run into the Arabian Sea each year. It is, therefore, imperative to critically examine the country's water storage strategy, loss of water due to floods and suggest ways and means how this water can be utilized for agrarian and power generation purposes effectively. Ironically, Pakistan's water storage capacity is only 30 days as compared to Egypt which has around 1000 days of water storage only on one river, the River Nile (Mustafa, 2020).

Pakistan is primarily an agrarian economy and depends heavily on its rivers. But it is becoming increasingly vulnerable to flood hazards, which not only cause damages to life and property but also severely impact agrarian productivity. The shortage of medium and small dams has further aggravated the national security situation in Pakistan. Food security is an integral part of national security and with such a vulnerable pace the future seems dark. Thus, the passive flood management, meager disaster management infrastructure, and incapable early warning systems could not avert flood hazards in Pakistan in the recent and remote history. Keeping in view its remote history, the country is highly vulnerable to the continuity of floods. It had faced around 38 major floods in the past 7 decades through the 1990s and 2000's proved extraordinary inflicting to the national economy as floods run amok eight times in each decade (Government of Pakistan, 2016). Between 1991 till 1998 Pakistan had to go through eight years of continuous flooding including two massive flows of floods in 1992 and 1998. Similarly, eight floods came in the decade of 2000. The floods of 2010 are considered the most calamitous floods in the history of Pakistan. During these floods, 1,985 people died and 20.185 million among the population were directly affected. Official estimates of the economic damage ranged from \$8.74bn to \$10.85bn. Over 18000

villages were affected and directly damaging 1.6 million houses (Government of Pakistan, 2010). The floods of 1950 were also considered the worst in the history of Pakistan. 2,900 people died in that flood (Khalid & Begum, 2013, 15).

According to Sabir Shah, between 1950 and 2014 Pakistan had encountered two dozen major floods. These major floods have consumed around 11,500 people and affected an area of about 0.6 million square kilometers ("Nearly two dozen," 2014). The scenes of floods disaster have become too familiar in Pakistan. Pakistan has a landmass estimating 310400 square miles. It is equipped with a wide range of territory which includes plains, deserts, glaciers, and forests. In terms of hydrological units, Pakistan is separated into three groups. The first and of foremost importance is the Indus River Basin which remained an epicenter of the oldest civilization in the world. The second hydrological unit is Kharan which is now closed. The third hydrological unit is the Makran Coastal Basin that hosts many more coastal basins. When it comes to major sources of the surface water in Pakistan there are six major rivers that the country is solely dependent on, which include, (a) Indus, (b) Jhelum, (c) Chenab, (d) Ravi, (e) Sutlej, (f) Beas.

These rivers along with their tributaries mitigate the sole purpose of Pakistan's surface water sources. The catchment area which also includes some parts of India and China is 364700 square kilometers (Mirza, 2016). Indus Basin involves the Indus River and its five left-bank tributaries of Jhelum, Chenab, Ravi, Sutlej, and Beas, and one right bank tributary of Kabul. According to a report:

Pakistan has one of the largest canal systems in the world. About 75% of the mean annual flow is diverted through 3 major storage reservoirs, 23 barrages/ headworks, 12 inter-river link canals, 45 canal commands, and some 90,000 watercourses to irrigate the land. The total length of the canal system is about 38,000 miles with watercourses, farm channels, and field ditches running another one million miles (UNESCO, 2020).

Types and Causes of Floods in Pakistan

There are multiple reasons for excessive flooding in Pakistan. Few are manmade and others get influenced by climate change with the extensive impact of global warming. Though, some reasons belong to the political maneuverability of India that uses water as a war gaming exercise while opening the gates of its reservoirs. Furthermore, floods are divided into different types that further help to distinguish the reasons.

a. Types of Floods

- **Riverine Floods:** Riverine floods are most common in the Indus Plain and its surrounding catchment areas. Coastal flooding is caused due to monsoon incursions. Glacial lakes are formed due to global warming and other climatic changes. Heavy snowmelt or excessive rainfall causes this type of flooding. The flood caused by heavy snowmelt is called Glacial Lake Outburst Flood (GLOF). A 2012 study summarized that "out of 2420 glacial lakes in the Indus Basin, 52 lakes were potentially dangerous and can result in GLOF with serious damages to life and property and this phenomenon is likely to increase in future" (Ashraf, Naz & Roohi, 2012). Though to the known facts, there are about 7,253 glaciers in Pakistan that are one of the biggest ice packs situated outside the Polar Regions ("Glacier melting," 2018). The *Attabad Village* landslide of 2010 along with the July 2018 artificial lack in Gilgit Baltistan

(GB) that happened due to glacier melt, are the glaring examples of climate change and Riverine flooding in Pakistan.

- **Floods caused due to Weather and strength**

There are 3 types of floods Category I, II, and III.

- ✓ Category-I floods are caused due to semi-permanent weather changes erupting out of moisture in the Arabian Sea that travels upwards towards catchment areas of Chenab and Jhelum rivers. This semi-permanent weather is mostly static over South Eastern Baluchistan, adjoining parts of Sindh along with South West Punjab. This semi-weather system intensifies due to moisture caused in the Arabian Sea, hence fabricate the climatic conditions suitable for the category-I floods.
- ✓ Category-II and III floods are more severe and are caused due to monsoon and low-depression temperatures. The monsoon system plays a critical role to ignite this extensive flooding that in fact travels from the Bay of Bengal towards the Western and Northern side of India and settles over the areas of Rajasthan region. From here it gets nourished from the moisture of the Arabian Sea and travels towards the Northern direction into Pakistan in areas of Khyber Pakhtunkhwa, Mangla, and Chenab catchments.

- b. Causes of Floods in Indus Basin Rivers**

Precisely it can be said that the fast-changing climatic environment, heavy rains, and melting of glaciers are the causes of floods in the Indus Basin. The types of flooding Pakistan has been inflicted with are mainly occurring due to climate change and issues of global warming.

- **Climate Changes:** Due to change in the climate, weather conditions are severely changing globally resulting in extreme temperatures, variability in precipitation, and fluctuating weather events. It is likely that in South Asia due to climate changes more melting of glaciers is witnessed that would result in massive flooding and apprehensively deplete the freshwater resources in a couple of decades. Recently, in July 2018 GB has experienced glacier melt that formed an artificial lake over Immit River that claimed around “more than 30 houses, cultivated land, an intersection road and cattle farms. Moreover, it has washed away over a dozen vehicles and hundreds of cattle head in the upstream areas” (“Another Attabad?”, 2018).
- **Global Warming:** Due to ever increased reliance of the developing nations on fossil fuels, greenhouse gases have overshadowed the immunity of the natural environment. According to a recent report published in 2018, “there is a recorded increase of about 411 parts per million (ppm) of CO₂ concentration in world atmosphere which caused 1.5-degree centigrade temperature rise in Pakistan and surrounding regions.” Thus, adverse effects of “global warming give “rise to occurrences of unnatural climatic events such as droughts, floods, wildfires, and glaciers melting” (Loria, 2018).

Prevailing Trends of Climate Change in Pakistan

A 2009 report by Pakistan Meteorological Department (PMD) categorically alarmed and indicated that:

there will be a daily rise in temperature in coastal areas and North-Western parts of the country at a mean of 0.6 to 1.0-degree centigrade. 12% decrease in rainfall, both in winter and summer, in coastal belt has been predicted while there will be an increase of 20-32% rainfall in monsoon in humid areas. 5% decrease in relative humidity over arid plains of Baluchistan and 3-5% decrease in cloud cover over central and southern Pakistan resulting in increase in sunshine. Increase in frequency of heavy rains, flash floods, dust/thunderstorms is predicted (Ch., Mahmood, Rasul, & Afzaal, 2009).

Prevailing trends of climate change are diverse and could not be gauged from this discussion. Though, the 2012 report of the PMD that was compiled over Sindh had given quite alarming predictions about the future environment in Pakistan. The report stated that:

Pakistan is particularly vulnerable to climate change because it has generally a warm climate; it lies in a geographical region where the temperature increases are expected to be higher than the global average; its land area is mostly arid and semi-arid (about 60 percent of the area receives less than 250 mm of rainfall per year and 24 percent receives between 250-500 mm); its rivers are predominantly fed by the Hindu Kush-Karakoram Himalayan glaciers which are reported to be receding rapidly due to global warming; its economy is largely agrarian and hence highly climate-sensitive; and because the country faces increasingly larger risks of variability in monsoon rains, hence large floods and extended droughts. Under the influence of all these factors the Water Security, the Food Security, and the Energy Security of the country are under serious threat. Compounding these problems are the expected increased risks to the coastal areas and the Indus deltaic region due to sea level rise, coastal erosion, saline seawater intrusion, and increasing cyclonic activity in the Arabian Sea. The Indus Delta is already located in the intense heat zone and any rise in temperature would impact human health due to heat strokes, diarrhea, cholera, vector borne diseases; and human settlements due to frequent floods, droughts, and cyclones. In this region, temperature is likely to increase by 4°C till 2100 and rainfall is going to be highly variable on temporal and spatial scale. The deltaic region would not only be affected by the local weather conditions but also weather activities upstream Indus and over the neighboring sea in the south due to climate change (Rasul et.al., 2012).

DAMS FOR MANAGING FLOODS IN PAKISTAN

In recent times dams are the biggest infrastructure build by mankind, for not only conserving water, producing electricity, irrigating land but also to control and mitigate flood water. The idea of constructing dams to control floods is a relatively new one in sharp contrast to the idea of the living with the flood, as practiced by many countries in the past. About US\$2 trillion were spent in the last century to construct the dams. There are more than 45 thousand large dams as well as millions of medium and small dams (Goldemberg, 2012). One of the oldest dams that mankind has ever built was constructed over River Nile in 2900 BC with 15 meters high structure at Sadd-el-Kafara about 30 kilometers south of Cairo (E&T Group, 2020). One of the oldest dams still in use was built in 1300 BC at Orontes in Syria (E&T Group, 2020). Hoover Dam in North America is the first dam of modern era; it was completed in 1935 to regulate the flow of flood water (Rogers, 2010). It became the model for the other countries. In Pakistan Mirani Dam is the largest in the world for flood-stock, whereas Sabakzai Dam is the 7th largest in the world for flood-stock capacity.

Flood management can be beneficial not only for mitigating the distinctive effects of floodwaters; it can also help in water security faced by contemporary Pakistan. The two main reasons are discussed here and supported by the available data. With this background, this paper presents the positive effects of small and medium dams which can be a game-changer and mitigate the damage which is slowly ending the agriculture of Pakistan and impacting on aspects related to food, energy, and human security. The two types of dams considered in the study are small and medium dams, which are detailed as under (Siddiqi, 2009, 110):

- Small dams, which are dams up to 15 meters in height through dams up to 20 meters, can be termed small.
- Other factors like cost and length of a dam can also be sighted in naming the type of dam.
- While the medium dams are those dams that are above 20 meters but below 50 meters.
- Flood management not only can be beneficial for mitigating the distinctive effects of floodwaters, but it can also help in water scarcity facing Pakistan.

Role of small and medium-size dams in preserving floodwaters

1. Mitigation of flash floods and hill torrents, which not only destroy the cultivable land for irrigation also causes damages to infrastructure and even habitats, costing human lives and livestock.
2. Small and medium dams also help in storing the flood water which can be used in the season of cultivation of crops or supplement the available water resources.
3. The dams also help in mitigating the erosion of topsoil where there dams act as check dams and stoop the sill flowing down into the rivers and large reservoirs.
4. These dams also help in the rising of groundwater levels in surrounding areas of the dam ponds, which help in irrigation by exploiting the tube-well irrigation system. It also improves the water table in surrounding areas that provides the adjacent towns and villages a source of drinking water.
5. Improvement by providing the dams results in an enhanced water supply both in terms of reliability and quantity.
6. Small dams in grid areas like Potohar have significantly improved the social environment and benefitted to store water.

In case of Pakistan, where at present it is not possible to build Kalabagh or other large dams on rivers due to one or the other reasons, the building of small and medium dams can help in reducing the floodwater causing flashfloods into large rivers. Although our large rivers have more than 25 percent of water due to snowmelt but extensive rain during the period of normal floods results large increase in water. If the rainwater leading into these large rivers are somehow contained through small and medium dams built on their way, this will stop the flash flooding and wastage of useful water. Furthermore, the storage of water in small to medium dams can be used for irrigation along with ponding small hydropower plants. This will not only help in the storage of water but can also help in improving the situation of energy security.

To manage the energy gaps back in 2010 the then government decided to invest about Rs 250 billion over the construction of 32 new small and medium dams. In the first phase, 13 dams were planned. Baluchistan was supposed to host five dams and four dams were planned for Sindh. In

Punjab and Khyber Pakhtunkhwa (KP) two dams for each province were envisioned (“32 dams to be,” 2010). In January 2018, the Secretary Planning, Shoaib Ahmed Siddiqui told the Senate’s Standing Committee on Planning, Development, and Reforms that in Baluchistan out of 100 proposed small and medium dams about 42 are completed. These dams were completed under the ongoing five-tiered project. The construction of 42 dams is in fact part of packages 1 and 2. The remaining dams in Balochistan would be completed under packages 3, 4, and 5. The Secretary Planning also stated that “the construction of small and medium dams in Baluchistan would help boost agriculture production, besides mitigating acute water scarcity. Moreover, groundwater would also be recharged artificially, risk of flash floods would be mitigated, and poverty would be eliminated” (“42 out of 100 dams,” 2018).

Moreover back in 2009, the then government was believed to prepare a feasibility report on the construction of 40 small and medium dams in the region of Kohistan and Nagarparkar. Even the Central Development Working Party (CDWP) in April 2009 had also finalized the proposal to build small reservoirs in Sind province (“Small dams for,” 2009). WAPDA’s official webpage in its section ‘Projects’ identifies key ongoing and already constructed projects in the domain of the water and hydropower sector (WAPDA, 2020). The details are given below:

Sr. No.	Name of the Project	Status
1.	CJ-Link Canal	Operational
2.	Darwat Dam Project	Operational
3.	Greater Thal Canal	Operational
4.	Hub Dam	Operational
5.	Kachhi Canal Project	Operational
6.	Khanpur Dam	Operational
7.	Mirani Dam	Operational
8.	Rainee Canal Project	Operational
9.	Satpara Dam Project	Operational
10.	Muzaffargarh & T.P Link Canal Lining	Under Construction
11.	Nai Gaj Dam	Under Construction
12.	RBOD-I	Under Construction
13.	RBOD-III	Under Construction
14.	Garuk Dam Project	Ready for Construction
15.	Naulong Dam	Ready for Construction
16.	Papin Dam Project	Ready for Construction
17.	Pelar Dam Project	Ready for Construction
18.	Winder Dam Project	Ready for Construction
19.	Badin Zai Dam Project	Future Project
20.	Bara Dam Project	Future Project
21.	Bhimber Dam Project	Future Project
22.	Chiniot Dam Project	Future Project
23.	Daraban Zam Dam	Future Project
24.	Dotara Carry Over Dam	Future Project
25.	Pilot Treatment Plant	Future Project
26.	Sukleji Dam Project (Site-C)	Future Project

It seems that the motto of WAPDA “Our Vision-Dam a Decade” could only be made feasible if national leadership in real terms gets united and declare the emergency and come together to address the pertaining challenges amicably. Following are the projects that Pakistan is working on hydropower projects (WAPDA, 2020).

Sr. No.	Name of the Project	Status
1.	Tarbela Dam	Operational
2.	Mangla	Operational
3.	Warsak	Operational
4.	Duber Khwar Hydropower Project	Operational
5.	Chitral Hydel Power	Operational
6.	Kurram Garhi Hydropower Project	Operational
7.	Allai Khwar Hydropower Project	Operational
8.	Khan Khwar Hydropower Project	Operational
9.	Ghazi Barotha	Operational
10.	Chashma	Operational
11.	Jinnah Hydel Power Station	Operational
12.	Nandipur	Operational
13.	Chichoki	Operational
14.	Shadiwal	Operational
15.	Rasul	Operational
16.	Renala	Operational
17.	Dargai	Operational
18.	Dasu Hyropower Project	Under Construction
19.	Keyal Khwar Hydropower Project	Under Construction
20.	Kurram Tangi Dam	Under Construction
21.	Mangla Power Refurbishment	Under Construction
22.	Tarbela 5 th Extension	Under Construction
23.	Bunji	Ready for Construction
24.	Diamer Basha Dam	Ready for Construction
25.	Harpo	Ready for Construction
26.	Lower Palas Velley	Ready for Construction
27.	Lower Spat Gah	Ready for Construction
28.	Mohamand Dam Project	Ready for Construction
29.	Akhori Dam Project	Future Projects
30.	Basho	Future Projects
31.	Chitral Power Enhancement	Future Projects
32.	Hingol Dam Project	Future Projects
33.	Middle Palas Velley Hydropower Project	Future Projects
34.	Middle Spat Gah Hydropower Project	Future Projects
35.	Murunj Dam Project	Future Projects
36.	Patan	Future Projects
37.	Phandar Hydropower Project	Future Projects
38.	Renala Power Rehabilitation	Future Projects
39.	Shyok Dam Multipurpose Project	Future Projects
40.	Tank Zam Dam Project	Future Projects
41.	Thakot	Future Projects

42.	Tungas Hydropower Project	Future Projects
43.	Upper Palas Valley Hydropower Project	Future Projects
44.	Upper Spat Gah Hydropower Project	Future Projects
45.	Yulbo Hydropower Project	Future Projects

Enlisting all the 164 dams of Pakistan is not possible in this study. The above-enlisted dams have already been envisioned. WAPDA has been currently working on 71 dams as enlisted above. Still, 93 dams need government funding and appropriate attention to play a significant role in national security.

Way Forward

Water resources are depleting fast in Pakistan. There are two major reasons for the shortage of water: floods and bad water management policies. Each year an estimated 715,000 people become a victim of floods, which inevitably result in an economic loss of about US\$2.7 billion. According to a careful estimate, until 2030 around 2.7 million population of Pakistan will directly get affected by the floods (Ebrahim, 2015). A huge amount of water is also wasted during conveyance up to farm gates. Similarly, the bad utilization of groundwater resources is another cause of water scarcity. Pakistan must understand and work accordingly on the following points:

- **Floods are a Recurring Phenomenon:** Complete prevention of it is impossible. It is, therefore, Pakistan must create parallel water storage reservoirs to control flash floods that directly impact the national economy, its infrastructure, people, and agriculture.
- **Learn to Adapt to Annual Floods:** Even in most developed countries, it is not possible to have total protection from floods. No system can predict potential floods nor predict changes occurring due to climate. Therefore, Pakistan must learn to adapt to annual floods and develop an efficient water management system to convert the floods into opportunities.
- **Flood Forecasting Capabilities Need Serious Improvement:** National disaster management plans also need serious improvement in execution strategy. There are no evacuation plans for flood victims and alternative housing areas. The institutions responsible for early warning, evacuation and rehabilitation are highly under-resourced.
- **Study for Climate Changes:** Serious climate changes are expected. Phenomenon needs to be studied and analyzed for improvement in structural designs of Bunds, Dams, and reservoirs. Precaution for global warming also requires rigorous enforcement to avoid occurrences of unnatural climatic events. To minimize loss to human and animal life evacuation plan needs serious evaluation and aggressive implementation.
- **Management of Flood Plains:** Almost every alternative year floods occur in Pakistan and cause huge damage. It repeats everything whenever the floods come. A host of climatic and non-climatic factors affect the flooding process every year. Due to large immigration and population growth unorganized settlement happens in the flood plains. This makes a majority of the riverine areas and flood plain zones highly vulnerable to flash floods. Pakistan land authorities regardless of indulging in corrupt practices must address this challenge.

- **Think Tanks for Study of Flood and Water Conservation Strategy:** There is no serious work both on disaster management and water preservation. The country lacks think tanks where research work could be carried out on water scarcity and future plans. A sustained culture of scientific research should be encouraged as a traditional way of reacting to flood management is more *ad-hoc* in nature rather brought permanent solutions to the issue.
- **Protecting Forests and Natural Resources:** The culture of deforestation had already caused great damage to the environment. Federal Government's decision to launch "Clean and Green Pakistan" is the right way to protect the forests and natural resources of Pakistan ("Clean and Green Pakistan," 2018). Prime Minister Imran Khan during his last provincial government in KP had successfully launched a Green Ribbon Movement under the slogan of "One Tree One Life" ("Imran starts Green," 2016). At last someone from the national leadership took the right step to protect forests and declared them the natural resources for generations to come.
- **Water Diplomacy:** Pakistan has become paralyzed in front of Indian water diplomacy. Pakistan has not been able to highlight its water issues at the international level and it is primarily due to the reason that no homework has been done and there is no institutional framework that could undertake this issue with India as well as at the international forum. Due to the rising demand for water in the future, the government of Pakistan shall not hesitate to expose Indian draconian acts and also develop strategies of water management to tackle short, medium, and long term needs.
- **Construction of Dams:** Water reservoirs need to be increased at a faster pace. It is estimated that by 2025 water demand and supply would reach up to 25-30 MAF annually and the requirement will continue to rise with every passing day. Thus to meet this shortfall, Pakistan requires one major reservoir every 10-15 years. Prime Minister Imran Khan's vision to construct Diamir Basha and Mohmand Dams is a timely step. Moreover, a national consensus over Kalabagh Dam should also be generated and soon construction on this site shall also be started.
- **Corruption Free Regime:** A corruption-free regime is need of the hour to implement the construction of structural measures like embankments, spurs, dikes/gabion walls and diversions. Political expediencies and prevalent corruption in the irrigation and other departments related with floods and water conservation have serious implication on overall water situation of the country.
- **Conserving Water of Hill Torrents:** The hill torrents in Pakistan constitute a secondary network of the natural surface drainage system. In Pakistan, 6935560 hectares of cultivable wasteland has an 18.69 MAF average. Baluchistan has the biggest potential of 10 MAF. This has not been utilized and almost ends up as complete waste. KP has the potential of 6.06 MAF and its flow of it could be used to irrigate agricultural lands. Starting from Suleiman Range to D.I. Khan into River Indus there are almost 13 Hill Torrents that Pakistan needs to appropriately exploit. It is important that whatever Pakistan is blessed with, the government in office must get it once. Prioritizing projects often delay and funding just flows with the floods.
- **Improvement in Irrigation and Canal System:** As explained earlier that Pakistan has one of the largest canal systems in the world. "About 75% of the mean annual flow is diverted through

3 major storage reservoirs, 23 barrages/ headworks, 12 inter-river link canals, 45 canal commands, and some 90,000 watercourses to irrigate land.” Moreover, the “total length of the canal system is about 38,000 miles with watercourses, farm channels and field ditches running another one million miles” (UNESCO, 2018). Pakistan needs to improve the irrigation and canal system. With such an exceptional legacy Pakistan could sustain centuries to come through the condition is our commitment to exist.

- **Crafting a Clear Strategic Policy Framework and Legislation:** A country facing successive floods since its inception has suffered a loss of almost 140\$ billion due to water waste while another 200\$ billion due to flood damages needs to chalk out an Integrated Flood Management Policy (IFMP). Such policy should not only cater for short-term measures to block destruction caused due to floods but should also see the long-term needs and adequately adapt legislations required to save human lives.
- **A Mix of Strategies:** Pakistan needs to have a mix of strategies focusing on reducing flood effects which include:
 - a) construction of dams
 - b) Dikes
 - c) flood embankments
 - d) high flow diversions
 - e) catchment management
 - f) channel improvements
 - g) flood plain regulations

The policy should also look into reducing susceptibility to damage through:

- a) design and location of facilities
- b) housing and building codes in suspected areas
- c) flood proofing of the houses
- d) enhancing flood forecasting
- e) warning, information, and education of masses likely to be affected by floods

The policy framework should also incorporate mitigating impacts like:

- a) disaster preparedness
- b) post-flood recovery and flood insurance

A mix of strategy should also include:

- a) preserving the natural resources of flood plains through flood plain zoning and regulation

CONCLUSION

To effectively mitigate the flood destruction and enhance water conservation above suggested points are deemed necessary. The water resources of the Indus basin are becoming scarce thus it is imperative to have efficient irrigation in the Indus basin. In Pakistan, the inefficient use of water resources is the main cause of water shortage. The gap between water demand and its availability is

rising with each passing day. Pakistan is confronting serious global warming challenges as well. Energy demands have put added pressure on water demand. Federal and provincial governments will have to ensure the completion of dam projects without political scoring. Any shortcoming will have adverse effects on the occurrence of any major floods in the future. Water is an important ingredient of human life as well as the development of society. All living organs need water for survival. Societies need water for energy as well as cleaning purposes. The development of any society is directly linked with water resources and their storage capacity. Inability to understand and mitigating the challenges erupting out of water mismanagement would have a diverse impact on the national security of Pakistan. Therefore, it is high time to consider the issue on war footing grounds. Failure to do so would have an unbearable cost to the whole nation.

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