

Issues of Water Management in Pakistan: Why Dams Demand National Resolve?

1. Introduction:

Today the panorama of floods has almost 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 same political rhetoric has to be raised but there will be no moving forward. Since, construction of medium and small dams fall outside political scoring, why shouldn't the flood water be harnessed by building medium and small dam? In a country with a fast-growing population and growing demand of water for drinking and irrigation both the wastage of flood water draining into sea is enough reason to study the advantage of building the small and medium size dams. Pakistan has already been victim of Indian draconian acts meant to restrict the free flow of water that it had promulgated to bypass the 1960 Indus Waters Treaty facilitated by the World Bank. By violating the treaty India had constructed Baglehar Dam over River Chenab in the Doda district of Indian Occupied Kashmir in 1999 along with Ratle Dam and Kishan Ganga Dam over Chenab and Neelum-Jhelum rivers, respectively.¹ Trapped with its legacy, Pakistan's leadership felt convenient to indulge into 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.²

Other than mingled with flood security, water is also a life line for agricultural security, food security, energy security, human security, and above all national security. As claimed by Pakistan Meteorological Department (PMD) in its 2012 report that due to climate change and global warming "the water security, the flood security and the energy security of the country are under serious threat".³ In June 2018 Pakistan's Water and Power Development Authority (WAPDA) warned the national leadership to build more dams about ever increasing consumption of water in Pakistan. The

¹ Waseem, A., Water as a Human Right: A Case Study of the Pakistan-India Water Conflict, Penn. St. J.L. & Int. Affairs, issue 2, vol. 5 (2017).

² Sabir Shah, Pakistan has 164 of 57,000 dams built worldwide, The News, Sep. 03, 2018, at 1.

³ Dr. Ghulam Rasul, Climate Change in Pakistan: Focused on Sindh Province (Islamabad: PAKISTAN METEOROLOGICAL DEPARTMENT (Apr. 4, 2012), http://www.pmd.gov.pk/report_rnd.pdf .

warning also brought into the lime light the decreasing capacity of Tarbela Dam that has decreased its water storage capacity by 30%.⁴ According to International Commission on Large Dams, Tarbela is one of the biggest dams of Pakistan. Due to its earth filled capacity it stands first in the inventory of international dams with 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 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 capacity of 23,638 cubichectometers.⁵

Pakistan is blessed with 164 dams with minimum 15 meters of height (49 ft) and above.⁶ 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.⁷ 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 illpreparedness 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 Motorways, Mass-transit projects like Metro Lahore, Rawalpindi, Islamabad, Multan along with Orange Line are important but projects like construction of dams somehow threatens the federation of Pakistan or becomes the doomsday for democracy. It is also important to notice that Pakistan has been victim of climate change that to the best of its impact had brought floods of enormous magnitudes that caused great damage to crop, land, human life, livestock, and infrastructure. Knowing the fact that in Pakistan only politics defines the interest of the nation, it's 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,

⁴ Isabella Beham, "How Important is it for Pakistan to build dams," VALUE WALK, June. 6, 2018, <https://www.valuewalk.com/2018/06/pakistan-to-build-dams-importance/>.

⁵ Sabir Shah, "Pakistan has 164 of 57,000 dams build worldwide," The News, Sept. 3, 2018, <https://www.thenews.com.pk/print/363264-pakistan-has-164-of-57-000-dams-built-worldwide>.

⁶ International Commission on Large Dams (ICOLD), Number of Dams by Country Members, (2018), http://www.icold-cigb.org/article/GB/world_register/general_synthesis/number-of-dams-by-country-members.

⁷ "Pakistan may run dry by 2025: study," The Express Tribune (2016), <https://tribune.com.pk/story/1112704/pakistan-may-run-dry-2025-study/>.

without compromising the importance of dams and also keeping a side from the phenomenon of political ego, this article 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 decreasing capacity of national leadership to address the issue; this article has taken a perspective that construction of medium and small dams will play crucial role in flood management in Pakistan, a phenomenon which is going to challenge the agricultural security, food security, energy security, flood 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 enormous impact on national economy. 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 massive shortfall of its reservoir's capacity?

2. 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 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 global environment, increase in their frequency and intensity has been predicted by experts.⁸ The country once used to be water stressed is now transforming into 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 of the country is exposed to natural hazards which enlist it at the 7th number among top 10 most affected states of the world.⁹ The scenes of submerged crops, stranded humans and livestock's, 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 survival of living things and it is additionally an indispensable factor for economic improvement which expands development of civic and agricultural industry.

⁸ Kira, K., Maria A., Sophie, A., Florent, B., Climatic risks and impacts in South Asia: extremes of water scarcity and excess, *Regional Environmental Change* 17, no. 6 (2017): 1569-1583.

⁹ Reuters, "New study: Pakistan among to 10 disaster-prone countries," *The EXPRESS TRIBUNE* (March 24, 2016), <https://tribune.com.pk/story/1071455/new-study-pakistan-among-top-10-disaster-prone-countries/>.

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.¹⁰ As a result about 8,887 human lives were lost and almost 109,822 villages were destroyed costing US\$19 billion to national economy. In nutshell between 1960 till 2012 the flood damages are accounted against 1% 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 country was inflicted with due to this single flood disaster.¹¹

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.¹¹ Water crisis are about to knock 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”.¹² 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 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”.¹⁴ In 2016, the bells were even rang by 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 2005.¹³ Furthermore, the

¹⁰ Misbah, M., Sidra, B. Mirfa, M., and Rukhsana, J., Historical Analysis of Flood Information and Impacts Assessment and Associated Response in Pakistan (1947-2011), Research Journal of Environmental and Earth Sciences 5, no. 3 (2013). ¹¹ Nasreen Memeon, Malevolent Floods of Pakistan 2010-2012 (2012), <http://www.malevolentfloodrepo.pdf>.

¹¹ Shah, M., Water crisis: Why is Pakistan running dry?, DEUTSCHE WELLE (DW) (2018), <https://www.dw.com/en/water-crisis-why-is-pakistan-running-dry/a-44110280>.

¹² Ibid. ¹⁴ Hafsa, B., “How to best deal with water shortage,” The EXPRESS TRIBUNE (July. 26, 2018), <https://tribune.com.pk/story/1766418/6-best-deal-water-shortage/>.

¹³ PCRWR, “Annual Report 2015-16,”

[http://pcrwr.gov.pk/Publications/Annual%20Reports/Annual%20Report%202015-16%20\(Published\).pdf](http://pcrwr.gov.pk/Publications/Annual%20Reports/Annual%20Report%202015-16%20(Published).pdf).¹⁶

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.¹⁶ The remaining 131.3 MAF is wasted due to Pakistan incapacity to save it. IRSA in June 2018 also rang the bell and claimed that 40 million-acre feet water is Pakistan's requirement for the agricultural needs. About 29 million-acre feet flood water is wasted and allowed to run into Arabian Sea.¹⁷

The benefits of water storage particularly flood-stocking through small and medium dams are enormously significant. In absence of efficient response mechanism not only 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 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 glaciated mountains to hot and dry deserts, with forests and plains in between. Efficient management of flash floods to conserve water and afterwards 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 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, increase in the frequency and intensity of floods is inevitable. The country's underground water resources are fast depleting and as mentioned earlier it had already entered in the endangered zones of water scarcity and millions of acre feet can run into 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

Engr. Sh. Mushtaq Ahmed, The water picture of Pakistan, The Nation (February. 14, 2017). ¹⁷ Sabir Shah, *ibid.*

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, River Nile.¹⁴

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 the agrarian productivity. The shortage of medium and small dams has further aggravated the national security situation in Pakistan. Food security is integral part of national security and with such 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 past 7 decades though 1990's and 2000's proved extraordinary inflicting to national economy as floods run amok eight times in each decade.¹⁵ Between 1991 till 1998 Pakistan had to go through eight years of continuous flooding including two massive flow 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 ranges from \$8.74bn to \$10.85bn. Over 18000 villages were affected and directly damaging 1.6 million houses.¹⁶ The floods of 1950 were also considered worst in the history of Pakistan. 2,900 people died in that flood.¹⁷

According to Sabir Shah, between 1950 and 2014 Pakistan had encountered with two dozen major floods. These major floods have consumed around 11,500 people and affected an area of about 0.6 million square kilometers.¹⁸ The scenes of floods disaster have become too familiar in Pakistan. Pakistan has a land mass estimating 310400 square miles. It is equipped with a wide range of

¹⁴ Khalid Mustafa, Pakistan heading towards water scarcity catastrophe, The News, June. 26, 2018), <https://www.thenews.com.pk/print/333973-pakistan-heading-towards-water-scarcity-catastrophe>.

¹⁵ Pakistan Floods 2014: Recovery Needs assessment and action Framework 2014-16, http://www.ndma.gov.pk/new/Documents/Recovery_Needs_Assessment.pdf

¹⁶ Annual Flood Report 2010, Government of Pakistan Federal Flood Commission Ministry of Water and Power, <http://www.ffc.gov.pk/download/flood/archive/Annual.report2010.pdf>

¹⁷ Imran, K., and Ishrat. B., Hydro Politics in Pakistan: Perceptions and Misperception," A Research Journal of South Asian Studies, Vol.28, No.1 (2013)

¹⁸ Sabir Shah, Nearly two dozen floods hit Pakistan since 1950" The News, Sep. 10, 2014, at 1.

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. 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 surface water sources. The catchment area which also includes some parts of India and China is 364700 square kilometers.¹⁹ Indus Basin involves Indus River and its five left-bank tributaries of Jhelum, Chenab, Ravi, Sutlej and Beas, and one right bank tributary of Kabul. According to UNESCO 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/ head work, 12 inter-river link canals, 45 canal commands and some 90,000 water courses to irrigate land. Total length of the canal system is about 38,000 miles with water courses, farm channels and field ditches running another one million miles”.²⁰

3. Types and Causes of Floods in Pakistan

There are multiple reasons of excessive flooding in Pakistan. Few are manmade and other gets influenced by the climate change with extensive impact of global warming. Though, some reasons belong to 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.

¹⁹ MUHAMMAD NASRULLAH MIRZA, INDUS WATER DISPUTE AND INIDA-PAKISTAN RELATIONS (GERMANY: PhD DISSERTATION, (2016).

²⁰ UNESCO Report, Flood Mechanics & Flood Management in Pakistan,(2018),

http://unesco.org.pk/ns/documents/Workshop_Workbook/Session_5/1_Engineers-Directorate-GHQ.pdf.

- Riverine Floods: Riverine floods are most common in the Indus Plain and in its surrounding catchment areas. Coastal flooding is caused due to monsoon incursions. Glacial lakes are formed due to global warming and other climatic changes. In fact, 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”.²¹ Though to the known facts there are about 7,253 glaciers in Pakistan that is one of the biggest ice packs situated outside the Polar Regions.²² The Attabad Village landslide of 2010 along with July 2018 artificial lake 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 semipermanent weather is mostly static over South Eastern Baluchistan, adjoining parts of Sindh along with South West Punjab. This semiweather 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

²¹ Arshad, A., Rozina, N., and Rakhshan, R., Glacial lake outburst flood hazards in Hindukush, Karakoram and Himalayan Ranges of Pakistan: implications and risk analysis, *Geomatics, Natural Hazards and Risk* 3, no. 2 (2012).

²² Glacier melting in Gilgit-Baltistan, Pakistan Today (2018), <https://www.pakistantoday.com.pk/2018/07/20/glacier-melting-in-gilgit-baltistan/>.

critical role to ignite this extensive flooding that in fact travels from Bay of Bengal towards 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 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 fast changing climatic environment, heavy rains and melting of glaciers are the causes of floods in 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 into 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 massive flooding and apprehensively deplete the fresh water resources in 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”.²³
- **Global Warming:** Due to ever increased reliance of the developing nations over fossil fuel, greenhouse gases have overshadowed the immunity of natural environment. According to 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. Effects of global warming are exponentially adverse; it simply gives rise to occurrences of

²³ Another Attabad? Artificial lake created in GB due to melting glacier, PAKISTAN TODAY (2018), <https://www.pakistantoday.com.pk/2018/07/19/another-attabad-artificial-lake-created-in-gb-due-to-melting-glacier/>.

unnatural climatic events such as droughts, floods, wild fires, and glaciers melting”.²⁴

4. Prevailing Trends of Climate Change in Pakistan:

A 2009 report by Pakistan Meteorological Department categorically alarmed and indicated that, “there will be 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 rain fall, 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 are predicted”.²⁵ Prevailing trends of climate change are diverse and could not be gauged from one discussion. Though, 2012 report of the PMD that was compiled over Sindh had given quite alarming predictions about 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 per cent of the area receives less than 250 mm of rainfall per year and 24 per cent 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 Flood Security and the Energy Security of the country are under serious threat. Compounding these problems are

²⁴ Kevin Loria, The amount of carbon dioxide in the atmosphere just hit its highest level in 800,000 years, and scientists predict deadly consequence, BUSINESS INSIDER (June. 12, 2018), <https://www.businessinsider.com/carbon-dioxide-record-human-health-effects-2018-5>.

²⁵ Dr. Qamar-uz-Zaman, Climate Change Indicators of Pakistan (Islamabad: PAKISTAN METEOROLOGICAL DEPARTMENT (PMD), 2009).<http://www.pmd.gov.pk/CC%20Indicators.pdf>.

the expected increased risks to the coastal areas and the Indus deltaic region due to sea level rise, coastal erosion, saline sea water 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”.²⁶

5. Dams for Managing Floods in Pakistan

In recent times dams are the biggest infrastructure build by the 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 relatively a new idea 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.²⁷ One of the oldest dams that mankind has ever built was constructed over River Nile in 2900BC with 15 meters high structure at Sadd-el-Kafara about 30 kilometers south of Cairo.²⁸ One of the oldest dams still in use was built in 1300BC at Orontes in Syria.²⁹ Hoover Dam in North America is the first dam of modern era; it was completed in 1935 to regulate the flow of flood water.³⁴ It became the model for the other countries. In Pakistan we have Mirani Dam which is the largest in the world for flood-stock, whereas Sabakzai Dam is the 7th largest in the world for flood-stock capacity.

²⁶ Dr. Ghulam Rasul, Climate Change in Pakistan: Focused on Sindh Province (ISLAMABAD, METEOROLOGICAL DEPARTMENT (Apr. 4, 2012), p. 1. http://www.pmd.gov.pk/report_rnd.pdf.

²⁷ JOSE GOLDEMBERG, ENERGY: WHAT EVERYONE NEEDS TO KNOW (LONDON: OXFORD UNIVERSITY PRESS (2012).

²⁸ “The History of Dams,” E&T Group, <https://entcambodia.wordpress.com/tag/nile-river/>.

²⁹ Ibid. ³⁴ David, R., Hoover Dam: Operational Milestones, Lessons Learned, and Strategic Import: In Hoover Dam’, 75th Anniversary History Symposium, (2010).

The 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 positive effects of small and medium dams which can be the 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:³⁰

- 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 dam can also be sighted in naming the type of dam.
- While the medium dams are those dams which are above 20 meters but below 50 meters.
- The flood management not only can be beneficial for mitigating the distinctive effects of flood waters, it can also help in water scarcity facing Pakistan.

Role of small and medium size dams in preserving flood waters:

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.

1. Small and medium dams also help in storing the flood water which can be used in season of cultivation of crops or supplement the available water resources.
2. The dams also help in mitigating the erosion of top soil where their dams act as check dams and stoop the sill flowing down into the rivers and large reservoirs.
3. These dams also help in rising of ground water 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.

³⁰ Dams and Reservoirs Planning and Engineering, Iqtidar H. Siddiqui Ch.6 Reservoir Planning pg. 110

4. Improvement by providing the dams results in an enhanced water supply both in terms of reliability and quantity.
5. Small dams in grid areas like Potohar has 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 flood water causing flashfloods into large rivers. Although our large rivers have more than 25% of water due to snow melt but extensive rain during the period of normal floods result large increase in water. If the rain water 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 hydro power plants. This will not only help in storage of water but can also help in improving the situation of energy security.

In order to manage the energy gaps back in 2010 the then government decided to invest about Rs 250 billion over 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 two dams for each province were envisioned.³¹ 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 package 1 and 2. The remaining dams in Balochistan will be completed under package 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, ground water would also be recharged artificially, risk of flash floods would be mitigated, and poverty would be eliminated".³²

³¹ "32 dams to be constructed," The Nation (March 10, 2010), <https://nation.com.pk/10-Mar-2010/32-dams-to-beconstructed>.

³² "42 out of 100 dams in Balochistan completed, Senate body told," PAKISTAN OBSERVER, Jan. 31, 2018, <https://pakobserver.net/42-100-dams-balochistan-completed-senate-body-told/>.

Moreover, back in 2009 the then government was believed to prepare feasibility report over 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.³³ Pakistan Water and Power Development Authority (WAPDA) official webpage in its section ‘Projects’ identify key ongoing and already constructed projects in the domain of water sector and hydropower sector.³⁴ The details are given below:

Water Sector Projects of Pakistan		
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

³³ “Small dams for Sindh’s remote areas,” Dawn (July. 27, 2009), <https://www.dawn.com/news/480278>.

³⁴ For more details please consult the official website of Pakistan Water & Power Development Authority (WAPDA), <http://www.wapda.gov.pk/>.

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.

Hydropower Projects of Pakistan		
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 Valley 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 there are 93 dams that need government funding and appropriate attention to play significant role in national security.

6. **Conclusion:**

Water resources are depleting fast in Pakistan. There are two major reasons for shortage of water: floods and bad water management policies. Each year an estimated 715,000 people become victim of floods, which inevitably result an economic loss about US\$2.7 billion. According to a careful estimate, until 2030 around 2.7 million population of Pakistan will directly get affected from the floods.³⁵ A huge amount of water is also wasted during conveyance up to farm gates. Similarly, the bad utilization of ground water 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 flashfloods that directly impact on national economy, its infrastructure, people and agriculture.
- Learn to Adapt to Annual Floods: Even in most developed countries it is not possible to have a total protection from floods. No system can predict of potential floods nor predict changes occurring due to climate. Therefore, Pakistan must learn to adapt to

³⁵ Zofeen Ebrahim, Pakistan's new plan to embrace floods, Dawn July. 30, 2015, at 1.
<https://www.dawn.com/news/1197349>.

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annual floods and develop efficient water management system to convert the floods into opportunity.

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 at 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 majority of the riverine areas and flood plain zones highly vulnerable for flashfloods. Pakistan land authorities regardless of indulging into 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. Country totally 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 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 environment. Federal Government's decision to launch 'Clean and Green

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Pakistan' is the right way to protect forests and natural resources of Pakistan.³⁶ Prime Minister Imran Khan during his last provincial government in Khyber

Pakhtunkhwa had successfully launched a Green Ribbon Movement under the slogan of 'One Tree One Life'.³⁷ 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 totally become paralyzed in front of Indian water diplomacy. Pakistan has not been able to highlight its water issues at international level and it is primarily due to the reason that no home work has been done and there is no institutional framework which could undertake this issue with India as well as at international forum. Due to rising demand of water in future, 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 short fall, Pakistan requires one major reservoir every 10-15 years. Pakistan Supreme Court's Chief Justice Saqib Nisar and PM 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 side shall also be started.
- Corruption Free Regime: A corruption free regime is need of the hour to implement 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.

³⁶ Clean and Green Pakistan' 5-year campaign to be launched on October 13: PM Khan, Dawn, October. 08, 2018, <https://www.dawn.com/news/1437638>.

³⁷ Imran starts Green Ribbon Movement with slogan 'One Tree One Life', The Nation, March. 21, 2016, <https://nation.com.pk/21-Mar-2016/imran-starts-green-ribbon-movement-with-slogan-one-tree-one-life>.

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- **Conserving Water of Hill Torrents:** The hill torrents in Pakistan constitute a secondary network of natural surface drainage system. In Pakistan, 6935560 Hectares of cultivable waste land has an 18.69 MAF average. Baluchistan has the biggest potential of 10 million acres feet (MAF). This has not been utilized and almost ends up as complete waste. KP has the potential of 6.06 million acres feet (MAF) and 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 is just flowed with the floods.

Improvement in Irrigation and Canal System: As already 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/ head works, 12 inter-river link canals, 45 canal commands and some 90,000 water courses to irrigate land. Total length of the canal system is about 38,000 miles with water courses, farm channels and field ditches running another one million miles”.³⁸ We need to improve the irrigation and canal system. With such an exceptional legacy Pakistan could sustain centuries to come though 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. 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 adopt legislations required to save human lives.

³⁸ UNESCO Report, Flood Mechanics & Flood Management in Pakistan,
http://unesco.org.pk/ns/documents/Workshop_Workbook/Session_5/1_Engineers-Directorate-GHQ.pdf.

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- 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

Policy should also look into reducing susceptibility to damage through:

- a) design and location of facilities

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- 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

Policy framework should also incorporate mitigating impacts like:

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

Mix of strategy should also include:

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

To effectively mitigate the flood destruction and enhance water conservation above suggested points are needed to ponder. The water resources of Indus basin are becoming scarce thus it is imperative to have an efficient irrigation in the Indus basin. In Pakistan inefficient use of water resources is a main cause of water shortage. 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 completion of dam projects without political scoring. Any short coming will have adverse effects on the occurrence of any major floods in future. Water is an important ingredient of human life as well as development of a society. All living organs need water for survival. Societies need water for energy as well as cleaning purposes. Development of any society is directly linked with water resources and its reservoir capacity. Inability to understand and mitigating the challenges erupting out of water mismanagement would have diverse impact on national security of Pakistan. Therefore, it is a high time to consider the issue on war footing grounds. Failure to do so would have an unbearable cost to the whole nation.