



Multidimensional Water Management Challenges in Pakistan: A Meta-Analysis Approach

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Abstract

Pakistan is struggling to manage its water resources, due to policy gaps, climate change, political and diplomatic failures, unchecked population increase, and declining water quality. It could trigger water riots and finally lead to social catastrophe. There are continuing issues with water allocation among the provinces despite the 1991 Award. The disagreement between the provinces is having an impact on the construction of the Kalabagh dam. On a global scale, Indian violations of the Indus Basin Water Treaty have significantly decreased Pakistan's water flow. Pakistan and Afghanistan need to work together to solve water conflicts. Research has been conducted on secondary based data like articles, journals, reports, books, official and unofficial documents, and academic studies by using the Meta-analysis approach. The current study aims to outline the different dimensions of water management challenges in Pakistan. Findings show that all options are linked with water resources development and improvement in management.

Keywords: Water Management, Groundwater, Water Apportionment, Kalabagh Dam, Cross-Border Water Issues, Indus Basin Water Treaty

Introduction

Water management is undergoing a paradigm shift globally, moving from water supply management to water demand management. By increasing water productivity, water demand management aims to encourage effective water usage. Pakistan's water demand is anticipated to increase from 191 million acre-feet (MAF) to 274 million acre-feet (MAF) by 2025 (Rizvi, 2022). A shortfall of renewable freshwater supply in comparison to demand is known as water scarcity (Damkjaer et al., 2017). Even though 70% of the earth's surface is covered by water, just 1% of it can be used for human, animal, and plant consumption. In many parts of the world, rivers that transport potable water are dangerously drying up as a result of an extended drought. The fourth-highest rate of water use in the world is found in Pakistan, one of the driest nations on earth. Pakistan's bulk of its water needs are met by the Indus River system (Tariq et al., 2020). Every year, the Indus River, which is also famous for giving rise to several civilizations, continues to dry up (Akbar et al., 2021). It could trigger water riots and finally lead to social catastrophes (Rehman, 2019).

In the Hindu-Kush Karakoram (HKK) region of the Greater Himalayas, snow and glacier melt contributes to around 70% of the average daily flows in the Indus system. Climate change is causing unpredictable changes in snowfall trends and timing as well as snow and ice melt, which will have serious effects on how the basin manages its water supplies (Munir et al., 2021). According to the Pakistan Council of Research in Water Resources (PCRWR), there will not be much clean water accessible in the country by 2025 (Shukla, 2018). In Pakistan, there is a general dearth of knowledge about how groundwater is stored, recharged, and subsequently extracted. Private tube well expansion has greatly increased. 50 million acre-feet of water are extracted annually for farm irrigation by Pakistan's 1.2 million tube wells (Haq, 2021). Pakistan is among the countries most negatively impacted by the increasing groundwater depletion, according to NASA satellite maps. According to the Indus Water Treaty (IWT), Pakistan was granted the rights to three rivers, the Indus River, also known as the Sindh River, Chenab River, and Jhelum River, which have mean flows of 80 million acre-feet (MAF), whereas India was granted the rights to three rivers, the Beas, Ravi, and Sutlej (Samuel, M., 2018).

India, Afghanistan, and Pakistan's competition for water in the Indus River Basin has intensified (Halvorson & Mustafa, 2000). As the lower riparian nation, the continued water supplies from upper riparian Afghanistan and from India must be managed by Pakistan properly. Pakistan may have a major water crisis if dams are built by India and Afghanistan on rivers that enter Pakistan (Ahmar, 2021). An agreement on distributing Indus Basin resources between the Pakistani provinces is known as the Water Apportionment Accord of 1991. It is mostly based on the historical consumption of water by the provinces,

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which are: Punjab 47%, Sindh 42%, Khyber Pakhtunkhwa 8%, and Baluchistan 3% (Anwar, 2016). Implementing the Accord is the responsibility of the Indus River System Authority (IRSA), which was created by a law passed by the parliament. IRSA operating rules known as the "Three-Tier Formula" have been in operation since 2003 (Khan, 2011). Recently, the Tarbela and Mangla dams, Pakistan's two main reservoirs, reached a record low level (Akbar et al., 2021). The Kalabagh Dam (KBD) project, a proposed hydroelectric dam on the Indus River at Kalabagh in the Mianwali District of Punjab, Pakistan, has been the subject of heated debate along ethnic and regional lines for more than 40 years (PILDAT, 2011).

The objectives are:

- To evaluate premises for water management challenges.
- To investigate different levels of success in the development of water resources.
- To highlight many related obstacles, issues, weaknesses, and gaps.

The research questions are:

- What are different dimensions of water management challenges in Pakistan?
- What are the details of water-resource management specifically ground water and Indus River?
- What are the details of Cross-Border Water Issues?
- What are the effects of inter-provincial water conflicts, due to water appointment issue, on dams specially KBD project?

The three levels of institutional, intra-provincial, and inter-provincial management should be used to address water management concerns, according to Bisht, M. (2013). According to Meribole, J. (2020), Pakistan needs to create a framework to aid in the management of surface and groundwater. Imran, K., (2022) asserts that when management is severely hindered, water concerns are likely to persist at a very high intensity, as seen in the case of Pakistan.

Focusing on conflict and collaboration may cause one to ignore circumstances that reverse depletion when neither conflict nor cooperation takes place, according to Steenbergen, F. V., et al. (2014). These could be referred to as "socio-institutional gaps." In the case of groundwater, "the race to the bottom" continues until the very end with no intervention. Sivapalan, M., et al. (2014) claim that the lack of sufficient handling of the two-way dynamic feedback between human and water systems results in the lack of explanatory and predictive capacity in present approaches to studying water sustainability concerns. Reviving the step-wells will allow people to restore their customary resources, claims Azmi, F. T. (2021).

To preserve authority and the health of the Indus Basin waterways, the Treaty needs to be reexamined, according to Nax, N. A. (2016). The availability of water in Pakistan is being harmed by some Indian water storage projects, according to Qureshi, W. A. (2018). Atef, S. S., et al. (2019) have stated that to share benefits and expand the set of benefits, the needs on both sides of the basin should be recognized and studied. Transboundary water issues are usually challenging due to the involvement of several nations with a variety of political, economic, and social interests relating to water, according to Qamar, M. U., et al (2019). According to Ibrahim, A., (2021), India has repeatedly broken the Indus Water Treaty by threatening to restrict the flow of water toward Pakistan and actually doing so on several occasions.

Conflict over water resources, according to Abdella, U. M. (2012), results from disparities in stakeholder perspectives. Every mega hydro-project must be built to be environmentally friendly, and previous projects must be reevaluated and adjusted to make them sustainable, according to the findings of Qadir, A., et al. (2013). Affected populations ought to be permitted to offer feedback on the dam design process, claims Houston (2017). Anwar, A. A., et al. (2018) contend that working within the Accord rather than changing it would be the best way to enhance the distribution of water across Pakistan's provinces. Building multipurpose, huge dams is crucial, according to Qureshi, R. H., et al (2019), to store extra water

produced by glaciers melting and monsoon runoff. Construction of small and medium-sized dams and ponds is required to store runoff and any additional water. Without a proactive strategy, the water problem, according to Rizvi, O., (2022), may even result in violence between provinces, shattering the foundation of social cohesion. According to Khan, A. F. (2022), Punjab and Sindh have decided to measure water discharges together and allow each other to make unauthorized visits to barrages to check inflows and outflows. This agreement can help address one of the main causes of provincial conflict, namely perceived misreporting.

Materials and Methods

Type of Study: It is a basic research, mainly concerned with qualitative Meta- analysis, which is a descriptive and inductive research design to synthesize qualitative studies.

Data Collection Method: This researcher relied on published secondary resources with the help of literature form of descriptive types of research data, based on multidimensional water management challenges in Pakistan.

Data Analysis Method: Qualitative Meta-analysis is an intentional and coherent approach to analyzing data across qualitative studies. The emphasis is on translating studies, which are then systematically compared or "translated" within and between studies while maintaining the structure of the connections between key concepts or themes and including a "thematic analysis".

Results and Discussion

Pakistan would experience extreme water scarcity by the year 2025. From 5,229 cubic meters in 1962 to a meager 1,187 in 2017, Pakistan's water consumption per person has substantially fallen. A vast integrated strategy for the development of water resources and hydropower was introduced by WAPDA under the name Vision 2025.

One of the largest groundwater aquifers in the world is in Pakistan (4th after China, India, and the USA). More than 60% of the water used for agriculture and more than 90% of the water used for drinking are sourced from this freely accessible resource. Anyone can set up any number of tube wells, any capacity, anywhere, pump any quantity of water whenever they want, and even sell it to others in the absence of any regulatory framework. Groundwater depletion and secondary salinization are the results of this indiscriminate drilling and operating of tube wells. Punjab is the province most severely impacted by groundwater depletion, as shown on the NASA satellite map. 1.2 million privately owned tube wells are currently operating throughout the nation, including 4.8% in Baluchistan, 6.4% in Sindh, 3.8% in Khyber-Pakhtunkhwa, and 85% in Punjab. A provincial groundwater management plan is also being created in Punjab. A similar law was approved in the province of Khyber Pakhtunkhwa in 2020. While a draught water policy is being developed in Sindh to give much-needed guidance for addressing waterlogging and salinity issues as well as for joint management of surface water and groundwater. A framework for coordinating groundwater stakeholders across Pakistan is being developed by the federal government as part of a five-year National Groundwater Management Plan.

Despite having at least nine rivers in common, Afghanistan and Pakistan have never penned a joint management agreement. In the KRB, Afghanistan and Pakistan are adjacent to one another upstream and downstream. Afghanistan is beginning to realize that efficient water resource management is necessary for maintaining the nation's peace. The Afghan government planned to build 12 reservoirs on the Kabul River with Indian financial and technical assistance, which would harm Pakistan's agricultural industry.

India has started constructing enormous dams for water storage across the western rivers that Pakistan was given access to as part of the Indus Waters Treaty. Eleven dams have been constructed in India, with the Baglihar and Salal Dams being the two largest. India has constructed nine hydropower

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facilities on the Indus River, several on the Chenab River, and thirteen on the Jhelum River in addition to the terrible Kishanganga Dam. These initiatives might drastically drain water from Kashmir's Neelum-Jhelum River, thereby deserting Pakistan's Neelum Valley. Pakistan has protested 27 water projects in India. About 43 million cubic meters of river water could be withheld from Pakistan as a result of these hydropower initiatives. By decreasing the supply of water, they are also undermining Pakistan's current water management infrastructure.

Due to siltation, Pakistani dams are getting close to the end of their intended lifespan. During the floods of 2010, 2012, and 2014, Pakistan lost more than 90 MAF of water due to insufficient storage. Punjab would receive 36.57 MAF of water under the 1991 agreement, Sindh 33.49 MAF, Balochistan 2.81 MAF, and KPK 0.80 MAF. IRSA had failed to put the 1991 Water Accord into practice. The Three-Tier Formula Operating Rules are those utilized by the IRSA. The three-tier system differs from the 1991 pact in that Punjab would receive 1.64 MAF more water, Balochistan 0.04 MAF more water, KPK 0.02 MAF more water, and Sindh would receive 1.69 MAF less water.

Punjab's provincial government has been accused by the smaller provinces of diverting their fair share of water from the Mangla and Tarbela dams. KBD posing a threat to the town of Nowshera is KPK's main worry. Because the Kalabagh Reservoir will alter the water level in the Kabul River in the event of a major flood, such as the flood of 1929, the town will be effectively flooded. WAPDA, however, cites computer simulations as evidence that this is a baseless charge. There has yet been no payment made to the 96,000 individuals who were displaced while the Tarbela Dam was being built. Because of this, there is a great deal of mistrust between the federal government of the nation, the displaced people, and the KPK provincial authority.

Conclusion

Different types of water management issues are present in Pakistan. The difficulties in managing water are becoming more difficult due to groundwater depletion, contentious dam development, inter-provincial water disputes, and cross-border water issues. Water is mostly utilized for agriculture, but in the future, water demand for urban and industrial purposes may increase. As a result, there may be a decline in the amount of water available for agriculture. The significance of the KBD has been obscured by politics. The storage capacity of the current dam is decreased. There has been a considerable loss in water storage. We need to utilize our historical step-well and forestation water management systems to solve these issues. Moreover, India's objectives for complying with the Indus Basin Water Treaty are not entirely clear. External transboundary water resources can foster unity, progress, and collaboration instead of war. Nevertheless, Afghanistan and Pakistan can at least cooperate with the basin's water resources after overcoming hurdles related to mistrust and capability limitations. While India is engaging in water aggression and violations of the Indus Water Treaty, Pakistan's Kabul River serves as another dependable water source to meet needs.

Recommendations

The government should declare a water emergency, designate Pakistan as a country experiencing water stress, and impose penalties for water waste. Look into groundwater mining. Make farmers aware of the groundwater issues. Incorporate and manage contemporary agricultural technologies. Intensify the forestry. Introduce the aquifers' artificial replenishment system. Create aquifer wells. Step-wells can be used to manage rainwater and as a tourist destination. Create small dams to increase storage capacity. Before focusing on KBD, reduce mistrust among the provinces. People should be made aware of water waste by religious establishments. To transform conflict into cooperation over water conflict management, Pakistan, India and Afghanistan should determine the needs of the basin and any shared benefits.

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