DOI: https://doi.org/10.52131/pjhss.2022.1001.0171

Pakistan Journal of Humanities and Social Sciences

Volume 10, Number 1, 2022, Pages 29–42
Journal Homepage:
https://journals.internationalrasd.org/index.php/pjhss

Water Governance and Management in the 21st Century: A Case Study of Pakistan

Aisha Saddiqa[1], Sarfraz Batool[2], Shahzad Ali Gill[3], Ali Junaid Khan[4]

[1] Department of Political Science, The Islamia University of Bahawalpur, Pakistan.
Email: aishasadiqa17@gmail.com
[2] Assistant Professor, Department of Political Science, The Islamia University of Bahawalpur, Pakistan.
Email: sarfraz.batool@iub.edu.pk
[3] Assistant Professor, Department of Public Administration, The Islamia University of Bahawalpur, Pakistan.
Email: shahzadaligill@gmail.com
[4] Institute of Business, Management & Administrative Sciences, The Islamia University of Bahawalpur, Pakistan.
Email: junaaidkhan@yahoo.com

ARTICLE INFO

Article History:
Received: December 06, 2021
Revised: January 16, 2022
Accepted: January 18, 2022
Available Online: January 18, 2022

Keywords:
Water Management
Water Governance
Water Crisis
Water Management Policy
Climate Change

ABSTRACT

Given the continuous population growth and climate change, water resources are becoming increasingly scarce. With the escalation of this water crisis, water management and governance have become essential concerns across policy agendas. Every country has a different regulatory system, policy framework, specific management requirements, institutional challenges, and capacity gaps concerning the administration of its water resources. The present study focuses on the policy frameworks and institutions for managing water resources in Pakistan at both provincial and federal levels. The paper analyzes water governance challenges and major hurdles regarding effective water management and the development of water resources in the country. A descriptive analysis of the country's water management and water distribution between the federation and federating units is based on secondary data sources with a qualitative approach through a desk research method. While describing the underpinning issues and challenges of water governance and management in Pakistan, the study findings reveal that the country needs to adopt a collaborative approach towards water governance and management and capacitate the relevant institutions and stakeholders to perform their mandated tasks effectively to ensure a water-secure future for Pakistan. The study recommends launching mass awareness campaigns concerning efficient usage of water, adopting intelligent agriculture techniques, and fast-tracking the completion of new reservoirs while discouraging build-neglect-rebuild policies for the existing water infrastructure. The study also presents limitations and recommendations for future research.

Corresponding Author's Email: shahzadaligill@gmail.com

1. Introduction

It is a scientifically proven and admitted fact that water is the most critical factor and a valuable resource to sustain human life and maintain ecological balance in the universe. Nothing in the living world can survive without water. Today, it is estimated that 71% of the land is covered with water, but only 2.5% of water is considered fresh and useable. With the population growth, water consumption has also increased, and now almost one-third world is facing different kinds of issues related to water scarcity (Sayal, 2015). The water shortage is becoming a significant challenge for the world, but developing countries will become vulnerable if water scarcity is not addressed efficiently and effectively. Most developing countries face water insecurities due to inappropriate policies and management. Kofi Anan, the Seventh Secretary-General (1997-2006) of the United Nations, declared in 2002 that most of the water

eISSN: 2415-007X

crises in the world are actually due to the governance crisis and mismanagement of water resources (Philip, 2010).

Further, the Asian Development Bank (ADB) also reported that most of the countries in Asia will experience a water crisis in the future. That crisis will be caused by the shortage of water, improper water governance, and inadequate management (Rola, Pulhin, Tabios, Lizada, & Dayo, 2015). To handle this issue, it is essential to exert efforts to revamp water resources management in political, constitutional, legal, institutional, social, and technological spheres.

Pakistan is an agricultural country, and its economy mainly depends on water availability. International Monetary Fund (IMF) has already listed Pakistan as the most water-stressed country (Khoso, Wagan, Tunio, & Ansari, 2015). Climate change and cross-boundary water management have reduced water availability in Pakistan. Many factors such as urban development, demographic and economic growth, and improved agricultural practices have increased the demand for water on a large scale (WWF, 2007). In Pakistan, water-related issues are primarily associated with water governance and management. It is a fact that climate change and transboundary issues have affected the availability of water in the country, but water mismanagement has worsened the water crisis in Pakistan (Shafiq, Gillani, & Shafiq, 2021; Yang, Brown, Yu, Wescoat Jr, & Ringler, 2014). Mismanagement of water resources has changed the country's status from a water surplus country to a water-stressed country. For several decades, the availability of per capita water has been decreased a lot in Pakistan. In 1951, available per capita water was about 5000 cubic meters. In 2009, per capita water was 1500 cubic meters, and current per capita water availability has fallen about 960 cubic meters that will go down further 500 cubic meters by 2025 (W. Ali, Javid, Hussain, & Bukhari, 2018).

Along with the physical water scarcity, Pakistan is also facing economic water scarcity due to insufficient and obsolete water infrastructure, low investment in the water sector, and improper management of water resources. Poor water management and governance gap have worsened the water crisis. A weak regulatory system, lack of administrative checks, coordination, and funding hinder better water governance in Pakistan (Mirjat et al., 2017).

2. Literature Review

2.1 Water Governance and Management

Water management requires effective water services on a regular, monthly, seasonal, and annual basis through joint activities of all stakeholders, infrastructure, finances, and other resources (FAO, 2018). Further, water management is defined as the practice of analyzing and monitoring water resources and developing and implementing steps to maintain the resources in a desirable state. Water governance is a social, political, and administrative measure to efficiently manage water resources and provide effective water services to different sectors of society at national, provincial, and local levels (Ahmad, Khan, Soharwardi, Shafiq, & Gillani, 2021; Maharjan, 2018). Governance encompasses a regulatory framework, procedures, and processes for accessing, using, and controlling water resources and managing water-related conflicts (FAO, 2018). Water governance is also defined as a set of systems that control the process of policies, strategies and planning, financial structures, and monitoring processes regarding management and development of water resources and promotes the involvement of all stakeholders in the management of water resources (Neef, 2009). Additionally, water governance explains how allocative decisions and regulatory politics are used regarding water security through formal and informal institutions and determines that "who gets what and how much, and who does what" transparently and equitably (Jiménez et al., 2020).

2.2 Constitutional and Institutional arrangements for Water Management in Pakistan

Efficient services rely on effective management, while effective management depends on good governance; hence, to be efficient, water governance should be adapted to the contexts of the country's unique geopolitical and biophysical environment and its cultural and political practices (FAO, 2018). Being a Federation, Pakistan has different political institutions, policies, and regulatory authorities working at both federal and provincial levels. After 1947's partition, Pakistan and India mutually agreed to the systematic division of the Indus water system through the Indus Water Treaty, and Pakistan was required to reform its legal

framework and institutions to manage the water of the Indus River between the provinces (Briscoe, Qamar, Contijoch, Amir, & Blackmore, 2005).

Therefore, the country adopted the British Canal and Drainage Act of 1873 to formulate a regulatory system for water management which is still active, whereas some amendments were made in 1967 (Bisht, 2013). According to this Act, any water resource in a country is the government's property. The Act established a legislative basis to allocate the water for an irrigation system called 'Warabandi' (a traditional rotational water delivery method on domestic level farmers over certain hours, days, and weeks) (Qureshi & Ashraf, 2019). The Act provided castigates for the damages of irrigation water infrastructure (Mustafa & Akhter, 2013). Article 155 (3) of the 1973 Constitution of the Islamic Republic of Pakistan deals with the procedure in case of disagreement between provinces and the federation on water distribution. Under this article, water-related disputes are referred to the Council of Common Interests (CCI) to resolve the issues and both federal and provincial governments are bound to respect the decision of the Council.

2.3 Evolving Policy Framework and 18th Amendment

The Water Policy's evolution and its framework have gone through many phases in Pakistan. Many national and international reports (especially in the last three decades) drew the higher authorities' attention to address water governance issues. For instance, the report of the National Commission on Agriculture, Chapters 6, 17, and 18 published in 1988; Report of the Inter-Provincial Committee on the Apportionment of the Indus Waters in 1991; Water Sector Strategy by the Asian Development Bank (ADB) (2002); WAPDA's Vision 2025 Report (2003); John Brisco's report titled Pakistan's Water Economy running dry in 2005; Development of Integrated River Basin Management for Indus Basin: World Wildlife Fund (2012); A Productive and Water Secure Pakistan: Report by Friends of Democratic Pakistan (Water Sector Task Force, 2012); Pakistan Vision 2025: Pillar IV: Energy, Water and Food Security by Planning Commission, Government of Pakistan (GOP, 2018); and A Region at Risk-The Human Dimension of Climate Change in Asia and the Pacific: Report by ADB and Potsdam Institute for Climate Impact Research in 2017, stimulated this debate in the academic and professional circles (MWP, 2018).

However, the water governance policies were mainly centralized in the federal administration. The 18th Amendment, passed in 2010 in the 1973 Constitution, shifted the paradigm from centralization to decentralization, empowering the provinces in policy and decision making (Yang et al., 2014). After the 18th Amendment, water authorities and institutions were divided between provincial and national governments. The authorities regarding environmental pollution, public health, and agriculture (related to water) have been moved to the list of exclusively provincial matters (Gillani, Shafiq, & Ahmad, 2019). Each province has its separate departments for irrigation, water supply, and sanitation (Mustafa & Akhter, 2013).

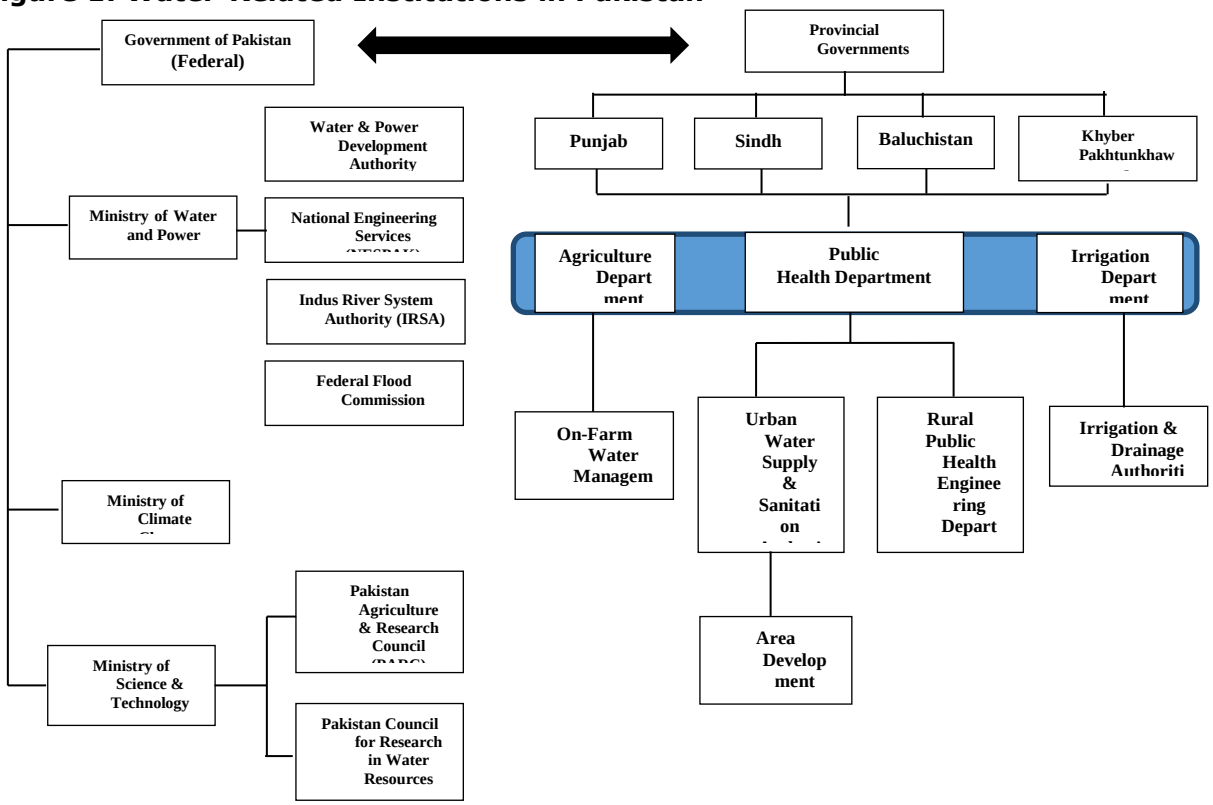
On the other hand, water resources (ground and surface water resources) became the federal subjects. Through the National Water Policy 2018 (NWP), the issue of water scarcity received high-level political attention, support and was adopted as a national imperative. The policy aims at addressing the following issues:

- Water conservation, water storage, water treatment, and clean drinking water.
- Sustained national commitment to substantially increase public and private resources for the water sector.
- Creation of institutional framework that can address present deficiencies in project management and cost-effective maintenance on a war footing to revive the technical capacity and efficiency of the system that achieved such remarkable progress between 1950 and 1990.
- Promotion of sustainable consumption and production patterns throughout the water sector from exploitation to utilization.
- Augmentation of the available water resources of the country through judicious and equitable utilization via reservoirs, conservation, and efficient use.
- Improvement of the urban water management by increasing the efficiency of the system and by reducing non-revenue water through adequate investments to address

the demands of drinking water, handling of waste-water, sewage disposal, and industrial effluents.

- Hydropower development to increase the share of renewable energy.
- Building of new large dams for system augmentation, medium and small dams for local and regional uses to conserve water with a consensus of all federating units.
- Checking and repairing of dams on regular basis.
- Adoption of water conservation techniques and technologies for sustainable use of water at every level.
- Treatment and possible sustainable reuse of wastewater in agricultural, industrial, and domestic sectors." (MWP, 2018)

Figure 1: Water-Related Institutions in Pakistan



Source: (Mustafa & Akhter, 2013)

Keeping in view the changing scenarios, both federal and provincial governments have a keen interest in resolving water-related issues. There is a strong consensus that building new dams is an essential step to prevent water scarcity in the future in Pakistan. Although Pakistan has many large, medium, and small dams, water management, and resource allocation are still significant concerns for the government. According to the 'International Commission on Large Dams' (ICoLD), "150 dams and reservoirs of Pakistan are over 15m (49 ft) in height. 'Tarbela dam' is the largest earth-filled dam in the world, 'Mirani Dam' is the largest dam in the world in terms of volume for flood protection with a flood stock of 588,690 cubic hectometers while 'Sabakzai dam' is the 7th largest with a flood stock of 23,638 cubic hectometers" (ICOLD, 2012). ICOLD further clarified that dams with a height over 15m above the ground/foundation are known as large dams. However, experts said that 150 large dams and almost 30 small dams are working in Pakistan, but still, Pakistan is included in the list of water-scarce countries. So, it is suggested to build more than 750 small dams to fulfill the increasing water requirements in different provinces and regions. The following table listed large dams that exist in different regions of Pakistan, along with a listing of small, proposed, and under-construction dams in Pakistan:

Table 1: Detail of Dams in Pakistan

Province/Region Name	Number of Large Dams	Number of Small Dams	Number of Proposed Dams	Under-construction Dams
Azad Jammu & Kashmir (AJK)	02	N/A	N/A	N/A
Balochistan	29	N/A	05	01
Gilgit Baltistan (GB)	03	N/A	02	01
Islamabad Capital Territory (ICT)	02	N/A		
Khyber Pakhtunkhawa (KPK)	28	02	01	05
Punjab	31	29	04	01
Sindh	03	N/A	N/A	01

Source: ICOLD and Wikipedia (information updated in December 2021)

2.4 Water Resources Management in Pakistan: Institutions and Policies

The federal government of Pakistan is responsible for water allocation between provinces, managing the transboundary water issues, development, management of water resources, operation, and maintenance of water infrastructure (Ranjan, 2019). Further, the construction of hydropower infrastructures is also a responsibility of the federal institutions. All water management institutions are under the Ministry of Water Resources (Saleem, 2017), including the Water and Power Development Authority (WAPDA), Federal Flood Commission (FFC), and Indus River System Authority (IRSA). WAPDA is responsible for constructing water infrastructure, development, operation, and maintenance of water reservoirs, link canals, and barrages (Ranjan, 2012). It also provides water information to Provincial Irrigation Departments (PIDs) and IRSA and cooperates in water allocation to provinces. WAPDA has done remarkable work in the 1960s-1980s to develop and construct multiple small and large hydro projects, including central water reservoir Mangla and Tarbela dams (Saleem, 2017). Salinity Control and Reclamation Projects (SCARPs) were established under the domain of WAPDA to control the waterlogging and reduce the salinity (Sayal, 2015).

In 1991, Water Apportionment Accord (WAA) was drafted to distribute water between provinces. It was the first legal document on water distribution (Janjua & Hassan, 2020). IRSA was established under the 1991 Indus Water Accord (IWA), responsible for water allocation between the provinces for the irrigation system. It consists of five members, four representatives of provinces, and one from the federal government (A. H. Khan, 2014). Before *Kharif* and *Rabi* seasons, all the members of IRSA and advisors determine the water share of the provinces according to the available water level in the Indus system and reservoirs. This information is reviewed with the coordination of provinces WAPDA (FoDP, 2012). IRSA collects water data and sends it to provincial irrigation departments and other local water-related offices. Data is sent back to provincial departments and IRSA every ten days (Ranjan, 2012). However, IRSA is not responsible for constructing water infrastructure; it only ensures that water is provided to the provinces according to their allocated share (FoDP, 2012).

Moreover, two other ministries, the Ministry of Science and Technology (MoST) and the Ministry of Climate Change (MoCC), coordinate water management. Two major water research institutions, the Pakistan Agricultural Research Council (PARC) and the Pakistan Council for Research in Water Resources (PCWR), are also working under the MoST (Mustafa & Akhter, 2013).

Further, The National Environment Policy, 2005, was approved under the Ministry of Environment (MoE) to address the environmental issues of polluted water and wetlands and provide water treatment facilities and water quality monitoring system (EPD, 2007). FFC was established in 1977 for flood control planning, collecting accurate data, constructing infrastructure to mitigate disaster risk and minimize vulnerability (Tariq & Van De Giesen, 2012). The Provincial Irrigation and Drainage Act, 1997, is responsible for distributing canal water and providing water for irrigation and industrial sectors at the provincial level, along with

maintenance and rehabilitation of canals and water bodies (Sayal, 2015). The first National Water Policy (NWP) has approved by the Council of Common Interests (CCI) in 2018. This policy contains 41 pages and 29 sections, excluding the preamble, and presents 33 significant objectives. It covers almost all aspects of water, including the construction of new water storage and hydroelectric power projects with the consensus of all the stakeholders, management and development of surface water and groundwater resources, planning according to climate change, development of domestic and urban water strategies, drought and flood management, and update the water data (GOP, 2018). Soon after the approval of NWP, 2018, The Punjab Water Act and The Khyber Pakhtunkhwa Water Act were approved in 2019 and 2020, respectively, by their respective provincial assemblies.

2.5 Financial Allocations System

The National Finance Commission (NFC), under the Ministry of Finance (MoF), collects the primary source of national revenue sales tax, income tax, property tax, capital tax, and customs duty. Then it divides into all provinces and the federal government. Provinces get their share based on population (Pasha, 2011). About 40% of revenue goes for debt servicing, salaries, subsidies, loans, and pensions. Half of the other 40% goes for the defense budget, half is allocated to the Public-Sector Development Program (PSDP), and the remaining 20% is divided between the federal government and provinces. Provincial governments allocate funds for water development projects through the Ministry of Water and Power. In the water sector, irrigation and municipal water services, tariffs, and private sector investment are the primary sources of finance (Nawaz, Hussain, & Hussain, 2021). At the federal level, funds allocation to the water sector is only 4% over the last three years, with an average allocation of 11% from the last 18 years (Young et al., 2019).

Table 2: Water-related Legislation and Institutions in Pakistan

Policy and Institutions	Year	Implementation	Main Objectives
Canal and Drainage Act	1873	Provincial and Federal	Framework for irrigation water
Sindh Punjab Agreement	1945	Provincial	To resolve the water dispute on the Indus River
Punjab Development of Damaged Areas Act	1952	Provincial	Allow provincial government
Water and Power Development Authority Act (WAPDA)	1958	Provincial and Federal	To establish the WAPDA for water and power development under the Ministry of Water and Power (MoWP)
Land Reforms	1959	Provincial and Federal	Limitation for land ownership
Indus Water Treaty	1960	International	Agreement between Pakistan and India on Indus River System
The Pakistan Council for Research in Water Resources (PCRWR)	1964	MoST	PCRWR researches with the collaboration of different national and international organizations and collects data in multiple sectors related to water
Territorial Waters and Maritime Zones Act (TWMZA)	1976	Federal and International	Declares maritime territory and boundaries
Federal Flood Commission (FFC)	1977	Federal	Floods control planning
Council of Common Interests (CCI)	1973	Federal	Constitutional body formed under the Act 153
Water Boards and Farmer Organizations	1982	Local-level	At the local level, canal water distributions and revenue collection
Water Apportionment Accord	1991	Provincial	Water allocation among the provinces
Indus River System Authority (IRSA)	1992	Provincial	Federal and provincial water coordinating organization

National Environmental Quality Standards	1993	Federal and Provincial	Control domestic and industrial pollution
Provincial Irrigation and Drainage Authority Acts	1997	Provincial	Control irrigation and drainage systems in all provinces.
National Drainage Program	1998	Federal and Provincial	Control access drainage for canals and control water salinity
Devolution Plan	2001	Provincial	Local government election
WAPDA Water Vision 2025	2001	Federal and Provincial	Long-term water infrastructure projects and development, construction of new water storage, hydropower infrastructure investment, and water Sector Strategy
National Environment Policy	2005	Provincial and Federal MoE	Pollution control and environmental management
Balochistan Water Policy	2006	Provincial	To provide a regulatory framework at the provincial level
National Drinking Water Policy	2009	Federal MoCC	Provide a framework for the provinces to make sure the quality and supply of drinking water
Pakistan Vision 2030	2007	Provincial and Federal	National economic policy highlights the effect of water insecurity, agricultural efficiency for food security, water pollution control, and water pricing
National Disaster Risk Management Framework	2007	Federal and Provincial	Framework for reducing risks and vulnerabilities and efficient recovery from natural disaster
National Climate Change Policy	2012	Federal MoCC	Framework for addressing the climate change vulnerabilities
First Private Water Utility	2012	Provincial and Federal	Privatization of water services
18th Amendment to the Constitution of Pakistan	2010	Federal	Decentralization of powers
Pakistan Vision 2025	2015	Federal	Strategy and road map to achieve the SDGs
National Water Policy	2018	Federal and Provincial	Official regulatory framework for water management in Pakistan
The Punjab Water Act	2019	Provincial	Provincial water regulatory framework
The KPK Water Act	2020	Provincial	Provincial water regulatory framework

Source: (Bisht, 2013; Mustafa & Akhter, 2013; Young et al., 2019)

2.6 Challenges of Water Governance and Management in Pakistan

The water situation in Pakistan has deteriorated due to administrative inefficiencies and poor governance mechanisms. In addition, lack of seriousness, poor management, inadequate financial resources, political deadlock, poorly defined water rights, and corruption exacerbate the circumstances. These norms and the skills deficit affect the governance patterns of Pakistan and increase institutional inefficiency that results in escalating the mistrust between the stakeholders. Some key challenges are discussed below:

2.6.1 Lack of Coordination

Lack of coordination across relevant institutions of both provincial and federal governments is a major hurdle in the planning and implementing water management policies (Cooper, 2018). Generally, the federal system has a complex institutional and legal framework between provinces and the national government. Pakistan has both constitutional and federal systems (Ranjan, 2019). After the 18th Amendment, the situation became more complicated.

The devolution process resulted in more than 18 different institutions and authorities at the federal and provincial levels (Alam, 2019). Different ministries like climate change, defense, industries, and agriculture are also stakeholders in the water management process. Conflict of interest and different points of view of the stakeholders and decision-makers make it challenging to reach viable solutions to the problems (Winston, Yang, Savitsky, Alford, & Brown, 2013). The policy process at the federal level is very complicated; large bureaucracies formulate it. Sometimes, there are connection gaps between the respective authorities, which ultimately lead to issues of cooperation and coordination (Saleem, 2017).

There is no platform at any level that creates coordination between the stakeholders and authorities; they cooperate only based on their needs (Lerebours & Villeminot, 2017). According to a 2017 report of the State Bank of Pakistan, most of the authorities and responsibilities overlap at federal and provincial levels for domestic and agricultural water supply (Ali, Ashfaq, & Masood, 2017). PIDs and PIDAs are also overlapping between both governmental levels creating many contradictions. In Punjab and Sindh, multiple departments formulate drinking water and sanitation policies without having their role in execution. Policy enforcement by multiple agencies further adds to the complexity and confrontation (Sleet, 2019). Consequently, the conflict between institutions and authorities slows down the advancement of the water sector (MWP, 2002).

2.6.2 Lack of Accountability and Transparency

Corruption is one of the permanent features of the administrative structure of Pakistan. Adequate administrative checks on authorities are lacking. Water bureaucracy is influenced by politicians and local landowners (Mustafa & Akhter, 2013); therefore, weak accountability mechanisms cause the poor implementation of the sectoral programs. Many water projects like Mangla and Tarbela dams, SCARP, and LBOD got funds from the government coupled with heavy external funding. But still, most of the projects aren't adequately maintained. A major portion of the budget goes into the salaries of the water bureaucracy (Kugelman & Hathaway, 2009).

2.6.3 Lack of Efficiency and Planning

The primary responsibility of MoWP is the development and management of water resources, but water is the least priority of this ministry. Only one out of six joint secretaries in the ministry deals with the water sector, and the other five work for the power sector (Saleem, 2017). Further, there has been no water policy for the last 70 years at the national level. The first NWP was passed in 2018. Major water management institution, WAPDA, was established for strategic planning for the water sector and the development of hydro projects. It remained an efficient institution that completed multiple hydro projects in the 1970s and 1980s (Ranjan, 2012). Later, it was divided into two separate wings with separate mandates for water management and power generation. After the split of responsibilities, its work efficiency decreased due to the division of trained staff and inadequate planning. This can be managed by proper training and development, which will increase the efficiency as well as commitment of staff (A. J. Khan, Bashir, Nasim, & Ahmad, 2021).

Further, it has to consult foreign consultants regarding different R&D projects (Young et al., 2019) and the construction of new water reservoirs. One prominent example of a lack of planning is that the country could not construct any new dam after constructing the Tarbela Dam in 1974. As per the international standards, the country has only 30 days of water storage capacity compared to the minimum storage capacity of at least 120 days (Ali et al., 2017). Further, due to sediments and slits, three major dams of Pakistan have lost their 35% storage capacity and 10% average annual flow (Qureshi & Ashraf, 2019). Due to a lack of storage during winter, the country faces a water shortage. At the same time, the heavy monsoon rainfall brings terrible floods.

Consequently, the excess water falls into the Arabian Sea. In Pakistan, annually, 29 Million Acre Feet (MAF) water falls in the Arabian Sea, and one (01) MAF has an economic worth of one (01) billion U.S. dollars with a capacity to irrigate four (04) million acres of land (Kiani, 2020). Overall, it costs the country an economic loss worth USD 29 billion per annum. Although Pakistan's two large dams, Diamer Bhasha and Mohmand Dam, are under

construction, Mohmand Dam is projected to be completed in 2025 and Diamer Bhasha by 2028 (WAPDA).

2.6.4 Poor Water Quality

Pakistan is facing water scarcity and confronted with poor water quality. More than 60% of people in Pakistan do not have access to clean drinking water. Both surface and groundwater are affected by untreated industrial waste, leakage of sewerage lines (Sleet, 2019). In most Sindh and Punjab cities, the drinking water is highly contaminated with hundreds of micrograms of arsenic per liter. In contrast, the limit set by the World Health Organization (WHO) is ten micrograms of arsenic per liter (Ranjan, 2019). Thousands of people suffer from waterborne diseases annually. According to a 2016 report, PCRWR collected 369 water samples from 23 main cities of the country, from which 255 sources were found unsafe (Daud et al., 2017).

2.6.5 Weak Regulatory System and Institutional Deficiencies

Another challenge is the fragility and inadequacy of the regulatory system in implementing the policies, which is one of the main reasons for ineffective water management. Even though IRSA was exclusively established to settle down water disputes among the federating units, the conflict is still unresolved after a lapse of 30 years (A. H. Khan, 2014). Sometimes, Punjab uses its dominance and refuses to consider IRSA's decisions. In September 2014, during the *Rabi* season, it obtained 3% more water than its allocated share (Tariq, van de Giesen, Janjua, Shahid, & Farooq, 2020). Provinces are still accusing each other of stealing their water share. Instead of resolving the dispute, disagreements have been increased on the daily water allocation, construction of dams, and canal closures (Winston et al., 2013). WAPDA installed a telemetry system in 2002 to measure the discharge of water from the Indus system, and IRSA was responsible for managing it, but just after a few months, the telemetry system was abandoned due to its semi-automatic scheme (Alam & Saleem, 2016).

Another telemetry system was fixed in 2008 with the support of The World Bank on Nara Canal, Sindh, to check the flow at the head and tail of the canal; however, it was also abandoned soon. The negligence of IRSA and PIDs was the primary reason for this system failure (Arfan et al., 2020). Deficiencies in the regulatory framework revealed the structural weaknesses of the institutions that they are failed to enact the approved policies (Alam & Saleem, 2016). The cherry on the cake is that such policies and regulatory frameworks are poorly planned and executed, resulting in inefficient administrative monitoring processes (Sleet, 2019). Although NWP of 2018 considers the importance of monitoring and assessment in policy implementation and suggests establishing a monitoring committee of 18 members with the representation of provinces and other ministries to monitor the progress of the relevant projects, but it is not specified that when or how this committee will be formed, what will be its scope, etc. (Sumra, Mumtaz, & Khan, 2020).

2.6.6 Financial Constraints

Lack of financing and inadequate funding are significant issues in policy planning and implementation at the local and provincial levels. Due to insufficient financial resources, most projects are still on paper, in the planning phase, and many are dysfunctional. The government does not allocate funds for maintenance of the infrastructure due to high maintenance and repair costs; hence water infrastructure is ignored or poorly repaired (Cooper, 2018). Most water-related institutes are not financially stable due to meager investments, low revenue recovery, and exorbitant salary packages to water bureaucracy (Bisht, 2013). The Punjab government implemented a few new irrigation technologies under the "High-Efficiency Irrigation System," which helped improve water production efficiency from 40% to 90% and reduced the water wastage in irrigation. But, due to financial constraints, the government of Punjab cannot implement these technologies on a larger scale (Ranjan, 2019).

Moreover, the water authorities lack expertise and fail to balance operations and maintenance budget and cost recovery, whereas, in developed countries, irrigation revenue is 100% (Arfan et al., 2020). However, Pakistan consumes about 90% water for irrigation and has the lowest irrigation water charges, and *Abiana* collection is less than 35% of the total cost. Farmers pay only PKRs. 135 per acre annually (Bell, Shah, & Ward, 2014). The estimated budget of Punjab was PKRs. 6.6 billion during F.Y. 2016-17, but the recovery of *Abiana* was just PKRs. 1.6 billion (Alam, 2019). Moreover, the municipal revenue recovers only 16% of the

total cost; therefore, most of the funds of the provincial governments are consumed on urban water supply services rather than in rural areas.

2.6.7 Poor Water Supply Network Management

Poor and defective water infrastructure causes a high level of water wastage. About 61% of waste happens through water diversions from watercourses to fields command through canals to small canals and water channels (Winston et al., 2013). More than 40% of irrigational water is wasted through seepage and side leaks from unlined canals, and 25% is lost in flood irrigation methods. Proper water wastage statistics in irrigation are not available in all provinces, but the official data of Punjab shows that the water delivery capability of the watercourse is 30% lower than its planned design due to lack of maintenance and slow rehabilitation process (Briscoe et al., 2005). Although heavy investment has been made in water infrastructures, they are not working properly due to negligence and poor maintenance (Sleet, 2019). It often seems the authorities believe in "build-neglect-rebuild." Thousands of hectares of land cover various major dams and barrages in Pakistan; if not managed properly they could be disastrous (Briscoe et al., 2005).

2.6.8 Capacity Development Issues

With other mismanagement, water resources in Pakistan are poorly managed, whereas ground and surface water are overused and overexploited (Ali et al., 2017). Most of the laws and policies were adopted from the colonial era on water distribution, and these acts and laws are not reformed adequately over time. Canal and Drainage Act was formed in 1873, after about 150 years, it is still implemented in the country. It was slightly reformed in 1967, but it is not legally modified (Sleet, 2019). Under this act *Warabandi* (rotational water distribution method) causes the exploitation of canal water. Water distribution in this system is according to time, land, and size rather than the need for crops. And its rotational schedule promotes water inequity. The influential and upper areas landowners get more water or can get the water share of others (Bisht, 2013). Local irrigation officials also supply more water to those who can pay bribes (Rinaudo, 2002). So, lower land areas could not get sufficient water.

Consequently, they use groundwater, whereas overuse of the groundwater has reduced the groundwater table, reaching the dead level in many areas. When the *Warabandi* system was developed, the water demand was low, but now the situation has changed with population growth. Hence the *Warabandi* system can cause more water shortages (Winston et al., 2013).

2.6.9 Lack of Reliable Data and Information

Accurate and reliable data is essential to monitor and evaluate the performance and effectiveness of any institution and system (A. J. Khan & Iqbal, 2020; A. J. Khan, Tufail, & Ali, 2021). In contrast, unrealistic information affects transparency and reliability and negatively affects project implementation (Lerebours & Villeminot, 2017). There are different institutions established in all provinces that collect data and information. Still, no monitoring system exists to check the accuracy and transparency of the collected data that would be further used in policy planning (Jamil, 2019). In 1991, the data collected concerning the available water was inaccurate as it showed more water than that was available.

Consequently, the WAA was established to resolve the water distribution dispute between provinces. The issue has not been resolved, and provinces still claim their allotted water share (Khan, 2014). During the spring of 2008, IRSA claimed that rivers and dams would have 3% extra water this season, but in reality, the country suffered from a 30% shortage of water. These miscalculations and data manipulation cause mistrust between the provinces (Kugelman & Hathaway, 2009). Furthermore, owing to a weak network and outdated system, the country's meteorological department cannot forecast floods and weather accurately. As a result, false information about floods and weather creates a lousy impact on the organization's work. In June 2010, Pakistan Meteorological Department predicted a regular monsoon season, but in July, the upper Indus River and the Kabul River had heavy floods due to unusually heavy rainfall. This flood swept through the Sindh and Punjab districts and some parts of Balochistan. Heavy floods occurred at the Chashma and Tounsa Barrages, and the historic flood was recorded at the Kotri Barrage. During the year 2011, there was also a forecast of light rainfall, but later on, heavy rainfall flooded the Sindh and Balochistan districts (Winston et al., 2013).

Furthermore, hydro-meteorological data about the Indus basin is not uniform and standardized, and most of the data were not available in a computerized format before the 1990s. During the 1990s, data was processed with German software D.B. Hydro. Pakistan has recently begun to use HyStar software for data analysis (with Australian assistance), but it has limited online access. Only the latest data is shared at the provincial and federal levels, and no past data is available in the public domain. Moreover, slow internet speed makes data analysis and forecasting difficult. Likewise, institutions do not promote public cooperation and involvement to collect and analyze data for planning, management, and other scholarly purposes (Young et al., 2019).

3. Conclusion

In Pakistan, water management and governance are highly disappointed and unsatisfactory due to policy inefficiencies, structural inconsistencies, and inadequate infrastructure in all water sectors. Many years of managerial negligence have created a significant water crisis in Pakistan. Many water management policies and institutions exist, but policy implementation is slow and incomplete. Given a lack of coordination and technical expertise, most policies are overlapped and contradictory at federal and provincial levels and within institutions. It causes ambiguity and confusion in allocating responsibilities between the federal and provincial governments.

Further, the legal framework for water management in Pakistan is very complex. Many Acts were enforced decades ago that have never been reviewed and amended with the changing of time and necessities. Due to political deadlock, new reservoirs were not constructed. That's why Pakistan cannot store enough water during rainy days, resulting in the wastage of plenty of freshwaters. Over the last 70 years, the country could not resolve the water allocation dispute within the country. There is no quick solution to resolve this problem. The government must act simultaneously on several fronts. Pakistan requires strenuous and sincere efforts to resolve this issue. Effective reforms and coherent decision-making processes will provide appropriate legislative mechanisms for sustainable water development. Pakistan needs to re-examine its water management and governance-related issues and capacitate its institutions to bring efficiency and accuracy in data collection. Because authentic information will help in effective planning for ensuring a just distribution of water, effective collaboration across all stakeholders is essential to this effect. There is also a dire need for strict monitoring and evaluation mechanisms to ensure transparency in the data collection processes, effectiveness in policy execution, and corruption in the canal irrigation water. Pakistan does not have any other option to ensure effective management of this scarce resource. Negligence and ineffective planning could only cause damage to the existing water infrastructure.

The recent Government has realized the urgency and importance of this issue and decided to construct new dams to increase the storage capacity of the water in Pakistan for its better use later. Both mega projects, Diamer-Bhasha Dam and Mohmand Dam, are under-construction with many other small dams in the initial phases of development like Naulong Dam, Kurram Tangi Dam, Nai Gaj, and Dawarat Dam. Similarly, the government is planning to build seven (07) more dam projects in Pakistan, including Hingol Dam, Akhori Dam, Shyok Dam, Munda Dam (Mohmand Dam), Tank Zam Dam, and Chiniot Dam. Based on the findings and conclusion, the study presents the following recommendation revamp the existing system of water governance and management in Pakistan:

4. Recommendations

The solution to the water crisis demands collaboration among all stakeholders. The following recommendations are put forth based on the research findings:

- Regulatory and mentoring mechanisms and relevant institutions need to be strengthened to perform their mandated functions and deliver effectively. The irrigation and drainage system should also be developed on modern techniques, keeping similar regional and international models.
- Government should arrange awareness campaigns regarding practical water usage. People should understand that every drop of water is precious. People must learn the techniques to reuse and recycle the water for relevant purposes. Only proper use and management of water can save the water for the coming generations. The farmers

should also be sensitized about the new intelligent agricultural methods through electronic and print media channels through public service messages.

- The hour needs to construct solid and concrete or brick lining canal and river banks to control water wastage through seepage and leakages from unlined canals during water transmission for irrigation. It will also help control the issues of salinity and waterlogging.
- The flood irrigation method is not suitable for all crops. Once the plant comes up from the soil, it uses only water that reaches its roots zone, and the soil absorbs extra water that causes waterlogging later. The government should adopt a better water drainage system from irrigated land to control waterlogging and salinity.
- In summers, when glaciers melt, water overflow becomes a significant cause of a flood. A large amount of water (that cannot be stored) cause a lot of damage. So, the government must accelerate the building of new dams to store water for its better use. Government should construct new multipurpose storage channels with the consensus of all the provinces to store this extra water (Tariq et al., 2020), with less environmental degradation that can help control the floods with hydropower generation capacity. Small and medium-sized dams are more effective than large dams due to a security purpose and volume of financial costs (Jamil, 2019).
- Pakistan needs proper and efficient planning to reduce water wastage. New dams will not create new water; they will only store water. Pakistan needs to make better strategies and effective planning to manage existing water. There's a need to control misallocation, over-allocation, and inefficient allocation.
- The country need to change the *Abiana* system in agriculture. Water prices are meager, and they should be based on water consumption, not on cropped land.
- One of the significant factors linked to the water crisis is climate change. There is a need to understand the risk of climate change in the water sector, including floods, droughts, heavy rains, sea-level rise in coastal areas, degradation of ecology, and negative impacts on the Indus Delta. Better understanding and strategies are crucial to mitigate their impact and safeguard Pakistan's water interests.
- The government should direct the concerned water management departments to take green initiatives to preserve the environment and employees who demonstrate green behaviour should be rewarded and green initiatives should be encouraged in all public departments as indicated by A. J. Khan, Tufail, et al. (2021) that green employee behaviours lead to better environmental and organizational performance.

5. Limitations and Future Research

The authors have chosen qualitative methodological approach to conduct this study. For the purpose of this extant study, secondary data sources have been used that includes published journal articles, government publications, newspapers, institutional reports, websites etc. Since the study was conducted in the context of Pakistan, hence, generalizations of the findings may be made cautiously. Future researchers may choose some other qualitative methods like expert interviews for data collection. The instant phenomenon may also be explored employing quantitative methods and data analysis techniques.

References

Ahmad, T. I., Khan, R. E., Soharwardi, M. A., Shafiq, M. N., & Gillani, S. (2021). Socioeconomics and agronomy of wheat yield in cotton-wheat cropping system in Punjab, Pakistan: A quality-quantity assessment. *International Journal of Agricultural Extension, 9*(1), 69-78.

Alam, A. R. (2019). *A constitutional history of water in Pakistan*. Retrieved from Islamabad, Pakistan: https://jinnah-institute.org/publication/policy-brief-a-constitutional-history-of-water-in-pakistan/

Alam, A. R., & Saleem. (2016). *Pakistan Water Law*. Retrieved from

Ali, Ashfaq, K., & Masood, S. (2017). *Water sustainability in Pakistan: Key issues and challenges*. Retrieved from Pakistan: http://www.sbp.org.pk/reports/annual/arFY17/Chapter-07.pdf

Ali, W., Javid, A., Hussain, A., & Bukhari, S. M. (2018). Diversity and habitat preferences of amphibians and reptiles in Pakistan: a review. *Journal of Asia-Pacific Biodiversity, 11*(2), 173-187. doi:https://doi.org/10.1016/j.japb.2018.01.009

Arfan, M., Ansari, K., Ullah, A., Hassan, D., Siyal, A. A., & Jia, S. (2020). Agenda Setting in Water and IWRM: Discourse Analysis of Water Policy Debate in Pakistan. *Water, 12*(6), 1-22. doi:https://doi.org/10.3390/w12061656

Bell, A. R., Shah, M. A. A., & Ward, P. S. (2014). Reimagining cost recovery in Pakistan's irrigation system through willingness-to-pay estimates for irrigation water from a discrete choice experiment. *Water resources research, 50*(8), 6679-6695. doi:https://doi.org/10.1002/2014WR015704

Bisht, M. (2013). *Water sector in Pakistan: policy, politics, management*. Retrieved from Delhi, India: http://arks.princeton.edu/ark:/88435/dsp01f7623g00n

Briscoe, J., Qamar, U., Contijoch, M., Amir, P., & Blackmore, D. (2005). *Pakistan's water economy: Running dry*. Retrieved from Washington, DC, USA: https://johnbriscoe.seas.harvard.edu/files/johnbriscoe/files/7._briscoe_-_qamar-_pakistans_water_economy-running_dry-_oxford_univ_press_2007.pdf

Cooper, R. (2018). *Water management/governance systems in Pakistan*. Retrieved from Brighton, UK: https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/14246

Daud, M., Nafees, M., Ali, S., Rizwan, M., Bajwa, R. A., Shakoor, M. B., . . . Murad, W. (2017). Drinking water quality status and contamination in Pakistan. *BioMed research international, 2017*, 1-18. doi:https://doi.org/10.1155/2017/7908183

EPD, H. (2007). *Review of the International Water Resources Management Policies and Actions and the Latest Practice in their Environmental Evaluation and Strategic Environmental Assessment*. Retrieved from Government of Hong Kong: https://www.epd.gov.hk/epd/SEA/eng/file/water_index/pakistan.pdf

FAO. (2018). *Water Accounting for Water Governance and Sustainable Development*. Retrieved from

Gillani, S., Shafiq, M. N., & Ahmad, T. I. (2019). Military Expenditures and Health Outcomes: A Global Perspective. *iRASD Journal of Economics, 1*(1), 1-20. doi:https://doi.org/10.52131/joe.2019.0101.0001

GOP. (2018). *National Water Policy*. Retrieved from Islamabad, Pakistan:

Jamil, M. (2019). *Running Dry: Water Scarcity in Pakistan.* (Master), Naval Postgraduate School Monterey, California United States. Retrieved from https://apps.dtic.mil/sti/citations/AD1080277

Janjua, S., & Hassan, I. (2020). Use of bankruptcy methods for resolving interprovincial water conflicts over transboundary river: case study of Indus River in Pakistan. *River Research and Applications, 36*(7), 1334-1344. doi:https://doi.org/10.1002/rra.3621

Jiménez, A., Saikia, P., Giné, R., Avello, P., Leten, J., Liss Lymer, B., . . . Ward, R. (2020). Unpacking Water Governance: A Framework for Practitioners. *Water, 12*(3), 1-21. doi:https://doi.org/10.3390/w12030827

Khan, A. H. (2014). Water sharing dispute in Pakistan: standpoint of provinces. *Berkeley Journal of Social Sciences, 4*, 1-17.

Khan, A. J., Bashir, F., Nasim, I., & Ahmad, R. (2021). Understanding Affective, Normative & Continuance Commitment through the Lens of Training & Development. *iRASD Journal of Management, 3*(2), 105-113. doi:https://doi.org/10.52131/jom.2021.0302.0030

Khan, A. J., & Iqbal, J. (2020). Do High Performance Work Practices Increase the Organizational Performance of Public Sector Companies? An Investigation of Mediation Mechanism. *Pakistan Journal of Social Sciences (PJSS), 40*(2), 1007-1021.

Khan, A. J., Tufail, S., & Ali, A. (2021). Factors Affecting Performance of Small & Medium Enterprises: The Mediating Role of Knowledge Management. *Pakistan Journal of Humanities and Social Sciences, 9*(2), 197-209. doi:https://doi.org/10.52131/pjhss.2021.0902.0129

Khoso, S., Wagan, F. H., Tunio, A. H., & Ansari, A. A. (2015). An overview on emerging water scarcity in Pakistan, its causes, impacts and remedial measures. *Journal of Applied Engineering Science, 13*(1), 35-44. doi:https://doi.org/10.5937/jaes13-6445

Kugelman, M., & Hathaway, R. M. (2009). *Running on empty: Pakistan's water crisis*. Washington, D.C.: Woodrow Wilson International Center for Scholars.

Lerebours, A., & Villeminot, N. (2017). *WASH governance in support of NGO work: trends and differences from field studies*. Paper presented at the 40th WEDC International Conference, Loughborough, UK.

Maharjan, K. (2018). *Political Ecology of Water Governance in South Asia: A Case Study of the Koshi River Communities.* (Docoral), The University of Sydney, Australia. Retrieved from http://hdl.handle.net/2123/19749

Mirjat, N. H., Uqaili, M. A., Harijan, K., Valasai, G. D., Shaikh, F., & Waris, M. (2017). A review of energy and power planning and policies of Pakistan. *Renewable and Sustainable Energy Reviews, 79*, 110-127. doi:https://doi.org/10.1016/j.rser.2017.05.040
Mustafa, D., & Akhter, M. (2013). *Understanding Pakistan's water-security nexus*. Washington, DC: United States Institute of Peace.
MWP. (2018). *Pakistan Water Sector Strategy*. Retrieved from http://www.waterinfo.net.pk/pdf/vol1.pdf
Nawaz, M. A., Hussain, M. S., & Hussain, A. (2021). The Effects of Green Financial Development on Economic Growth in Pakistan. *iRASD Journal of Economics, 3*(3), 281–292. doi:https://doi.org/10.52131/joe.2021.0303.0044
Neef, A. (2009). Transforming rural water governance: Towards deliberative and polycentric models? *Water Alternatives, 2*(1), 53-60.
Pasha, A. G. (2011). *Fiscal Implications of the 18th Amendment : The Outlook for Provincial Finances*. Retrieved from Washington, DC. : http://hdl.handle.net/10986/18707
Philip, A. N. M. (2010). *Natural Resources Conflict*. Retrieved from
Qureshi, R., & Ashraf, M. (2019). Water security issues of agriculture in Pakistan. In (pp. 41). Islamabad, Pakistan: Pakistan Academy of Sciences (PAS).
Ranjan, A. (2012). Inter-provincial water sharing conflicts in Pakistan. *Pakistaniaat: A Journal of Pakistan Studies, 4*(2), 102-122.
Ranjan, A. (2019). Water-Stressed Pakistan: Increasing Demand, Declining Availability, and Challenges of Management. *Asian Survey, 59*(6), 1116-1136. doi:https://doi.org/10.1525/as.2019.59.6.1116
Rinaudo, J.-D. (2002). Corruption and allocation of water: the case of public irrigation in Pakistan. *Water Policy, 4*(5), 405-422. doi:https://doi.org/10.1016/S1366-7017(02)00037-5
Rola, A. C., Pulhin, J. M., Tabios, G. Q., Lizada, J. C., & Dayo, M. (2015). Challenges of water governance in the Philippines. *Philippine Journal of Science, 144*(2), 197-208.
Saleem, F. (2017). Water Management Practices in Pakistan. *Institute of South Asian Studies, 2000*(274), 1-23.
Sayal, E. A. (2015). *Water Management Issues of Pakistan.* (Doctoral), University of the Punjab, Lahore, Pakistan,
Shafiq, M. N., Gillani, S., & Shafiq, S. (2021). Climate Change and Agricultural Production in Pakistan. *iRASD Journal of Energy & Environment, 2*(2), 47-54.
Sleet, P. (2019). *Water resources in Pakistan: scarce, polluted and poorly governed*. Retrieved from Nedlands: http://www.futuredirections.org.au/wp-content/uploads/2019/01/Pakistan-Water-Crisis.pdf
Sumra, K., Mumtaz, M., & Khan, K. (2020). National Water Policy of Pakistan: A Critical Analysis. *Journal of Managerial Sciences, 14*, 60-70.
Tariq, M. A. U. R., & Van De Giesen, N. (2012). Floods and flood management in Pakistan. *Physics and Chemistry of the Earth, Parts A/B/C, 47*, 11-20. doi:https://doi.org/10.1016/j.pce.2011.08.014
Tariq, M. A. U. R., van de Giesen, N., Janjua, S., Shahid, M. L. U. R., & Farooq, R. (2020). An engineering perspective of water sharing issues in Pakistan. *Water, 12*(2), 1-14. doi:https://doi.org/10.3390/w12020477
WAPDA. (2003). Pakisatn vision 2025.
Water Sector Task Force. (2012). *A productive and water-secure Pakistan: Infrastructure, institutions, strategy*. Retrieved from Islamabad, Pakistan: http://www.waterinfo.net.pk
Winston, H. Y., Yang, Y.-C., Savitsky, A., Alford, D., & Brown, C. (2013). *The Indus basin of Pakistan: The impacts of climate risks on water and agriculture*. USA: World Bank.
WWF. (2007). Pakistan's Water at Risk: Water & Health Related Issues in Pakistan & Key Recommendations. In. Lahore, Pakistan: World Wide Fund for Nature.
Yang, Y.-C. E., Brown, C., Yu, W., Wescoat Jr, J., & Ringler, C. (2014). Water governance and adaptation to climate change in the Indus River Basin. *Journal of Hydrology, 519*, 2527-2537. doi:https://doi.org/10.1016/j.jhydrol.2014.08.055
Young, W. J., Anwar, A., Bhatti, T., Borgomeo, E., Davies, S., Garthwaite III, W. R., . . . Makin, I. (2019). *Pakistan: Getting more from water*. USA: World Bank.