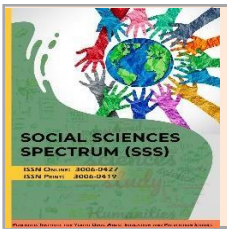

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Importance of Data in the Management of Kabul River Basin

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Abstract

Effective transboundary water management depends on data availability, but its shortage and non-sharing are main hurdles in the management of Kabul River Basin shared by Afghanistan and Pakistan. Accurate and timely shared data is necessary for managing droughts, floods, agricultural planning, irrigation arrangements, climate adaptation, dams' operation, river control structures, negotiations etc. It provides overall understanding regarding effects of upstream and downstream water use, fosters participative decision making and mitigates conflicts. The article emphasizes that both countries should not be critical and consider each other concerns. Therefore, Coordinated and integrated system of data exchange is necessary for equitable and durable management of Kabul River Basin.

Keywords: Kabul River Basin, Pakistan and Afghanistan Water Resources, Data and Information Sharing, Transboundary Water Management, Transboundary Water Cooperation, Riparian Countries.

1. Introduction

The data is an important tool of transboundary water cooperation which promotes transparency, fairness, reliance, harmony and enhances meaningful engagements between riparian countries. It serves as the backbone of viable transboundary water management.

Data provides basic information of the river basin for day to day management of storage, irrigation, hydro power generation along with successful execution of projects and investment plans of medium and large infrastructure etc. (Rasooli & Kang, 2015). It helps to assess the effects of irrigation, municipal, industrial and hydro-power uses of available water in a basin. It improves functionality of ecosystem and supports climate adaptation (Singh, 2017).

Data exchange plays an effective role in the decision-making process of a shared watercourse and facilitates transboundary dialogues and cooperation (Loodin, Eckstein, Singh & Sanchez, 2024). It addresses needs, common issues of riparian countries and supports participative decision making which leads to formal agreements and benefits sharing treaties.

Dr. Gul Afghan Saleh (President, Gul Engineering PLLC Alexandria, USA and former USAID, Senior Project Manager of Water & Energy in Afghanistan from May 2003 to July 2014) is of the view that the strategic importance of data sharing in Kabul River Basin management is indispensable—not only as a technical enabler of evidence-based decision-making, but also as a foundational pillar for climate resilience, trans-boundary cooperation, and sustainable resource governance. In a basin marked by geopolitical sensitivities and increasing hydrological variability, the ability to exchange timely, accurate, and interoperable data is critical for managing floods, droughts, and agricultural cycles. The global best practices show, data transparency is not merely a technical asset—it is a trust-building mechanism that underpins collaborative planning, energy optimization, and long-term ecological stewardship. (Email communication, October 26, 2025).

The long term transboundary water cooperation requires steady supply and exchange of data. Due to trust deficit situation, there is no mechanism to exchange data and information between Pakistan and Afghanistan. This distrust confounds issue as Pakistan apprehends Afghanistan up stream control while Afghanistan opposes perceived dominance of Pakistan. Due to such absence of data exchange, both countries are wasting the opportunities of expected development and progress in Kabul River Basin (Iqbal, 2020).

The article discusses the crucial role of data sharing in promoting trust, supporting collaboration, facilitating quality decision-making, reducing chances of conflicts, strengthening sustainable transboundary water resource management and cooperation.

2. Research Methodology

The article employs a qualitative approach to explore the importance of data in the management of Kabul River Basin. This approach helps riparian countries to understand how diverse forms of data assist in working together and resolving issues through collaborative decision making of a shared river basin. The research is based on secondary and primary sources, such as articles of academic journals and newspapers, reports of governments, international organizations and independent institutions, news, websites, books, etc., while primary sources pertain to views, opinions and experiences of the professionals, experts, academicians etc., based on discussions with them which provide in-depth understanding often missing from available data. After

cautiously consolidating, reviewing and relating information from documents and discussions, main ideas regarding data access, reliance and collaboration are developed. This blend of sources gives a transparent and trustworthy scenario that how data supports across borders cooperation of a shared river basin in monitoring and managing of floods, droughts, environment, climate change, agriculture, river control structures, resource planning etc.

3. Discussion

3.1 Importance of Data in Dams and River Control Structures Management

Since 2003 [after the end of first Taliban regime in 2001], Afghanistan is planning to develop 12 river infrastructure projects [dams, diversions etc.] on Kabul River and its tributaries for irrigation, hydropower, flood control, drought mitigation etc. On account of three decades of war, Afghanistan wants to develop dams without negotiation [without sharing data] with riparian countries being grace period for construction of infrastructure (Thomas,2014; Thomas, 2016;), but the international water law requires prior notification and exchange of data regarding dams and planned measures which may impact other riparian countries.

In the absence of bilateral mechanism to manage shared river, the construction of dams in Afghanistan will reduce the downward water flow to Pakistan which may cause conflict between both countries. The shortage of water and increasing demand may become a sign of insecurity and conflict in the region (Pervaz & Khan, 2014).

In this respect, dams' design, operation and environmental evaluation are important. Information regarding dams' location, construction stages, storage (water level, releasing of water), irrigation structures etc., removes misunderstanding and improves transparency. It enables riparian countries to manage floods, droughts, water allocation etc. For hydro power generation information regarding in and out flow of water, sediments accumulation rate, live reservoir level etc., is also necessary. Pakistan and Afghanistan can do basin-wide planning by cooperating in technical designing, hydrological modeling, evaluation of environmental impacts and maintaining safety standards of dams.

Trans-boundary water issue in Afghanistan is considered sensitive which involves confidentiality of data. Therefore, Afghanistan avoids to share data in order to gain advantage as "Afghanistan wants to develop infrastructure first then enter into negotiation". But, financing of international financial institutions and donors on river control infrastructure and dams requires consensus of riparian countries through notification, consultation, sharing of technical and environmental data etc., and there is no such consensus between Pakistan and Afghanistan (Iqbal, 2020). Data-driven cooperation is also a diplomatic imperative because the international support, as global funds (e.g., World Bank) often prioritizes data-driven projects (World Bank, 2020).

Syed Jamait Ali Shah (Former Pakistan Commissioner of Indus Waters Commission, 1993-2010) states that engineering data are of different kinds, some are related to environment or ecology or demographic or sediment flow data or hydrological data and information. However, hydrological data are very essential for the design of any kind of water resources and hydel projects or hydraulic structures. Generally, the designers prefer to have such physical or observed data of flows and sediments etc., for minimum of 25 years. However, in the absence, 10 years' data is also considered workable. Under modern techniques, the precipitation flow models related with catchment area may provide reliable hydrological data at a specific point in order to verify or check the observed data (Email communication, May 02, 2025).

Dr Mohammadreza Shahbazbegian (Associate professor in Hydropolitics and systems analysis at Tarbiat Modares University Tehran, Iran) is of the view that in the Kabul River Basin, the absence of a standardized data-sharing mechanism between Pakistan and Afghanistan has led to mistrust. The data scarcity leads to conflict escalation as unilateral development (e.g., dams) without shared data breeds suspicion and transforms water from a shared resource into a source of conflict. Afghanistan's planned infrastructure could disrupt Pakistan's wheat cultivation, but without Afghanistan's dam operation data, Pakistan cannot plan effectively. Similarly, Afghanistan's hydropower projects require downstream flow assurances, which remain contentious without joint hydrological models. Thus, consensus is impossible without flow data (LinkedIn communications, May 09 &12, 2025).

Data sharing of dams and river control structures promotes durable water management and prevents conflicts. It also avoids conflicts even when there is no treaty between riparian countries. It is not only just a technical requirement but also paves way for cooperation, stability, prosperity and peace. If data is shared, it will be an important initiative toward fair and dispute-free water management of the Kabul River Basin between Pakistan and Afghanistan.

3.2 Importance of Data in Negotiations

Data sharing is significant for successful transboundary water negotiations as it provides sound basis for cooperation on shared river basin (Susskind & Islam, 2012; Malyar, 2017). It builds diplomatic relations between riparian countries and highlights requirements of the negotiating parties (Boyd, Gatewood, Thorson, & Dye, 2019).

Pakistan and Afghanistan do not have cordial relations so data sharing mechanism cannot be developed under this trust deficit state of affairs which should be overcome through regular communication and coordination (Khalid & Iqbal, 2020). The sharing of data is not only important in negotiations of transboundary water cooperation but also helpful in the implementation of collaborative model. In this regard, there should be consensus on a uniform way of gauging river flows and riparian countries must exchange available technical data (Zeitoun & Mirumachi, 2008) In technical dialogues scientists lead data sharing initiatives which reduce mistrust (Habib, 1979) because negotiations stalemates occur when technical data is absent or disputed.

Prof. Jeff Camkin (Professor of Water Resource Management, University of Western Australia) considers that data sharing for the Kabul river basin or any shared basin is not only critical for more effective river basin management but can also be a bridge to broader collaboration. Sharing data provides a clearer picture for coordinated management of the entire river basin, creates opportunities for personal and institutional collaboration, and helps build trust between individuals, organizations and countries (Email communication, December 11, 2025). The riparian countries should strengthen their data collection capacity with improved technology which gives them advantage as uneven and unprepared positions in negotiations enhance conflict (Thu & When, 2016).

Okavango River Basin is a successful example of trust among riparian countries through data sharing. It consists of three Southern African Countries i.e., Namibia, Angola and Botswana. The countries concluded a treaty to setup a permanent commission named Okavango River Basin Water Commission (OKACOM) after years of negotiations wherein parties agreed to share data to assist OkACOM’s working and exchange information regarding any development affecting

shared watercourses (Bybee, 2015; Mogomotsi G.E., Mogomotsi, P. K., & Mosepele, 2020; Sarfraz et al., 2022).

Absence of institutional mechanism for sharing of transboundary water has deteriorated relations of riparian countries in Nile River Basin (Wehling, 2021) while cooperation of Pakistan and Afghanistan on Kabul River Basin depends upon data sharing which is a challenge due to trust deficit situation between them (Shams & Muhammad, 2023).

One of the reasons of successful Mekong River Cooperation is an organized data sharing system in regulating transboundary water resources (Wolf, 1997; Anh, 2019)). The Mekong River Commission (MRC) offers a successful model: member countries share real-time hydrological data which provides accurate forecasts regarding floods and droughts and reduces the damages considerably in the downstream [lower reaches] of Mekong River Basin. The MRC monitoring and forecasting system has three major components i.e., collection and communication of data, procedure and process of forecast, and spreading information of forecast (Manusthiparom, Apirumanekul, & Mahaxay, 2005). The Mekong River Basin presents an account of proper balance between water, food and energy utilization which is helpful in the production of food and energy and has turned into a necessary part of regional and global economies (Van That, Loi & Van, 2024). Therefore, a cooperative institutional mechanism for the Kabul River could yield mutual benefits.

Syed Jamait Ali Shah (Former Pakistan Commissioner of Indus Waters Commission 1993-2010) explains that Kabul River is shared by Pakistan and Afghanistan and the most important aspect should be to have information and data of the existing and potential uses from this river. It may include any dam, diversion, barrage and canals etc. with salient features. The Kabul River has almost 50% of its contribution of flow from river Chitral [originates from Pakistan] which is called Kunar River in Afghanistan. Since river Kabul water after entering into Pakistan is being fully utilized, therefore, it needs an agreement or a treaty between the co-riparian nations not for Kabul River only but for other small common rivers between Pakistan and Afghanistan. Afghanistan has never cooperated with Pakistan on sharing any data or detail and this aspect needs to be looked into as how to get such information at Govt. level. However, in order to roughly assess the existing and future uses of Afghanistan, efforts have been made by Pakistan and can again be reviewed to arrive at reasonable estimates etc. (Email communication, March 25, 2025).

To facilitate dialogues on transboundary water issues, efforts are required to monitor stream flow volume and assess the rate of enhanced dependence on ground water in Afghanistan (Fipps, 2007). The data provides sound basis for negotiations so there is need of consensus between Pakistan and Afghanistan to setup a joint data base (Vick, 2014).

The sharing of data not only improves technical ability but also facilitates cooperation on other matters which will eventually pave way for a strategic accord between Afghanistan and Pakistan. Therefore, data availability has game changing effects as it provides basis for negotiations and promotes cooperation between riparian countries.

3.3 Importance of Data in Climate Adaptation

Climate change is not restricted to certain political borders and therefore requires transboundary solutions (Renner, 2009). It has a considerable effect on water flow system particularly in dry and Semi-dry areas like Kabul River Basin which has faced devastating droughts and flash floods (Akhtar et al., 2018). It affects different sectors, communities and regions. Therefore, data is

necessary for effective planning as it helps countries regarding calculation of their yearly average temperatures, rainfall levels, droughts, floods and other trends related to climate. This eventually assists officials to prepare plans and policies at national level in order to deal with future requirements of climate (UNDP, 2022). Research studies to understand vulnerability of climate change are very few in Chitral Kabul River and there is no formal water sharing agreement between Afghanistan and Pakistan (Baig, Abid, Khan, Jiao, Amin & Adnan, 2020).

The climate change has affected the trend of snow and glaciers melt which provide water to Kabul River and resulted in change of seasonal rainfall/ monsoon pattern of the river basin (Ahmad & Fahd, 2014). There has been decline in Afghanistan's glaciers in 20th century and the speedy melting of glaciers and snow triggered river blockages, landslides and flooding (Vick, 2014).

There is prediction of increase in temperature of Hindukush-Karakorum-Himalayan region more rapidly than average temperature of the world by 2100. Therefore, yearly rain fall is likely to grow by 8-12% in Kabul River Basin and changing patterns of monsoon are causing devastating floods in Pakistan and Afghanistan (Iqbal, Dahri, Querner, Khan, & Hofstra, 2018). The rising temperature and variation in precipitation both in terms of time and volume may disturb availability of water. The variation in water flow due to climate change requires cautious policy and modification in water engineering and amendments in management techniques (Memon, 2009). In the absence of overall climate projections of the basin, there is increase of climatic effects as shifting precipitation patterns require prior preparation (for meeting added pressure on water system) which both countries don't have.

Dr. Anthony Turton (Professor: Centre for Environmental Management, University of Free State, Bloemfontein, South Africa) explains that data is vital if adaption to climate change is the objective. Climate change data needs to be captured accurately overt long time scales as the change is incremental and slow. This means that river basin management institutions need data that is accurate, but also covering decadal or even centuries of time. This is one of the most important roles of any river basin management structure, because data means power, especially when it is accurate and uncontested (Email communication, June 09, 2025).

There is no proactive strategic planning for development of entire river basin as the Kabul River Basin hydrology demands an all-inclusive approach for building resilience to mitigate the uncertainties of climate change (Iqbal, 2020). Joint planning is needed for the improvement of hydro-meteorological system and setting up of mechanism to share and implement water policies as the acute data scarcity in Kabul River Basin has hampered the progress of important scientific studies and analysis (Masood et al., 2018). Therefore, the information sharing enhances understanding about climate change, [its associated uncertainties], hydrological and socio-economic models together with water flows and water-quality standards. Such understanding strengthens early warning systems which can decrease the effects of dangerous events (Cooley et al., 2009).

Dr. Muhammad Zia-ur-Rahman Hashmi (Former Head, Water Resources & Glaciology Section, Global Climate-Change Impact Studies Centre, Islamabad.) emphasizes the setting up of hydrometeorological [weather & water resource] monitoring platforms in Kabul river basin to ensure efficient early warning system, sharing of information and improved collection of quality data so that challenges of changing hydrological cycle may be managed accordingly (Email communication, May 14, 2025).

Improved knowledge along with data sharing mechanisms is necessary requirement for closer and more integrated cooperation on climate change (Phol et al., 2014). To generate the best possible benefits for the whole river basin, climate change adaptation measures should be designed and managed to avoid negative transboundary impacts (World Water Council, 2009).

During environmental emergencies i.e., widespread flooding and drought, data sharing role is pivotal in organizing emergency and humanitarian aid (Boyd et al., 2019). Furthermore, long-term climate models and real-time weather data help to form adaptive strategies to address climate change, monitoring water quality, environmental flows and safety of biodiversity. Integrates substantial population

The Rhine River Basin integrates a substantial population of Europe from Alps to North Sea. The basin has 9 countries and is governed by the International Commission for protection of the Rhine. The cooperative spirit of member countries enables the commission to deal the issues of Rhine River associated with its future development i.e., socio-economic, climate change etc. (Iqbal, 2020). To manage shared issues, the Rhine River riparian countries have shifted from isolated actions to integrated climate-proofed management through data sharing and coordinated responses. The Socio-Economic Scenarios (SES) Project of Rhine River (2023-25) provides essential data to promote cooperative water management through integrative climate adaptive and socio-economic planning. It represents that constant data sharing and cooperative scientific evaluation are important for developing joint strategies to deal with the effects of climate change on shared waters (Ter Maat,Mes,Edler,Schasfoort, Buitink, Dalmin, Monji & Weiland, 2025).

The transboundary approach is essential for effective climate adaptation as declining water resources may cause conflict. The ecosystem resilience, economic prosperity, public well-being and security require sustainable use of land and water resources etc. (UNECE, 2018). Thus, the shared threats of climate change and water deficiency are powerful persuaders for Pakistan and Afghanistan to cooperate for sustainable solutions despite political differences. By this way, both countries can secure prosperous future (Yaqoob & Arjjumand, 2024). To all intents and purposes, the visible impacts of climate change require that Pakistan and Afghanistan should formulate a basin wide holistic plan for data sharing and responsible eco-friendly water resource management.

3.4 Importance of Data in Agricultural Planning

Mr. Li Lifeng (Director of the Land and Water Division, FAO) is of the view that "Water scarcity means less water for agriculture production which in turn means less food available, threatening food security and nutrition" (FAO, 2023).

Agriculture is a backbone of economy and water is a driving force of agriculture sector. It plays an important role in economic development and prosperity of the people (ANDS, 2008; Hanasz, 2011). Agricultural growth and development are directly dependent on water so availability of water for irrigation is important (Portar & Raulfs-Wang, 2017) which is affected by unpredictability in timing and amount of precipitation that causes increased flooding and corrosion of irrigation structures and canals whereas reduced quantity of water during parched period for irrigation further increases competition over water usage (Bastakoti, Ale & Shivakoti., 2015). Therefore, availability of data along with regular forecasts are necessary for preparation of crops and irrigation arrangements.

Agriculture planning is particularly dependent on the degree of accuracy of weather prediction. Measurement of frequency and quantity of precipitation contributes in water resource planning

and management. It not only helps planners and decision makers to make appropriate allocation of water for different seasons but also enables farmers in determining suitable cropping pattern in their areas (Memon,2009). Adopting effective irrigation strategy through sprinkler or drip methods can improve productivity and control wastage of water. Modifying plans of irrigation on the basis of real time data can enhance the efficient use of water (Sediqi & Komori, 2023). The connecting data to livelihoods is necessary as data sharing improves agriculture, energy and disaster management (USAID, 2019). Through prioritizing agricultural data, the improved planning will reduce the vulnerability and livelihood risks of farmers (Iqbal, 2020).

Decades of dispute in Afghanistan badly damaged irrigation system. Less rainfall, recurring droughts and decreased surface water flow further deteriorated the situation of agriculture sector (Hanasz, 2011). Reduction in the annual quantity of water of Kabul River due to climate change and increased use in Afghanistan will impose a serious problem to agricultural economy of Pakistan. Water shortage can cause worsening relations between Pakistan and Afghanistan (Akhtar & Iqbal, 2017). There should be a study into consumption of water in the Kabul River basin keeping in view the future demand for agricultural and economic development. Moreover, monitoring should be established to measure actual flow from Afghanistan into Pakistan from Kabul and other small rivers of the Kabul River Basin (GIRoA, 2007b).

Dr.-Ing. Fazlullah Akhtar (Senior Researcher Center for Development Research (ZEF), Genscherallee Bonn, Germany) states that in the Kabul River Basin, data is extremely important for farmers and managers of water resources. It helps them plan when and what to plant, manage scarce water resources, and prepare for floods and droughts. By using local knowledge alongside modern data, farming communities can make better and sustainable choices and build a more resilient agricultural future (Email communication, June 05, 2025).

For sowing crops in irrigated areas, the calculation of water for crops' requirement is necessary and water sharing system of Kabul River Basin should be documented between Pakistan and Afghanistan (Baig, Abid, Khan, Jiao, Amin & Adnan, 2020). The cooperation between Pakistan and Afghanistan matters as availability of reliable flow of water enhances agricultural productivity (Lautze, Meelad, & Hayat, 2023). Riparian countries can increase their hydro-power generation and agricultural production with appropriate data and coordinated planning of irrigation requirements, crop cycles/patterns and energy demands.

Chu-Talas River Basin is an instance where data sharing for agricultural planning and cooperation have been agreed on. The republics of Kyrgyzstan and Kazakhstan have common rivers i.e., Chu and Talas which are important for irrigation agriculture (of vast area in both countries) and electricity generation. Both countries entered into an agreement for equitable and fair management. The agreement facilitated the establishment of joint commission to administer Talas and Chu river basins. The commission agreed on a procedure for consistent and valid data sharing. The cooperative system made possible online consultation of data for determination of irrigation water which enabled transparent decision-making, mitigated tensions, and ensured regulated flows (Libert, 2015; UNECE, 2021).

Dr. Bo Libert (Former Regional Advisor on Environment of United Nations Economic Commission for Europe (UNECE), Geneva, Switzerland) is of the view that at present, data sharing is not fully functioning between riparian countries (Kyrgyzstan and Kazakhstan) as expected, particularly during dry years. No doubt, data sharing is needed for durable cooperation and we hope for the best that good sense will prevail and agreement will be implemented in letter

and spirit (Email communications, November 27&28, 2025).

Water use for irrigated agriculture is likely to increase. All the times smooth sailing is not possible, differences are natural which can be coped with available guidelines given in the treaty and will to cooperate. Continuous engagements of riparian countries to discuss their information requirements enable them to establish improved networks and find innovative solutions. In context of the Kabul River Basin, will to cooperate is necessary which initially does not need wide-ranging monitoring networks to start data-sharing.

The data will facilitate the policy makers to increase the efficiency of water and land use through the provision of a sustainable water supply; equitable and regular water sharing between sub-basins and irrigation systems; and a significant reduction in unproductive water losses on the way to the end users (Dukhovny, Mirzaev, & Sokolov, 2008). To prevent the leakages, seepages, outflow and to control the issues of over consumption require adaptive and efficient water management in order to develop agriculture on sound footings (Sultani,2018), but all these plans demand regular and reliable data in order to secure durable development.

3.5 Importance of Data in Flood prediction and Protection

Flood predictions are usually associated with large uncertainties due to lack of historical data and long gaps in the recorded data. The shortage of recorded data and limitation of available data depict that floods are poorly studied in this region. The available hydrological data are collected before and after the Afghan civil war period. This long gap and climate change effects split the dataset and creates difficulties to use this dataset for predicting flood characteristics (Mayar et al., 2020). Pakistan and Afghanistan are situated under the Hindu Kush Himalayas, and are susceptible to rapid and fast flooding due to torrential rains and snow melting (Taraky, Liu, McBean, Daggupati, & Gharabaghi, 2021). The changing patterns of monsoon are causing devastating floods in Pakistan and Afghanistan, but lack of mechanism of data exchange endangers lives and economies in both countries (Iqbal et al., 2018).

The deficiency of data and monitoring stations causes uncertain and generalized weather predictions. There is no assessment about the behavior of glaciers and glacial lakes in the Northern Areas of Pakistan nor their data on rainfall-to-flood-runoff relations for Chitral, or any other northern district. In the absence of accurate data, it is difficult to determine that rains trigger additional outflow through increase in snow and glaciers melt (Habib, 2015). The shocking floods of 2018 affected over 18 million people in Pakistan (Ahmad & Fahd, 2014) whereas in 2022 floods, one-third of Pakistan was under water and displaced population was around 32 million (Mallapaty, 2022).

Early-stage planning can have a major impact on the downstream river network and its communities across an entire basin (Tharme, 2015). To improve flood protection, installation of automatic water level monitoring stations in the Upper Kabul River in Afghanistan will help to provide swift information downstream in Pakistan for taking timely measures of safety from flood. Such mechanism is successfully run in the Dniester River shared by Ukraine and Moldova in Eastern Europe. The Dniester River rises in Ukraine then flows through Moldova and lastly discharges in Black Sea in Ukrainian area. The automatic water level monitoring stations in Upper Dniester River in Ukraine quickly provide available information to the relevant agencies downstream in the Republic of Moldova and Ukraine [Ukraine is both upper and lower riparian while Moldova is middle riparian] enabling both countries to make timely flood protection

decisions (UNECE, 2015; UN 2009). The sharing of real time data by member countries of Mekong River Commission (MRC) is an example of cooperation and water management. All member countries timely and regularly exchange hydrological, meteorological data and detail about planned projects. This exchanging of data builds trusts among riparian countries and improves flood and drought forecasting and related management. This efficient early warning mechanism considerably reduces losses (Mcpherson & Ropicki, 2021).

Another example is the Sava River shared by Serbia, Slovenia, Croatia, Bosnia and Herzegovina. The river basin is governed by the Sava River Basin Commission (ISRBC) The member countries under the commission prepared a "hydrologic and hydraulic (H&H) model" to develop a flood risk assessment system containing identification of flood risk regions, data collection, preparation of maps, management plan, flood forecasting and warning strategy. The model helped a lot to integrate, monitor and support all these activities (UNECE, 2018). Therefore, the data sharing between Afghanistan and Pakistan, under an efficient shared flood modeling, would not only improve cooperation, forecasting, monitoring and mitigation strategies, but also eases political tensions.

Flood zones identification facilitate risk mitigation process. The construction of storage reservoirs, embankments in flood prone zone and establishment of climate stations at high-altitude enable better monitoring of the hydrologic cycle. The future water availability and flood risk evaluation require water management treaty between Pakistan and Afghanistan which will ensure sustainable development (Baig, 2024).

3.6 Importance of Data in Drought Management

Drought is a usual phenomenon of climate which takes place in almost all areas of the world (Wilhite, Sivakumar, & Wood, 2000), but it is an intricate and less understood natural hazard in central and south Asia (Baig, Abid, Khan, Jiao, Amin & Adnan, 2020). Low winter precipitation continuously for two years is the major cause of droughts in Pakistan and Afghanistan which happens once in each 10 to 15 years' time period. Majority of population in Kabul River Basin is dependent on agriculture and livestock [dependent on water] therefore droughts not only badly affect livelihoods and incomes but also increase poverty (GIRoA, 2008; Sidiqi, Kasiviswanathan, Scheytt, & Devaraj, 2023).

There was growing trend of severe droughts in Kabul River Basin during the period from 1940 to 1960. This trend further accelerated after the year 2000 whereas dry spells have become more frequent in Kabul River Basin in recent times. (Tariq, Rahim, Aziz & Yousaf, 2021). The droughts of 1998-2002 badly hit the rural population in Pakistan which caused not only reduction in agricultural production but also withdrew the attainments of previous decade (Anjum, Saleem, Cheema, Bilal & Khaliq 2012).

The Kabul River Basin faced drought conditions from 2000 to 2004 with extreme drought of 2001, stated as worst in the region (Alami, Hayat & Tayfur, 2017). The drought of 2011 affected 14 provinces out of 34 of Afghanistan and around 2.6 million people suffered (Miyan, 2015). In 2018 drought, people faced severe food shortage due to reduction in crops' production and river stream flow and around 300,000 people displaced in Afghanistan (Sidiqi, Kasiviswanathan, Scheytt, & Devaraj, 2023). In coming 45 years, scientists assess that there will be decrease in rainfall and increase in average temperature of up to 4°C [4 degrees centigrade] as compared to temperature of 1999. There are chances of domination of droughts in Kabul River Basin by 2030

which further cause desertification and deforestation (UNDP, 2016). In this regard, detailed examination of drought situations and their harshness is necessary for preparation of drought planning to mitigate the chances of future events (Wilhite et al., 2000).

Data availability and analysis regarding evaluations of previous droughts along with systems of drought warning and managing in Pakistan are very limited (GOP,2018). Afghanistan is facing the constraints of inadequate availability of meteorological and hydrological data i.e., temperature, precipitation, stream flow etc., as long term combined water, crop and climate data provides sound basis for drought risk assessment. Therefore, limitations of data gaps i.e., incomplete data and short observational periods may lead to uncertain calculation and less reliable drought risk assessments (Samim, Lee, Hussainzada, Bhanage, & Nayyer, 2025).

The water scarcity can only be considered in detail subject to sufficient availability of data. Insufficient data results in improper analysis along with imperfect, partial and limited solutions (Aziz, 2007). Earlier, there was ample amount of water in the Kabul River, but due to constant droughts, there is deficiency of water (Sultani, 2018). In this regard, readily available data is necessary for assessment and drought risk mapping.

Keeping in view the recurring droughts, Afghanistan understands common challenges which require regional cooperation [data sharing] and strategy for managing water resources on durable basis in Kabul River Basin despite hurdles of political polarization and instability in Afghanistan (Yaqoob & Arjjumand,2024).

Dr. Donald A. Wilhite, (Professor & Director Emeritus, Applied Climate Science, School of Natural Resources, University of Nebraska-Lincoln, USA) enunciates that comprehensive early warning systems are key in detecting the early onset of drought conditions and severity across spatial scales. This information is critical for effective response and planning since water shortages affect a multitude of impact sectors. Early warning systems must be coupled with advanced assessments of vulnerability in these sectors, i.e., who and what is at risk and why, and the implementation of appropriate mitigation and response measures in order to deal proactively with future drought episodes (Email communication, November 03, 2024).

Further, he adds that growing intensity, duration and frequency of droughts in many regions are due to direct impact of climate change. The current drought management (crisis management) trends are not adequate as these are reactive. Therefore, adoption of proactive and holistic approach is necessary for effective drought risk management (Email communication, May 31, 2025).

Taking into account of international standards to protect water quality, there should be preferences to use the water of Kabul River under water deficient situations i.e. in dry year and Rabi period (Akhtar & Iqbal, 2017). The impact of water deficiency on food security can be reduced through the introduction of climate resilient varieties of crops and farming pattern which are less water consuming (Sediqi & Komori, 2023).

Turkey and Armenia have a history of strained relations. Despite all the bitter facts, they are cooperating over dam on Arpaay/Akhuryan River calmly and smoothly without involving political emotions. They addressed drought periods with consideration and innovation by changing water supply plans, data sharing and applying joint water-saving strategies (Altingoz & Ali, 2019).

Like floods, the Rhine River Basin is also susceptible to droughts due to water shortage and low-

flow in summer season. The International Commission for protection of the Rhine (ICPR) is promoting drought management practices among member countries through collaboration and science-based understanding of upcoming water accessibility, demand and reasonable distribution. To improve awareness about possible water scarcities, wide-ranging data concerning temperature, rainfall, reservoir storage, river flows, run off situations, water level and usage, environmental position, infrastructure planning etc., is collected to calculate future water availability, allocation, prioritization along with risks of impending water deficiencies, sectoral shortages, and low-flow discharges at important sites in the basin (Ter Maat et al., 2025).

Joint studies and information sharing are comparatively easy plans to execute which help countries to act in harmony for continuous mutual cooperation (Sadoff & Grey, 2005). In this regard, Pakistan and Afghanistan should consider water resource variability (fluctuation in water supplies) along with adoption of principle of priority of use under water scarce situations or droughts in Kabul River Basin.

4. Conclusion

The data acquisition and exchange assist in developing assessments and facilitate vibrant, improved and inexpensive solutions. There should be engagement of governments of Pakistan and Afghanistan through dialogues. There is also need of timely and reliable data regarding water measurement in different seasons and at different locations along with information about dams, diversions, water related infrastructure etc. Prompt and precise data helps riparian countries to fairly allocate water by measuring water flows and periodic variations. Cooperation on Sharing of information helps to prevent water crisis because right to information is an important element of any cooperative consideration.

The key will be to establish a relationship of negotiation in which data may be exchanged to develop a common body of information from where to work. Estimating the water availability within a basin is a difficult but decisive task. The dialogues based on incorrect and vague information may develop conditions with agreement which cannot be settled. Initiation of cooperation on water through technical and non-political grounds ensures mutual understanding and builds trust. Such sharing of data and improving capacity on technical aspects provide basis for further collaboration on other matters as well and will ultimately help to reach a strategic accord between Pakistan and Afghanistan.

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