The Kabul River Basin: Cooperation between Afghanistan and Pakistan for Shared Benefits

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Abstract

Pakistan and Afghanistan, are neighboring countries situated at the junction of South Asia, Central Asia, and China. Their relationship is marked by ethnic, historical, religious, commercial, and cultural linkages. They also share the water resources of seven rivers that flow from Afghanistan into Pakistan, with the Kabul River (KR) being the largest and most important. These water resources have come under severe threat of climate change and rapid population growth. Despite the significance of these water resources, no formal agreement exists between the two nations regarding the management and utilization of the shared waters. This paper provides an overview of the shared water resources of the KR, highlighting the KR Basin's significance for both countries. It also narrates past efforts to formalize collaboration on these shared resources, including efforts to negotiate an agreement and the involvement of international organizations such as the World Bank. The paper reflects on the socio-economic benefits of such collaborations and the challenges and opportunities for future collaborative efforts. Recommendations for both countries and the international community are provided to facilitate dialogue and joint management of the KRB, aiming to enhance water security, socio-economic development, and regional peace and stability.

Keywords: Afghanistan-Pakistan, Shared waters, Climate change threat, Kabul River Basin, International cooperation

1. Introduction

1.1. General Statement

Pakistan and Afghanistan are two bordering nations situated across crucial junctions of the Indian subcontinent, Middle East, Central Asia and China. Both nations are linked by 2670 km border and linguistic, historical, religious, business,

Jan, M.Q., Shafique, M., Raynolds, R.G., Jan, I.U., Ghani, M. (Eds.) Indus Water System. National Centre of Excellence in Geology, University of Peshawar & Pakistan Academy of Sciences, Islamabad, Pakistan (2024) weblink: http://nceg.uop.edu.pk/books/IWS.html

and social ties. Pakistan has been Afghanistan's largest partner and its nearest access route to the sea, in this case, the Arabian Sea. Since the Soviet Union's military ingress in Afghanistan in 1979, which the Afghans vehemently opposed, Pakistan has received millions of Afghan refugees whose presence has had profound impacts on Pakistan, especially the province of Khyber Pakhtunkhwa (KP). Pakistan continues to host a large number of them.

Afghanistan and Pakistan are members of many regional cooperation organizations, such as the Central Asia Regional Economic Cooperation (CAREC), the Economic Cooperation Organization (ECO), and the South Asia Association for Regional Cooperation (SAARC). An unacknowledged facet of Afghan-Pakistan relations is the sharing of as many as seven (7) rivers that flow from Afghanistan into Pakistan. Three of them, the Kabul, Kurram, and Gomal, are relatively more important (Fig. 1). Kurram and Gomal cater to the municipal water, irrigation, and electricity needs of Kurram and the two halves of Waziristan, and eventually drain into the Indus. The Kabul is the largest transboundary river shared by the two countries and the second-largest tributary of the Indus Basin (Fig. 2). Despite the heavy pollution of the Kabul River (KR) (Ali, 2024), over 20 million people in Pakistan and Afghanistan depend almost entirely on it for domestic use, irrigation, drinking water, hydropower, livelihood and recreational activities.

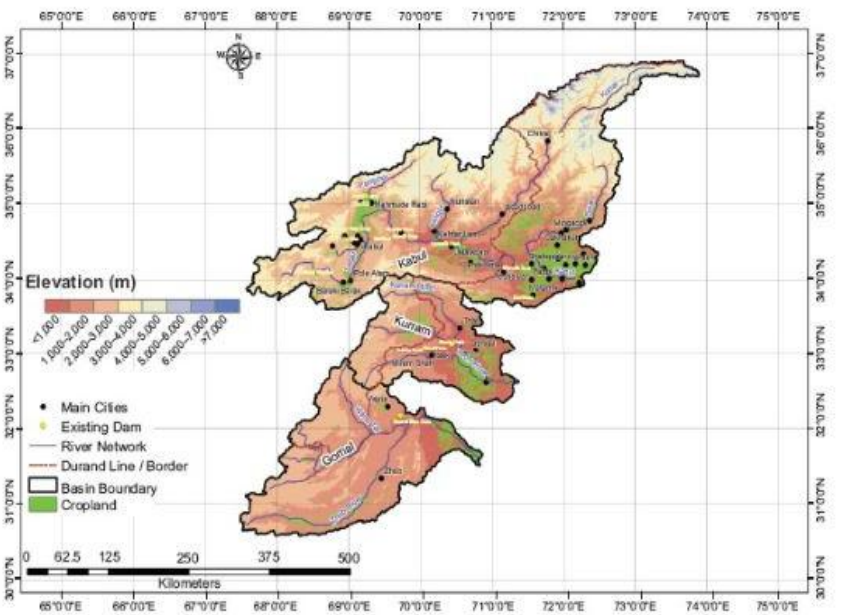

Figure 1. Shared waters of the Kabul, Kurram, and Gomal rivers between Afghanistan and Pakistan (from Shah et al., 2013).

Originating in the mountains of the Hindu Kush in Afghanistan, the KR receives large amounts of water from the Kunar River which originates in the Chitral region of Pakistan, flows through Afghanistan, and joins the KR near Jalalabad before crossing into Pakistan. In Pakistan, the Kabul's journey passes through 140 km of KP province during which it is significantly augmented by the flows of the Swat River and ends at Attock where it merges into the Indus (Fig. 1), adding between 19.25 and 21.5 km^3 of water per year. The fact that the bulk of the flows of Kabul are provided by snow melting and cloud outbursts in Chitral makes the KR unique: both Afghanistan and Pakistan can claim to be its upper riparian whilst the latter is also undisputed lower riparian.

The Kabul and other smaller rivers have flown from the west into Pakistan for millennia without any impediment or interruption. In Afghanistan, the KR delivers water for irrigation and 50% of the country's hydropower. In Pakistan, it powers the 250-megawatt Warsak Dam built in 1960 and, along with its tributaries, Swat and Panjkora, irrigates much of the fertile Swat and Peshawar valleys (Porter and Raulfs-Wang, 2017). Both countries seem to have taken these facts for granted. They have neither formally discussed the Kabul and other transboundary rivers shared by them, nor the need for cooperation on water resources. However, since 2003, Pakistan has made some efforts to discuss the possibility of a formal agreement or arrangement to regularize the sharing of the Kabul waters. The World Bank, perhaps emboldened by its successful and active role in the negotiation of the Indus Waters Treaty (IWT) signed between Pakistan and India in 1960, as well as initiatives for forging cooperative arrangements on shared transboundary rivers in other parts of the world, had also offered assistance. It is recognized that joint efforts by the two riparian countries, catalyzed and enabled by institutional mechanisms, will strengthen peace and collaboration between Pakistan and Afghanistan, and contribute to the socio-economic uplift and well-being of their citizens (Kakakhel and Mahmood, multi-dated).

This paper offers a bird-eye view of the state of water resources in the adjoining areas of Pakistan and Afghanistan and underlines the importance of the KRB for both countries. It recalls the efforts made during the past two decades to negotiate a formal, institutionalized means of cooperation for the mutual benefit of the two neighboring countries and highlights the multiple prospects of mutually beneficial cooperation. The paper draws information from many sources, including the earlier publications of the first author with other collaborators.

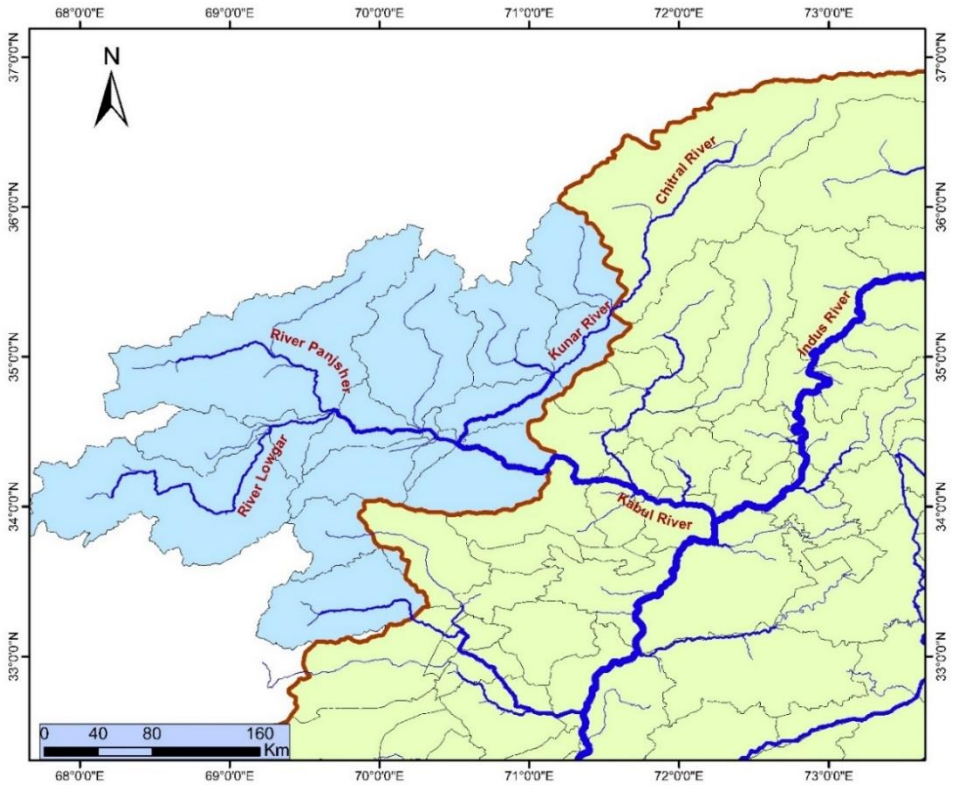

Figure 2. Drainage of the Kabul River Basin across the Afghanistan–Pakistan border. Also shown are the four major sources of the Kabul river and, to the south, the Kuram- and Gomal rivers. The KR joins the NE-SW flowing Indus River at Attock. (Source; Global Drainage Maps).

1.2. The Afghanistan–Pakistan transboundary Kabul River system

The three major waters shared by Afghanistan and Pakistan are the Kabul River, Kurram River, and Gomal river. Together they cover 157,619 km^2 or 10.3% of the total area of Afghanistan and Pakistan, and 13.6% of the Indus river basin. In this section, we provide general information on the KR, extracted from the internet, CABI Digital Library, Encyclopedia Britannica, Encyclopedia Iranica, Research Gate, Wikipedia, and other sources here referred to. The basin of the KR covers an area of 92,000 km^2 of which 57.9% lies in Afghanistan and 42.1% in Pakistan (Matheswaran and Akhtar, 2023; Fig. 3 and 4). Kabul is the major river in eastern Afghanistan and the Khyber Puktunkhawa province of Pakistan. It has been playing a multifaceted role in the region's geography, history, culture, economy, and food security. Table 1 shows the land cover and land use in Kabul and its

suburbs, and Table 2 shows annual precipitation and actual evapotranspiration in the three trans-boundary rivers of Afghanistan and Pakistan.

Table 1. Land use and land cover area in Kabul and its suburbs (Matheswaran and Akhtar, 2023).

Basin	Area (Mha)	Percent of Basin Area							
		Water Body	Snow And Glacier	Forest	Riverbed	Built-Up	Cropland	Barren	Rangeland
Panjsher	0.93	0.14	0.77	0.04	0.13	0.55	6.07	19.78	72.52
Alingor	0.64	0.17	1.00	4.49	0.09	0.35	4.22	13.62	76.05
Logar	0.99	0.00	0.00	0.01	0.02	1.16	5.39	45.68	47.74
Kunnar	2.60	0.17	17.88	6.67	0.34	0.25	2.55	18.44	53.71
Swat	1.53	0.26	9.67	15.38	0.45	0.26	24.16	1.23	48.61
Kabul Sub-Basin	2.58	0.24	0.03	2.35	1.72	2.53	23.36	19.18	50.59
Kabul	9.26	0.18	6.81	5.39	0.67	1.01	12.64	18.48	54.81

The KRB includes diverse terrains, ranging from mountainous regions in Afghanistan to plains in Pakistan (Fig. 2). According to Encyclopedia Britannica, the KR crosses two major climatic zones. Its upper ranges, both in Afghanistan and Chitral (Pakistan), have a continental warm-summer climate with an average temperature of ca. 77 °F (25 °C) in July, and an average January temperature below 32 °F (0 °C). The annual rainfall is less than 20 inches (500 mm), although it is higher on the mountain slopes around the KR headwaters. In the lower ranges in KP, the KR crosses a region of rather desert climate, with early summer maximum daily temperatures often over 104 °F (40 °C) and mean temperatures in winter above 50 °F (10 °C).

The KR emerges 72 km west of Kabul city in the Sanglakh Mountain Range of the Hindu Kush mountains in the northeastern part of Maidan Wardak Province, Afghanistan. A large portion of the Kabul River's water originates from the glaciers and snow of the Chitral District as Mastuj River, which originates from the Chiantar glacier in the Broghil valley. South of Chitral town near Mirkani, it flows into Afghanistan as Kunar River and, after it is joined by the Bashgal river flowing from Nurestan, it joins the KR near Jalalabad. Other tributaries of the Kabul River include Lowgar, Panjshir, Alingar, and Surkhab in Afghanistan and Swat (+Dir) rivers in Pakistan.

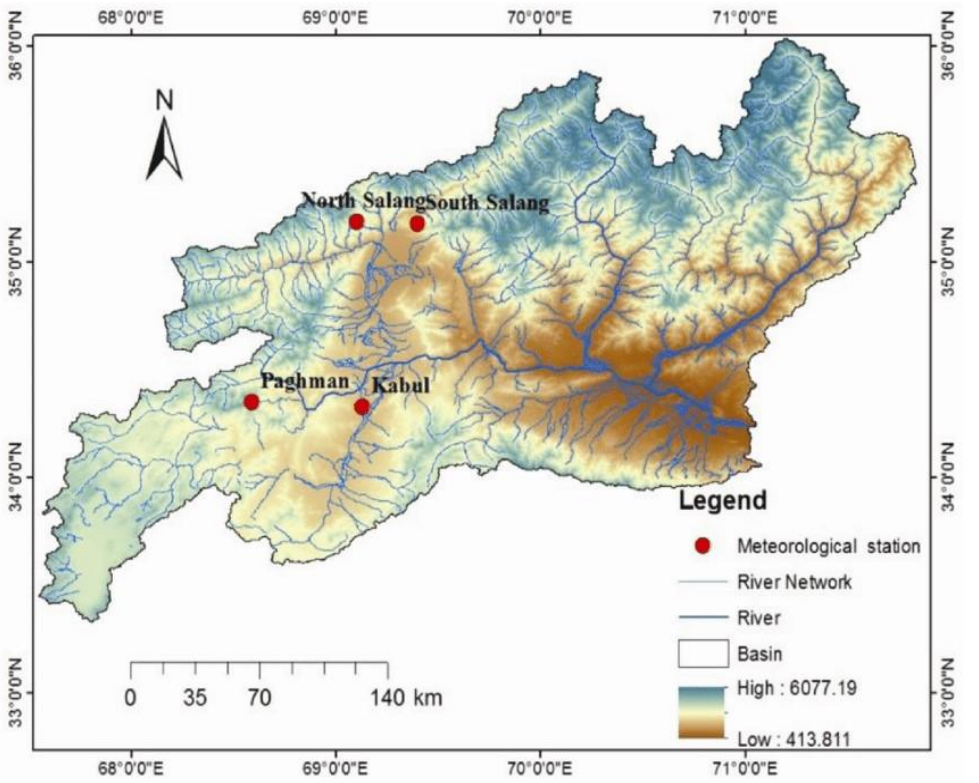

Figure 3. Map of the Kabul River Basin in Afghanistan, showing regional elevations (in meters above sea level), water courses and drainage pattern (from Sidiqi et al., 2018).

Table 2. Mean annual precipitation and evapotranspiration in Kabul, Kurram and Gomal river basins, 2001 – 2021 (from Matheswaran and Akhtar, 2023).

Basin	Afghanistan			Pakistan			Total		
	Precip. (mm)	ETa (mm)	Diff. (mm)	Precip. (mm)	ETa (mm)	Diff. (mm)	Precip. (mm)	ETa (mm)	Diff. (mm)
Kabul	433.9	364.0	69.9	596.1	470.8	125.4	503.9	410.1	93.8
Kurram	409.1	366.2	42.9	514.1	465.7	48.3	472.1	425.9	46.1
Gomal	261.3	225.5	35.8	288.9	261.4	27.5	283.4	254.2	29.2

The KR to the west of the Jalalabad confluence is little more than a trickle for much of the year. The water level increases in summer because of the snow melt in the Hindu Kush Range and monsoon rains in KP (Fig. 4, 5). Monsoon cloud outbursts in the catchment area of the feeder rivers of Kabul, especially in Upper Dir and Swat Kohistan, have resulted in adding large quantities of water to KR, causing flooding in the Indus basin. Fig. 6 shows the volume of water in the Kabul

at Nowshera on April 30 for the years 2015 to 2024. The much larger than normal quantities of water during 2015, 2019, 2020 and 2024 were probably caused by floods due to unusual cloud outbursts in Swat and upper Dir region, and could well be connected to climate change (Jan et al., 2017). Table 3 shows the precipitation, evapotranspiration and consumption statistics of the KR. Analysis of hydrological data shows that the average flow of water in the KRB dropped by 4.6% between 1950 and 2018 (Ali, 2024). Since the 1990s, the river has experienced substantial droughts in summer.

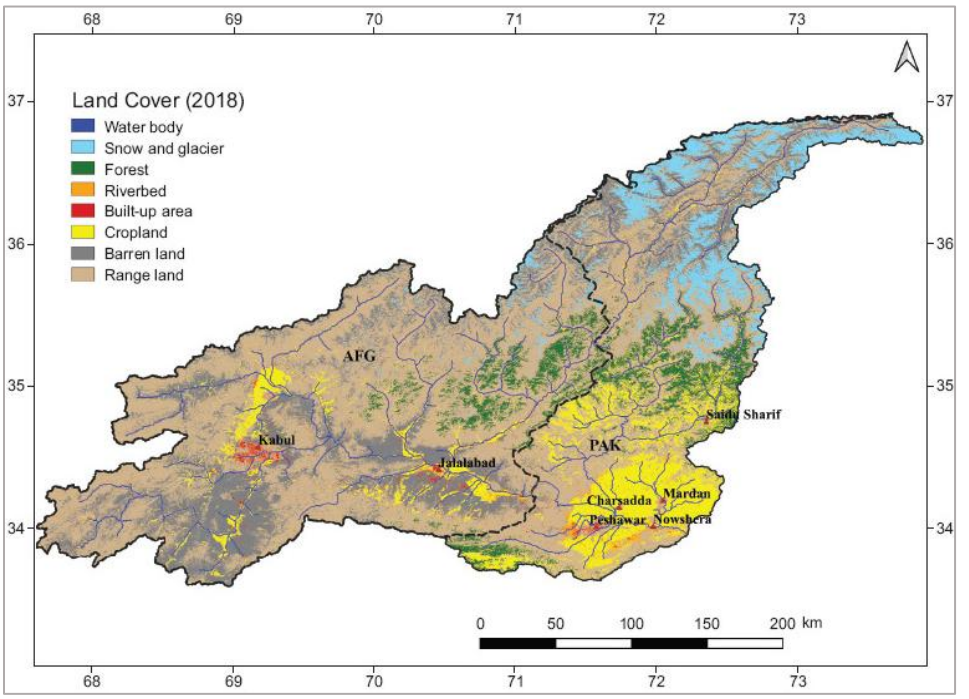

Figure 4. Land cover and geographical details of the KR basin in Pakistan and Afghanistan (from Matheswaran and Akhtar, 2023).

Figure 5. Left: Kabul River flood plain east of Kabul. Right: High Flood at Nowshera, 2022.

Despite the Kunar River carrying more water than the KR, the river is called the Kabul River after the Jalalabad confluence, due to the political and historical importance of the name. The KR is a west-to-east running tributary of the Indus River, flowing into the latter near Attock, Pakistan. It measures some 700 km in length, of which 560 km are in Afghanistan. It passes through/near the cities of Kabul, Surobi and Jalalabad in Afghanistan, and Peshawar, Charsadda, and Nowshera in the KP province of Pakistan

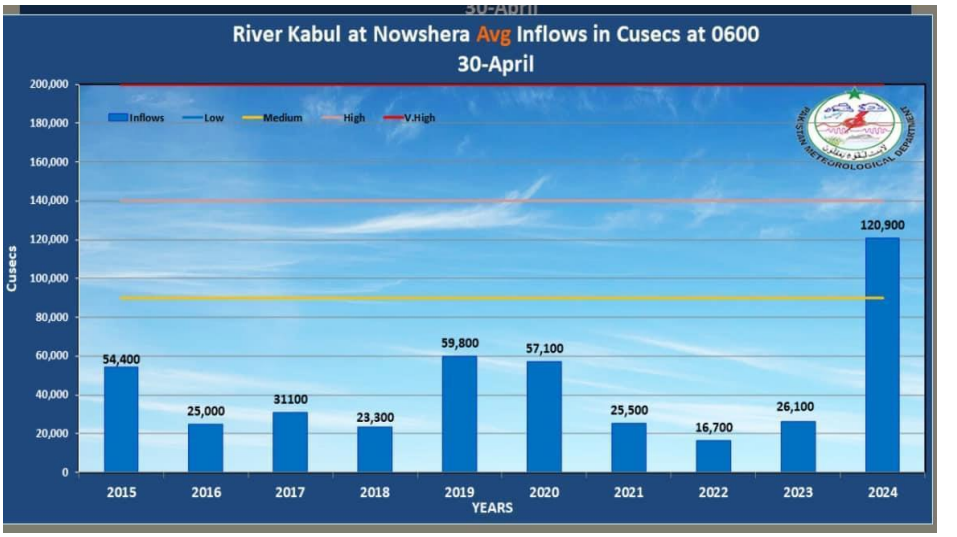

Figure 6. Temporal fluctuation of water in the Kabul River at Nowshera.

Table 3. Long-term average annual water consumption relative to the long-term system (surface) outflows (in mcm from Rehmen et al., 1997; cf. Matheswaran and Akhtar, 2023).

Basin	Rainfall (mcm)	Basin ETa (mcm)	Domestic (mcm)	Industrial (mcm)	Total Basin water Consumption (mcm)	Rainfall-total Consumption (mcm)	Basin Outflow (mcm)
Gomal	11,093	8875	21	4	8900	2197	863
Kabul	46,735	39,770	554	115	40,439	6296	23,770
Kurram	12,177	10,250	106	21	10,377	1800	776

1.2.1. Quality of water of the Kabul River. The KR is highly polluted throughout its course. Huge quantities of garbage, including plastic, domestic and industrial waste, sewerage, chemicals, agricultural runoff, and all sorts of pollutants from a large number of towns and cities end up in the feeding rivers/streams/channels and, ultimately, in the KR, affecting water quality and ecosystem health. Over 20

million people in Pakistan and Afghanistan depend on the Kabul River for irrigation, drinking water, livelihoods, hydropower and recreational activities. Since March 2019, thousands of gallons of untreated sewage from the Makroyan Waste Water Treatment Plant has been dumped into the KR every month, reportedly causing gastrointestinal (and possibly other health) issues among the more than 3,000 families living along the river (Lawrence and Babakarkhail, 2020). The situation is not encouraging in the downstream KP province in Pakistan. Domestic sewage and industrial wastewater and from many towns and around 10 cities in the KP discharge into the river. Wastewater treatment plants are lacking in the province, including its capital, Peshawar.

According to Ali (2024), "The PCRWR found most of the water sources along the Kabul River to be unsafe for drinking. The report states that the river's water was similar to drain water in quality, with chemical oxygen demand (COD) at 170 milligrams per liter and biological oxygen demand (BOD) at 98 mg/l. This exceeds the permissible limits set in Pakistan's National Environmental Quality Standards even for municipal and liquid effluents, which stipulate a COD of 150 mg/l and a BOD of 80 mg/l for inland waters". If Pakistan were to reach a treaty on the waters of the Kabul River, the issue of water pollution should be given as much importance as the quantity of water. But cleaning just the Kabul River would not be enough. In Pakistan, 89% of the rural and 96% of the urban population suffer from water pollution. Just 1% of industrial effluent is cleaned before disposal, and wastewater is discharged directly into rivers (Nasir et al., 2016). It is high time Pakistan pays serious attention to the massive pollution of its river waters.

1.2.2. Dams and reservoirs on the Kabul River. In the 20th century, the KR attracted the attention of European countries to pursue the construction of large-scale dams for the production of hydroelectric power. Many water reservoirs were also built to sustain agriculture. The KR waters are impounded by several dams (Fig. 7) that were constructed in the 20th century for various purposes, such as power generation, agriculture, and domestic and local industrial use. Four major dams worthy of note are located in the Kabul and Nangarhar provinces: Surobi, Naghlu, Darunta and Mahipar.

The Sarubi Dam, a hydroelectric source for the city of Kabul, was built in 1957 with assistance by the then-West Germany. Ten years later the Soviet engineers finished the Nagˉlu project above Sarobi. The Soviets also erected a large dam further downstream in the Darunta gorge, located to the west of Jalalabad. A fourth project was taken up in the 1960s by German engineers for the production of

electricity near Mahipar, located between Kabul and Naglu. It was commissioned in 1967. The first phase of the Warsak Dam on the KR, approximately 20 km northwest Peshawar city, was completed in 1960 with the support of the Colombo Plan.

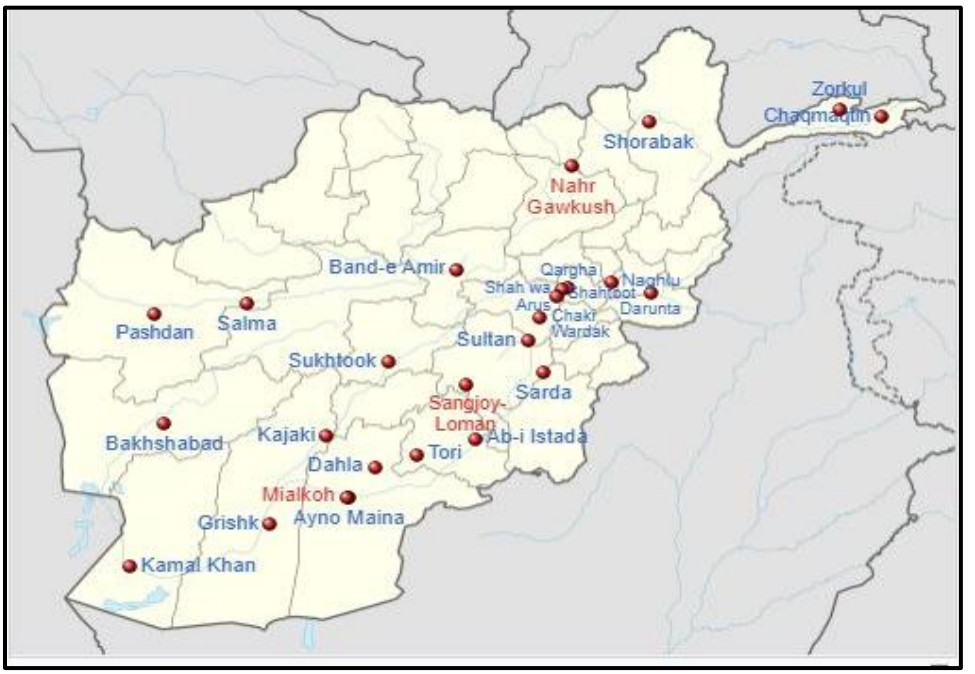

Figure 7. Some of the larger dams and reservoirs in Afghanistan (Wikipedia).

Being a typical mountain river that is fed by meltwater in spring and early summer, the KR is exposed to considerable fluctuations in the quantity of water. Because of global warming and climate fluctuations, the river has been repeatedly affected since the 1990s by severe droughts and has experienced substantial if not total drying up during summer. In recent years, Afghanistan has indicated the future construction of large dams for electricity and agriculture purposes using waters of the KR involving the Kunar River (Table 4). This has become a matter of serious concern for Pakistan because of the potential negative impact of these dams on Pakistan, especially the fertile Peshawar valley. Effective transboundary water management between the two neighbors is crucial to addressing the issues of water allocation, flood control, food security, and sustainable usage. The transboundary water issue between Afghanistan and Pakistan is being taken up in detail in this paper.

Table 4. Existing and proposed irrigation systems in Kabul Basin (after Matheswaran and Akhtar, 2023).

Country	Irrigation System	Status	Command Area (ha)
Afghanistan	Nangarhar	Existing	32,000
	Logar-Upper Kabul	Proposed	105,000
	Panjshir	Proposed	73,000
	Lower Kabul	Proposed	136,000
Pakistan	Upper Swat System	Existing	116,550
	Lower Swat System	Existing	54,430
	Warsak System	Existing	43,470
	Kabul Canal System	Existing	29,140

2. Afghanistan

Afghanistan is a predominantly arid region with a climate manifested by low precipitation and 12% arable land. Due to climate change and other reasons, the Afghanistan's water resources have dropped from 75 to 69 billion m^3 per year (Ariana News, 2023). It has five basins: the Amu Darya, Kabul, Northern, Harirod–Murghab, and Helmand. Of these, the Harirod- Murghab, Helmand, Amu Darya, and Kabul are transboundary rivers and shared with central Asian republics, Iran and Pakistan. The snow and glaciers of the Hindu Kush (Fig. 8) feed all the rivers of Afghanistan whose economy is mainly dependent on agriculture, livestock and farming, providing livelihoods for its rapidly growing population now estimated at 40 million.

Despite its enormous potential for hydropower generation, oil, gas, and minerals, Afghanistan has all along been energy deficit; only 50% of its population residing in cities and towns, has access to electricity supply. The country gets 600 MW of electricity from its hydropower plants and other sources, including fossil fuels and solar panels. Given the huge demand-supply gap, hydropower production has been a top national priority. Unable to exploit its potential for hydropower generation, Afghanistan has had to import electricity from neighboring Iran and central Asian countries.

The Kabul is not the largest river in Afghanistan. Still, it is a vital source of municipal water and sanitation and meets the irrigation and energy needs of the nearly seven million residents of Kabul, Jalalabad and other cities. The KRB is

Afghanistan's most developed basin; where four large multipurpose dams, Surobi, Naghlu, Darunta and Mahipar provide electricity and irrigation. Over a dozen sites for dams were identified, but could not be built owing to lack of peace and security as well as financial resources and technical capacity. Feasibility studies of a dozen or more sites for dams in the KRB were prepared by Afghanistan with external assistance, but the projects could not be implemented. If and when peace and security are assured and resources are available, the projects will be dusted up and updated for implementation. In the meanwhile, the country has recently embarked on construction of a water canal from the Amu Darya.

During 2001-2020, Afghanistan made significant progress in water resource development and management, including the enactment of environment and water laws in 2007 and 2009, and the establishment of a Supreme Council on Land and Water in April 2015. The US Geological Survey, the USAID, the World Bank, and EU countries assisted Afghanistan in rebuilding river flow data and trained hundreds of Afghans in various water resource–related areas, including negotiation on transboundary waters. The Ministry of Energy and Water along with the Ministry of Foreign Affairs were assigned responsibility for transboundary waters.

The cataclysmic developments following the resurgence and ascendancy of the Afghan Taliban and the sudden departure of the American forces precipitated the collapse of the government headed by Dr. Ashraf Ghani, which was accompanied by a mass exodus of Afghan civil servants. The Taliban once again took control of Afghanistan in August 2021, and declared the restoration of the Islamic Emirate of Afghanistan. The regime of the Taliban has not been formally recognized by any country, but a large number of countries, especially in Asia, have accorded de facto recognition of the Taliban government by maintaining their diplomatic missions in Kabul. The international community at large has declined to recognize the revived Islamic Emirate because of human rights issues in particular the treatment of women and girls.

At present, it is unclear what percentage of the educated, formally trained, and technically qualified Afghan personnel have remained in the country and serve in the ministries of the Islamic Emirate of Afghanistan. The country will need large financial resources and technical assistance to exploit the water of the KRB for multipurpose dams for power generation, safe drinking water, sanitation, and irrigation. Even if the present Afghan government is welcomed by the world community, bilateral and multilateral sources of support would be reluctant to positively respond to Kabul’s request for support in building dams in the KRB unless they are assured of the formal or tacit consent of Pakistan, the co- riparian.

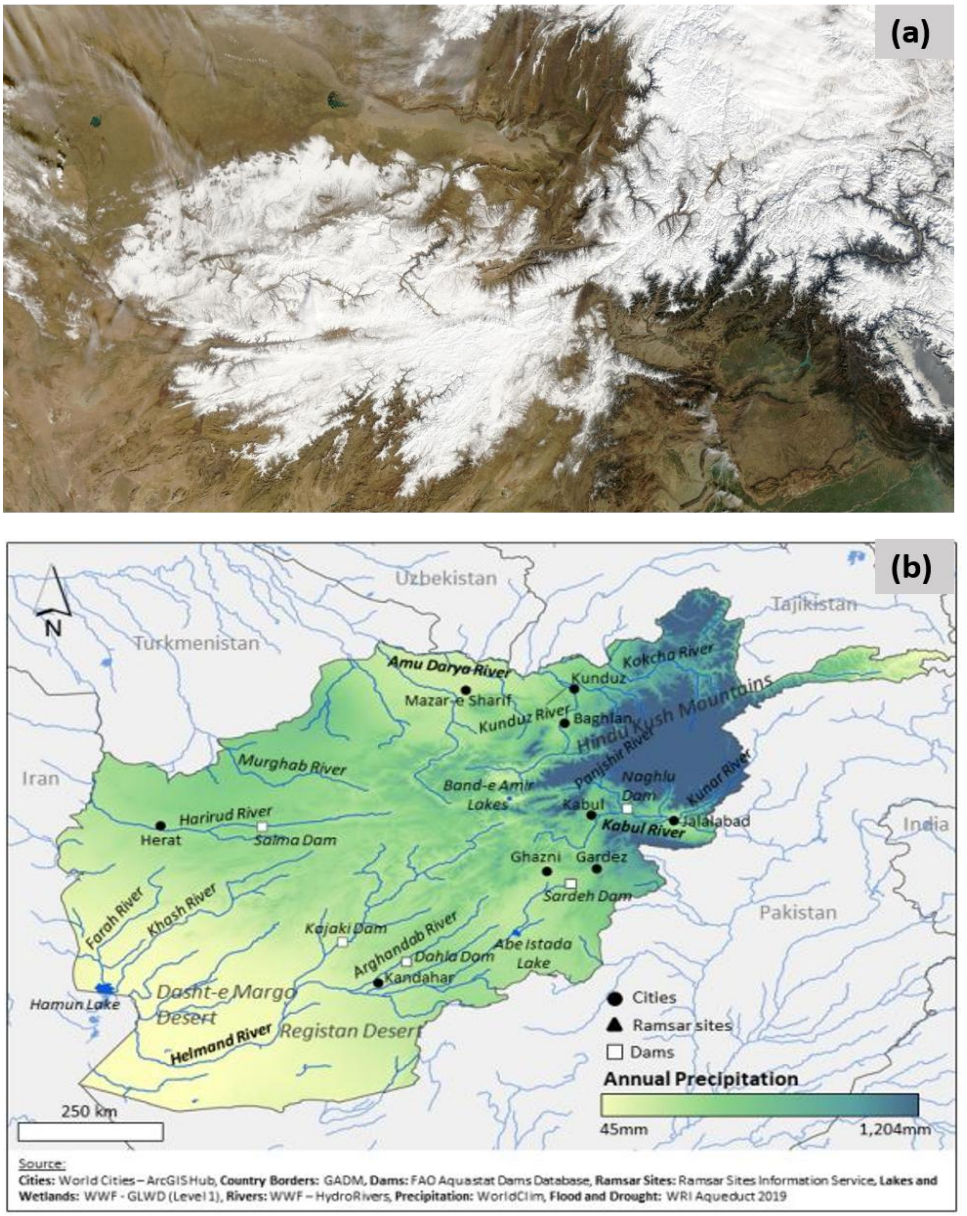

Figure 8. (a): Unusual heavy snow cover of winter, 2006, in the Hindu Kush region in Afghanistan (NASA Earth Observatory). (b) Drainage map of Afghanistan and adjacent parts of Central Asia, showing also the annual precipitation in Afghanistan.

3. Pakistan

Pakistan has continued to use the water supply from the KR for electricity production, drinking, irrigation, and sanitation, especially for the use of the several million residents of Peshawar metropolitan and its rapidly growing suburbs. The

Warsak Dam to the northwest of Peshawar, built in the early 1960s, is the first post-independence multi-purpose dam in Pakistan. The dam has an installed capacity to produce 243 MW of electricity, but it is threatened by heavy sedimentation. Canals from the dam reservoir irrigate nearly 18,000 acres area of the Peshawar basin. Water experts fear that a decrease in the flows of the Kabil River will badly affect KP's agriculture and livestock sectors.

In the KP province, which utilizes the water assets of the KR system, several provincial government departments look after various water-associated subjects. The Irrigation Department is responsible for land development and running of waterways, surveys, dams for water storage, as well as additional storage venues, flood protection, and the management of the KP Irrigation and Drainage Authority and Local Government elections. The Public Health Engineering Department is mainly in charge for the distribution of clean drinking water. The KP Integrated Water Resource Management Board, established in 2002, coordinates the development and execution of policy actions for enhancing sustainable social, financial, and ecological benefits of developing water resources and allocating water within competitive peoples.

The main sources of water in Pakistan, apart from groundwater, are precipitation and snowfall, which accumulate to produce glaciers, and the country's wide network of rivers, lakes, coastal basins, and small water lakes. The state of water resources in Pakistan is marked by declining per capita quantity as well as deteriorating quality. At its inception in 1947, Pakistan was a water-rich nation endowed with a per capita accessibility of 5200 cubic meters of water annually which has plummeted to less than 1000 cubic meters in recent years. Pakistan ranks 17th among water-scarce countries, with 79% contaminated drinking water (Jabeen et al., 2015). The main drivers of water scarcity are the increase of population from 32 million in 1947 to over 240 million in 2023, accompanied by irregular and haphazard urbanization; decay of water infrastructure owing to poor maintenance; the multiple adverse effects of climate change such as rapid melting and recession of the Himalaya-Karakoram-Hindu Kush glaciers, disruption of the pattern of monsoon winds, heatwaves, frequent, longer lasting, and hugely destructive floods, varying periods of drought, and rising level of the Arabian Sea leading to salinization of sweet water from intrusion of seawater. On top of all this, much of the water is consumed by highly wasteful irrigation.

The water-related functions and responsibilities throughout the country, i.e., in all provinces, Azad Kashmir and Gilgit Baltistan, are operated by national and provincial governments. The Federal Government looks after water issues that

concern all provinces as well as transboundary rivers. The Federal Ministry of Water Resources directs the functioning of four ministries, i.e., WAPDA (Water and Power Development Authority), originally mandated to carry out activities for developing the water and power sector, but later assigned the water sector only; IRSA (Indus-River-System-Authority), established in the year of 1992 to execute the 1991 Indus Waters Accord; FFC (the Federal Flood Commission); and the Pakistan Indus Commission, established in implementation for the India Pakistan IWT (Indus Waters Treaty). The Council of Common Interest (CCI), created in the 1973 Constitution to deal with the key national policy issues that need agreement from each province, also has a mandate concerning water resources, including the policies relating to WAPDA.

On 24 April 2018, the Government of Pakistan issued Pakistan's first National Water Policy (NWP), following its approval by the CCI and with the consent of the four provinces, Azad Kashmir and Gilgit Baltistan. The NWP addresses all aspects of water resources and calls for further elaboration of its broad recommendations. It also calls for increased investment by the Federal and Provincial Governments for enhanced integrated water resource management. Two important documents, among others, worth reading in this regard are Water resources and their management in Pakistan (Ahmad et al., 2023) and Water supply and sanitation in Pakistan (Wikipedia, 2024). Ahmad et al. (2023) critically analyzed 93 research publications on Pakistan water resource management, with particular emphasis on policy, governance, and environmental challenges, using a systematic review technique. The study noted gaps and weaknesses in the existing laws and regulations, alongside the threats of population expansion, urbanization, climate change, and water contamination. To properly address these problems, they proposed a comprehensive framework for water resource management and governance (Fig. 9), which includes a national water policy that argues for sustainability and institutional strengthening, education and raising knowledge about water resource management among the general public and relevant stakeholders. Infrastructure development, climate change adaptation, and examining social and environmental variables are all emphasized as important concerns. "By following these recommendations and the proposed OECD key principles on water governance, Pakistan may make significant progress towards achieving sustainable water management, aligning with its development objectives, and ensuring clean and safe water availability for future generations" (Ahmad et al., 2023).

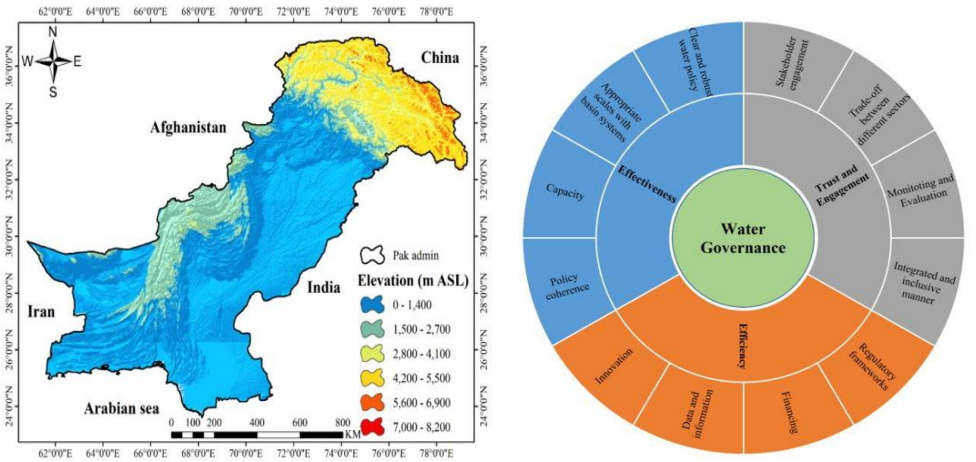

Figure 9. Left: Map of Pakistan with elevations in meters above sea level. Right: Organization for Economic Co-operation and Development (OECD) principles for water governance (after Ahmad et al., 2023, and other references therein).

4. Afghanistan–Pakistan Cooperation in the Kabul River Basin Water Resource Development and Management

As previously mentioned, no official or constitutionally binding protocol has been signed between Afghanistan and Pakistan regarding the distribution, expansion, and governance of transboundary water resources. Pakistan signed the Indus Waters Treaty in 1960, which tacitly recognized the contribution of the KR to the flows of the Indus Basin, but stated nothing more. The only agreement signed by Afghanistan on transboundary waters was signed with Iran in 1973 concerning the sharing of the Helmand River. This is rather unfortunate; the management of any transboundary water resources is predicated on mutual understanding, cooperation and benefit-sharing between upper and lower riparian states.

In September 2003, a report issued by the Institute of Policy Studies (IPS), an Islamabad-based non-government Think Tank, claimed that India had decided to support Afghanistan in constructing 13 multi-function reservoirs in the KRB that would decrease the KR's water supply toward Pakistan about 14 to 20%. After two months, the then-Pakistan Water and Power Minister declared preparedness to negotiate a water agreement with Afghanistan on the model of the IWT. Since then, senior Pakistani officials, including those associated with the Ministry of Water and Power (bifurcated in August 2017 into separate ministries for water and power), WAPDA, the Federal Flood Commission, IRSA, and even the Pakistan Indus Commissioner have raised deep concerns on repeated, unverified articles in

national media about Indian support for multi-purpose dams in KRB. They have suggested negotiations on reaching an agreement on the pattern of the IWT treaty with Afghanistan on the KRB. Different organizations and specialists have published articles emphasizing the imperative of dialogue and cooperation between the two neighboring countries on shared rivers.

4.1. Notable developments

The notable developments regarding the dialogue and collaboration between the two countries (Afghanistan and Pakistan) on shared transboundary rivers are cited below:

1) A five-member expert group led by the Federal Flood Commission Chairman was appointed by the country government in 2003 to prepare a water treaty with Afghanistan. A nine-member delegation, led by Chairman FFC, visited Kabul for discussions with Afghan officials on the water-sharing treaty. This visit was not effective, and Chairman FFC reportedly claimed that the effort was unsuccessful as the Afghan officials failed to withhold proper data records on river flows.
2) In 2004, the head of IRSA warned the Government of nearly a dozen dams planned to be built by the Afghan government in KRB with Indian assistance. He supported the negotiation of a water-sharing accord with Afghanistan.
3) By 2006, the World Bank offered to help in the consultation between Afghanistan and Pakistan. The Afghan government official reportedly stated a lack of requisite data and technical capacity to negotiate a treaty and pleaded for additional time to adequately prepare for the discussions.
4) In the year of 2011, the Water and Power Ministry's secretary said: "Now is the ideal moment for settling a treaty, otherwise, it will become too late".
5) The United States Government in April 2011 conducted preliminary discussions among Afghanistan and Pakistan regarding a water deal. In June 2011, the World Bank recommended a conflict resolution and collaborative policy measures for water resources, known as 'KRB Management Commission' and extended an offer to ""support and encourage communication and collaboration among Afghanistan and Pakistan for the safety and prosperity of the region". The World Bank placed a strong emphasis on developing the institutional ability for each nation, especially Afghanistan, to enhance work and comprehend by communicating and collaborating KRB

hydro-meteorological datasets utilizing hydrological, hydraulic, and financial models.

4.2. Developments since 2013

A summary of the negotiations since 2013 on the shared waters between the two countries are given in the following:

1) On August 25, 2013, the former Afghan Finance Minister, Dr. Hazrat Omar Zakhilwal, who subsequently served as Afghan Ambassador in Islamabad, went to Islamabad one day prior to the Afghan president's arrival. Hamid Karzai. He had extensive dialogue with Mr. Ishaq Dar, his Pakistani counterpart, and suggested shared investment for a 1500 MW hydropower project on River Kunar in Afghanistan. The Pakistani media reported that "It is probable that the two parties will make headway in creating a Kabul River Managing Council.".

2) In February 2014, the topic was discussed during the 9th meeting of the Joint Afghan-Pakistan Ministerial Commission (JMC) which took place in Kabul. The JEC planned to establish a combined working group (WG) tasked with developing proposals for collaborative works. They also decided that WG shall include officials from the ministries of Water and Power/ Energy, Foreign Affairs, and Finance of the two countries, as well as from WAPDA along with Afghan counterparts. The 10th visit of the Joint Economic Commission took place in Pakistan's capital city on November 23, 2015, additionally talked about the Kunar project. During the session, the JEC agreed to form a collaborative working team to explore the hydropower potential of the KRB, and both nations committed to nominating the officials for these tasked groups.

3. There was no progress on JEC's decision, perhaps because it did not meet since its 10th meeting. In August 2017, the two Finance Ministers met and the media highlighted that the 11th meeting of the JEC was scheduled to be held in September 2017. That session could never materialize because of the resignation of Mr. Ishaq Dar from his position.

4. Afghan Ministry of Water and Energy notified Pakistani official sources in December 2016 that preliminary research for eight hydropower projects in Afghanistan, notably three in the KRB (Surobi-2, Baghdara, and Kama), had been completed. The Afghan team emphasized on, Kama was the single of the three projects intended as a dual-use reservoir for farming and producing

electricity. The Afghan officials showed a desire to conduct Ministerial conversations in Islamabad with Pakistan regarding water-resources cooperation. The Pakistan authority's response to the Afghan Government's request is not known.

5. A World Bank study, called AWARD, issued in January 2013 as part of a larger study, highlighted that the cumulative impact of six hydropower projects intended to be undertaken by Afghanistan in the KRB, i.e., Gulbahar, Shatoot, Gambiri, Baghdara, Kunar, and Kama, shall result in 3% reduction in water flows from Afghanistan into Pakistan.

In unofficial conversations in 2017-18, Pakistani officials dealing with water resources underlined the importance of the moment at which the reservoirs of the dams were filled. They feared that if the reservoirs of dual-purpose dams in the KRB were loaded during March to April, and consequent reduction in water flowing into Pakistan could have a negative impact on rice and cotton planting in several areas of Punjab. Therefore, the proposed moment of the reservoir loading shall be discussed during Pak-Afghan negotiations on the utilization of shared water resources on the Afghan side.

During the informal exchange of views, Pakistani officials had told one of the writers of this paper (SK) that the World Bank had assured them that it would hold prior consultations with Pakistan whilst considering the provision of funds for Afghan water projects in the KRB.

5. Opportunities and constraints concerning cooperation on water resources of the Kabul River Basin

As noted earlier, the only significant initiative concerning collaboration between Afghanistan and Pakistan thus far is the deal made in August of 2013 by the Finance Ministers of the two countries for the joint development and operation of a huge hydropower plant on the Kunar River. The Joint Economic Commission (JEC), the main administrative body for advancing commerce and economic ties between Afghanistan and Pakistan, approved this agreement in 2014 and 2015. Nevertheless, the JEC's choices to form teams to look at the possibilities for cooperation was not implemented.

The SAWI (South Asia Water Initiative), sponsored by the UK, Norway, Australia, and instigated through the World Bank, reportedly prepared studies on projects in the Kunar region to be undertaken jointly by Afghanistan and Pakistan in 2014 and subsequent years. But there has not been a publicly known notable follow-up.

The decision on bilateral cooperation concerning the KRB, and its form and modalities will have to be taken by the governments of the two countries. The policy briefs prepared in 2018 (by one of us (SK) and Mr. Ashfaq Mahmood, former Secretary for Water and Power of the Government of Pakistan), on the challenges and opportunities relating to cooperation between Afghanistan and Pakistan for consultations between the unofficial stakeholders from both nations, contain comprehensive analysis and recommendations. The documents were commissioned by LEAD Pakistan, a Pakistani NGO / Think Tank for the Phase 4 program of the USAID Partnership for Enhanced Engagement in Research (PEER) program, "Understanding the Mutual Water-Climate Change Problem and Exploring Strategies for Coordination at the Afghan-Pakistan Transboundary Kabul River Basin."

The document, authored by the first one of us, outlined areas for cooperation, i.e., raising money for constructing hydropower facilities in the Kunar and KRB, as well as their care and functioning. It also highlighted irrigation-related building projects, sharing of relevant data, joint monitoring of river flows and groundwater, training Afghans in Pakistan's civil engineering colleges, universities, and technical institutes, addressing climate change impacts in the KRB (particularly floods and droughts), and sustainable management of the KRB watershed and water resource management issues including pricing of the water-related services. The paper included recommendations for the 'Way Forward', which described the roles of Pakistan and Afghanistan separately and jointly, and of the international community, and are reproduced in the following:

5.1. Role of Pakistan

1) Pakistan, perhaps with relevant external assistance, should conduct comprehensive research to measure the decrease in the KR inflows in Pakistan under various scenarios and different seasons and explore ways to mitigate the adverse impacts of these reductions. The findings of this research should be shared with Afghanistan as an element of the dialogue planning.

2) Pakistan should prioritize revising its national water policy for ensuring that it addresses the issues of transboundary waters. Appropriate institutions should be established afresh, or identified and strengthened within the existing ones, to execute the law and policies. Ensuring improved interaction amongst the national and provincial leadership, in addition to the Ministry of Water Supplies' is critically important. (The National Water Policy of Pakistan,

approved in April 2018, does not have any reference to the transboundary rivers shared with Afghanistan.)

3) Afghanistan is facing several internal issues related to water management, including weak human capital and lack of expertise, inadequate institutional capacity, unreliable and insufficient data, lack of public awareness of international water law and/or transboundary water matters, water quality assurance, particularly in the Kabul city (Malyar, 2024). We, therefore, suggest that Pakistan offers to provide higher education and training to Afghan personnel and get them engaged in collaborative research and capacity building of Afghanistan.

5.2. Joint role of Afghanistan and Pakistan

1) The impacts of global warming and climate change on the water resources of KRB have been considerable. We should realize the shortage of time and urgency for collaborative decisions. The KRB conflict provides positive opportunities and highlights the necessity for meaningful discussions and collaboration. Time is of the essence. Climate change, rapidly growing population and increasing water needs of the two countries do not allow sleeping over transboundary issues. We quote here from the Afghanistan Waters Portal (Malyar, 2024), "… the joint hydropower project – Kunar Cascade, is a good opportunity. The generated power from this project will meet the needs of both countries. Considering the current political unrest between Afghanistan and Pakistan, water cooperation could be an opportunity for greater regional stability. The spillover benefits into other areas could be significant".

2) The leaders of the two countries should express a shared commitment to dialogue and teamwork in solving–water-related problems and agree to collaborate on the transboundary waters. This intent should be demonstrated and updated when necessary, for instance, the annual sessions of the UN General Assembly or relevant high-level global conferences.

3) The JEC should be revived and it's meeting should be convened as early as possible to conclude discussions on the structure of the collaborative working group that was established during the Commission's ninth and tenth rounds to examine cooperation upon the Kunar hydropower project.

4) Both Nations need to consider the establishment of a joint commission tasked to address expanded teamwork regarding the transboundary waters.

5) Both countries should facilitate debates on the distributed waters by assigning the work to skilled and well-educated individuals. They should make thorough preparations, particularly ensuring the acquisition of accurate information and datasets on the water flowing from every stream of the basin. The negotiators should be provided with clear policy briefs, on which domestic consensus has already been forged. Broad support for the negotiations needs to be ensured during the interaction in Track 2, and there should be continuous contact between Track 1 and Track 2.

6) Climate change threats and rapidly growing populations necessitate urgent actions on the part of both Afghanistan and Pakistan about the conservation of water and regulating the extraction of groundwater, especially in urban areas.

7) The two neighbors, with many historical commonalities, should establish scientific collaboration on various aspects of the Kabul River system. The joint research data should enable the development of surface and groundwater models to be used by water managers in both countries to better predict droughts, floods, and other hazards, and improve water management decisions that impact millions of people (cf., Porter and Raulfs-Wang, 2017).

5.3. Role of the international community

1) The international community, friendly nations, UN agencies and organizations, international NGOs and networks, multilateral development finance organizations such as the World Bank, Asian Development Bank, the Asia Infrastructure Development Organization in China and the Islamic Development Bank may be requested to provide support to the negotiations between Afghanistan and Pakistan on the transboundary river waters.

2) The concern of Pakistan about the decrease in the KR water flow can be addressed by developing the provincial infrastructure optimizing it for water holding and improving water conservation and utilization efforts which may necessitate external assistance.

3) Promoting open talk about the advantages of collaborative leadership of shared tributaries and fostering contacts among relevant experts, civil engineers, and representatives of the community from the two countries.

4) Offering favorable financing and advice for water-based initiatives that promote collaboration throughout the region as opposed to projects that are developed individually; these projects must be carried out after engaging with co-riparian countries.

The policy brief compiled by Mr. Ashfaq Mahmood had recommended that collaboration on transboundary waters between the two countries should aim to achieve integrated water resource management (IWRM) based on the sharing of costs and benefits. He pointed out that: "Pakistan and Afghanistan show promising prospects for cooperation in constructing multipurpose dams, managing floods and droughts, improving efficiency, generating power and trading electricity, watersheds management, protecting water quality, jointly designing and operating infrastructure, and exchanging the knowledge''. The shared benefits identified by him include poverty alleviation, food security, employment creation, joint power generation and electricity trade, improved political relations, peace, and reduced military expenditure. He also emphasized that all stakeholders have to contribute to the efforts for an agreement between Afghanistan and Pakistan. His list of stakeholders includes the governments of the two countries, intelligence agencies, civil society, Think tanks, NGOs, academia, and politicians (personal communication).

Policy briefs prepared by one of us (SK), Mr. Ashfaq Mahmood, had, and presentations by other experts were discussed by non-official experts and representatives of the civil society from Afghanistan and Pakistan in discussions convened by LEAD Pakistan, the Pakistan branch of the International Water Management Institute (IWMI) in Almaty, Tashkent, and Dubai, during 2018-19. The Tashkent discussions were also joined by officials of the KP government, but they were understandably reluctant to say anything that could be misconstrued by the other participants. The exchanges of the aforementioned views promoted better understanding among the Afghan representatives concerning Pakistan's attitude toward Afghanistan, and a discernible readiness to discuss cooperation on shared waters. There has been no headway, however, in cooperation between Afghanistan and Pakistan concerning the KRB (see also, Ali, 2022).

6. Discussion

6.1. Significance of the Kabul River Basin

The KBR is a significant hydrological and geographical region spanning parts of NE Afghanistan and NW Pakistan. Snow melt from the Hindu Kush mountains during spring and summer is a main contributor to the three principal sources of water in the KBR, the Kabul, Kunar and Swat-Dir rivers. The KR is a fundamental provider of water for businesses, farms, and households use, in both countries. It supports extensive irrigation networks, crucial for agriculture and the growth of wheat, barley, maize, sugar cane, beat, local rice, and various fruits and vegetables

cultivation in KP. However, NW Pakistan also gets a substantial quantity of monsoon rain some of which ends up in the KR course in the Peshawar plain. The KR system also powers several hydroelectric plants located along the river and its branches, contributing to the energy supply in the region. Many hydroelectric plants and dams are located within the basin, of which the notable ones in Afghanistan include the Naghlu, Sarobi, and Darunta dams (Fig. 7). Several other multipurpose dams are planned. In Pakistan, the Warsak Dam and Malakand-Dargai projects are important.

The KRB is home to over 20 million people, with major urban centers like Kabul, Jalalabad, Peshawar, and Nowshera situated along the KR, and more along its tributaries, making the KR system vital for their water supply, sanitation and local economies. The KR has also been a cultural touchstone, inspiring local folklore, traditions, literature, poetry, music, handicrafts, and cuisines. It plays an important role in the daily lives of the people residing along its banks which have been tracked by travelers for thousands of years. The KRB, therefore, is a vital region with substantial natural resources, diverse ecosystems, and supporting millions of people. The management of its water resources is critical for the sustainable development of Afghanistan and Pakistan.

Unfortunately, however, the river system has recently been under severe multifaceted threats. The principal of these is climate change, resulting from global warming. The snowy reservoirs of Central Asia, including Afghanistan, may lose much of their water as a consequence of rapidly rising global temperatures. The detailed model of Fallah et al. (2024) suggests that Central Asia (CA) is most vulnerable to climate change; warming of 1.2°C has led to a decrease of 20% in snow depth, and an increase of 4°C by the end of the century is likely if no remedial action is taken. A profound impact on hydrological cycles and water resource management is feared, especially in the Amu Darya basin. Khan et al. (2023) used a tree-ring chronology of old-growth conifers from the Hindu Kush, a monsoon-shadow area, for a climate change study. They noted that droughts got shorter, more severe, more frequent, and interspersed with more frequent rains during the past century. Drought risks, compounded with projected flood intensification, pose significant threats to the transboundary KR. Shokory et al. (2023) reviewed 131 papers and reports on the changing hydrology of Afghanistan to synthesize implications for water resources. They conclude, that 1) temperature has risen between 0.6 and 1.8°C since 1950, 2) rising temperature would increase snow melting and reduce winter snow accumulation, with important implications for reduced summer streamflow and groundwater recharge, 3) surface area of glaciers reduced by 13.4% since 1990, 4) the total surface water volume has decreased, 5)

the glacier retreat means Afghanistan water resources are currently receiving a "glacial subsidy", masked by increasing ice melt, and 6) there is an urgent need to improve the quantification of current and future climate change-induced modifications of streamflow with hydrological models that can simulate streamflow contributions from glaciers.

Apart from the climate change impact, the KRB also faces issues of water scarcity due to over-extraction of the groundwater, lack of sufficient reservoirs, wastage of water used for domestic purposes, and inefficient irrigation practices. Climate change also poses threats through altered precipitation patterns, unpredictable weather conditions, and increased frequency of extreme weather events like floods and droughts. There are also severe impacts of various types connected to the rapidly growing population in the basin, from increasing water shortage to water and air pollution, food insecurity, growing poverty, healthcare and education. The issue of river pollution was discussed in some detail in section 1.2.1. Industrial effluent, untreated sewage, agricultural runoff and pesticide residues, and all sorts of solid waste contribute heavily to the pollution of the KR System, affecting water quality, ecosystem, and health of human beings as well as livestock, poultry, fish and birds.

6.2. Afghanistan–Pakistan tension over the use of KR waters

The Kabul River and its tributaries provide an important source of livelihood for some 25 million people living in the basin, and this population is expected to increase to 37 million by 2050. The situation is getting particularly precarious in the Kabul metropolitan area, which is the 5th most rapidly growing city in the world. An older study (reported in Amin and Adeh, 2017) estimated 123.4 million m3/year of water demand for Kabul city in 2015, and the groundwater potential of some 44 million m3/year is capable of covering only two (2) million inhabitants at a modest per capita consumption of 50 LCDP. The present groundwater extraction, estimated at over 120,000 m3/day, exceeds the average replenishment rate of 77,500 m3/day. This is unsustainable, as evident from the sharp declination of groundwater levels in Kabul city by an average of 1.5 m/year from 2008 – 2012 according to the US Geological Survey (Amin and Adeh, 2017).

Despite the potential of producing 23,000 MW of hydropower electricity, Afghanistan produces just 300 MW. Only 28% of Afghan households are connected to power supply systems. The country imports 75% of its power needs from regional countries. Improving its power and water infrastructure is a pre-requisite for the socioeconomic development of Afghanistan. Agriculture is the

backbone of the Afghan economy and improving its water and power infrastructures is imperative to jumpstart its slumped economy as well as improve internal stability. As foreign aid is diminishing, the Afghan government sees agriculture and its vast mineral deposits (worth $1 trillion) as long-term prospects for revitalizing a lagging economy. But the development of both these sectors essentially depends on reliable and sustainable water supply (Amin and Adeh, 2017).

The Afghan government lately claimed that the $236 million Shahtoot Dam on the KR would shortly begin building. The dam is planned to irrigate 4,000 hectares of the earth in the province's Charasiab region and retain 146 million cubic meters of drinkable water for the 2 million people who live in Kabul. The project is regarded as a component of Afghanistan's India-backed ambitious plans of building 12 dams in the Kabul River basin, a real concern for water-deficient lower riparian Pakistan. However, according to Majidyar (2018), the KR "is beyond a tool of coercive diplomacy against Pakistan. Nonetheless, Kabul must inevitably respect the rights of Pakistan as the lower riparian of the KR. A "win-win" solution, therefore, requires Afghanistan to ensure "equitable" and "reasonable" use of the river — under the framework of the 1997 UN Convention on Non-Navigational Uses of International Watercourses — to cause no harm to Pakistan. And, in response, Pakistan should contribute to the economic development of Afghanistan, especially by opening its trade and transit routes for the Afghan businesses". To these suggestions, the authors would like to add, 'joint investment in hydroelectric projects.

It is most unfortunate that in the presence of all these demanding issues adversely impacting sustainable development in the KRB, Afghanistan and Pakistan have been swamped by the KR water-sharing dispute. The conflict between the two neighbors over the shared waters of the KR primarily revolves around the issues of a) water allocation, usage, and management, b) infrastructure development, and c) installation of hydropower projects in the Afghanistan part of the KRB. As already mentioned, both countries depend heavily on the KR for their water needs, including agriculture, drinking water, and hydropower. Afghanistan, being the upstream country, has control over the KR's flow, which can impact the availability of water downstream. Afghanistan's efforts in harnessing the KR's potential through the construction of dams are viewed with skepticism and fear in Pakistan, where decreasing water supplies are becoming a major issue. Climate change has only exacerbated this predicament, further stressing an already strained relationship (Noor, 2024). Afghanistan plans to build several dams on the KR and its tributaries for the generation of hydroelectric power and the improvement of

irrigation. Execution of these projects could potentially affect the water flow and timing of water release downstream. The Afghanistan Waters Portal justifies these planned projects because the country a) "uses only 25% of surface water and less than 30% of groundwater resources available in the Kabul basin", and b) has limited capacity for water storage of 100-110 m^3/capita/year (among the lowest in the world), hydropower generation, and expansion of irrigated land and irrigation networks (Malyar, 2024). Afghanistan's announcement of the $236 million Shahtoot Dam project has sparked worry in Pakistan, notably in the KP. Pakistan is, thus, concerned that the new dams will jeopardize its water supply and scheduled availability for agricultural productivity, and other needs, including hydroelectricity.

Unlike the Indus Waters Treaty between India and Pakistan, there is no comprehensive agreement governing the management and use of the KR waters between Afghanistan and Pakistan. This absence of a formal treaty leads to uncertainties, confusion and disputes over water rights and usage. Effective transboundary cooperation on water management and water allocation between the two countries is crucial for economic sustainability and food security. There is an urgent need for an effective bilateral agreement in the form of a comprehensive water management treaty for peaceful coexistence, sustainable development and a fair share of the KR waters, more than half of which enters into Afghanistan from Chitral (Pakistan) via the Kunar River. There have been multiple attempts and efforts to initiate a meaningful dialogue on water-sharing (cf. sections 4.1., 4.2.), but these have often been overshadowed and stalled due to broader geopolitical issues and a lack of mutual trust. Occasionally, various international bodies and third-party mediators also tried to facilitate discussions, but with limited success. The ongoing and historical political tensions between the two countries complicate negotiations over the water-sharing agreements.

6.3. Suggestions for collaboration and signing of a Treaty for a win-win situation

6.3.1. The Treaty. If ever the two neighbors agree on signing a treaty, and we hope it is sooner than later for the benefit of both, the treaty should take into consideration:

1) Efforts to mitigate the impact of climate change on water resources. Addressing the impacts of global warming and climate change through joint initiatives and adopting water management strategies would be crucial.

2) The treaty should be formal and legally binding, to provide resource sustainability and a framework for resolving disputes. The agreement would

need to address issues of environmental protection, water allocation, dam construction, and mechanisms for conflict resolution,

3) Creating joint commissions to manage the KRB collaboratively, help both countries optimize water usage and address pollution concerns,

4) Regular data sharing, joint monitoring, and coordinated planning of infrastructure projects could enhance trust and cooperation, The presently available data is sketchy and needs updating (Shokofy et al., 2023).

5) Mediation by neutral third parties may help bridge the trust gap and reach mutually beneficial agreements. Hence, the involvement of international organizations, such as the World Bank, United Nations or Asian Development Bank, could facilitate negotiations and provide technical and/or financial support for sustainable water management practices,

6) For effective realization of benefits from the KRB, establishment of a joint institution, such as the Cross-border Basin Authority or Kabul River Basin Authority, for Afghanistan and Pakistan. Such an institution may consist of policy consultants and water experts for sharing of information, ongoing consultations and joint management of the water resources (cf., Moorthy and Bibi, 2023).

6.3.2. Water management-related policies. This paper cannot go into details of policy formulation. A very large quantity of information on this topic has been published and much is available on the internet. Both Pakistan and Afghanistan have their own policies on water. However, we would like to suggest that the policy document should be flexible enough to be revised periodically given new realities and climate change scenarios. Here we give some suggestions regarding water governance, matters of mutual interest, ground realities and changing climate scenarios which need to be addressed in the policies related to shared waters between Afghanistan and Pakistan.

1) To begin with, policies must emphasize compromises between ideal models, best practices and local realities, and include a variety of people, from farmers to local and ministry staff to be trained for the tasks. Capacity strengthening in water management/governance, and promoting innovation would enable both Afghanistan and Pakistan to not only adopt new technologies and approaches but also optimize water use and minimize its wastage and pollution. Capacity-building would also enhance resilience, improve decision-making and implementation of sustainable practices (Ahmad et al., 2023). Outputs of inclusivity would lead to a better understanding of the ground realities,

resulting in agreements on practical governance and management arrangements (Amin and Adeh, 2017). Promoting stakeholders, community and civil society organizations' engagement, transparency, and accountable and information-based decision-making processes would help effective implementation (for more detail, see Ahmad et al, 2023). This behavioral approach of participant involvement with all stakeholders can help gain wider acceptance of river water management decisions and strategies (Moorthy and Bibi, 2023).

2. Water conservation initiatives and water management aimed at reforestation, watershed management, and soil conservation (crucial for maintaining the basin's ecological balance), pollution control measures, promotion of environment-friendly and irrigation-efficient agricultural practices, and flood and rainwater harvesting, as we already stressed upon, are very important.

3. Devising policies that promote water conservation and use efficiency (especially in irrigation which is by far the biggest consumer of water), and monitoring unsustainable groundwater extraction methods (especially given the growing urbanization in KRB) would be an ideal framework for the two countries to pay attention to independently. The concerned ministries and organizations in the two countries would have to shoulder the responsibilities in these regards. According to Amin and Adeh (2017), water governance requires devolution and decentralization. A practical policy should reflect a good balance in decision-making authority between the government and water users.

4. Climate change, as earlier discussed, is going to have a profound impact on the availability of water, unpredictable weather, drought and floods (Fallah et al., 2024). Future water management needs to account for both flood and drought risks and be informed of climate change and long-term hydroclimatic variability (Khan et al., 2023).

5. According to Shokory et al. (2023), a) studies on patterns of glacier retreat in the Hindu Kush Mountain, and changing evapotranspiration and its role in hydrological models are urgently needed, and b) the new generation of climate change models would need updating over time, and should be bias-corrected with increasingly available in situ data.

In summary, the conflict over the KR waters is a complex issue rooted in both contemporary and historical geopolitical contexts and impacted by recent global warming, climate change and population boom. Resolving it requires sustained diplomatic efforts, assuring of confidence, the establishment of a comprehensive

framework (institute) for water-sharing, and a firm commitment to mutual benefits, collaborative management and environmental sustainability by both Pakistan and Afghanistan. The KRB conflict provides positive opportunities and highlights the critical necessity for discussion and cooperation for Afghanistan and Pakistan to collaborate on the KRB shortly (Malyar, 2024). The results of collaborative efforts in both head-stream and tail-stream nations can profit from a "pack of benefits" including, but not limited to, flood resistance, sedimentation reduction, the convenience of additional water in the basin, electricity production, and protection of ecosystems (Moorthy and Bibi, 2023). As water shortage worsens and geopolitical tensions rise, the stakes are never greater. Jamali et al. (2023) proposed the perspective of green water economy for the transboundary water conflict in the KRB, with focus on shared environmental benefits, and biodiversity and ecosystem services. "By adopting sustainable practices, prioritizing fair solutions, and encouraging regional collaboration, both countries can navigate the tumultuous waters of the Kabul River issue to a better, more stable future for everybody" (Noor, 2024).

7. Conclusion

1. The shared waters of the Kabul River have historically played a crucial role in the food security and welfare of the people of NE Afghanistan and NW Pakistan. Much of its water resource is derived from the melting of the Hindu Kush glaciers.
2. Both its upper and lower riparian countries, especially the Kabul River Basin, are passing through increasing shortages of fresh water.
3. The adverse effects of Global warming and climate change, and the demands of the rapidly growing population are going to lead to an imminent water crisis.
4. There is brewing tension between Afghanistan and Pakistan on sharing modalities of the waters of the Kabul River.
5. Owing to the uncertain situation in Afghanistan, non-acceptance by the international community of those governing it, and lack of trust between Afghanistan and Pakistan, progress has not been made on the subject of cooperation between the two countries on transboundary waters of the Kabul River.
6. In this paper, we have emphasized the need for negotiations to agree on an urgent accord on the shared waters of the Kabul River. It is hoped that this paper will contribute to the quest for cooperation between the two fraternal

countries on the most important issue concerning the welfare of their population.

7. A beginning can be made by the leaders of the two countries to express their resolve to cooperate in the optimal development of the assets of the KRB shared by them.

8. A working and robust treaty would be in the interest of both countries for the mutual benefit of their people. It would promote agriculture (hence food security), energy production, mutual trade, harmony, peace and security.

Acknowledgment. We would like to thank Mr. Ashfaq Mahmood and other colleagues for their collaboration and suggestions on earlier papers by SK. We are also very thankful for the critical reading of the manuscript and other support provided by Dr. Benazeer Iqbal and Dr. M. Shafique of the NCE Geology, University of Peshawar. MQ Jan would like to thank the Pakistan Academy of Sciences and Chinese Academy of Sciences for research grants (PAS RG103, and CAS PIFI Grant No. 2023VEA0010) for studies in northern Pakistan.

References

Ahmad, S., Haifeng Jia, Ashraf, A., Dingkun Yin, Zhengxia Chen, Changqing Xu, Wang Chenyang, Qimeng Jia, Zhang Xiaoyue, Israr, M., Ahmed, R., 2023. Water resources and their management in Pakistan: A critical analysis on challenges and implications. Water-Energy Nexus, 6, 137–150. https://doi.org/10.1016/j.wen.2023.10.001

Ali, F., 2022. Decades on, Pakistan is still Seeking a Kabul River Agreement. The Third Pole. Available online: https://www.thethirdpole.net/en/regional-cooperation/decades-on-pakistan-still-seeking-kabul-river-agreement%EF%BF%BC/

Ali, F., 2024. Dirty, depleted Kabul River a risk to millions in Afghanistan, Pakistan**.** Dialogue Earth, Newsletter May 9, 2022.

Amin, M. and Adeh, E.H., 2017 (August 22). Water Crisis in Kabul Could Be Severe If Not Addressed. The SAID Review of International Affairs (Retrieved 2024).

Ariana News, 2023 (April 4). Afghanistan's water reserves have dropped to 69 billion cubic meters.

Fallah, B., Didovets, L., Rostami, M., Hamidi, M., 2024. Climate change impacts on Central Asia: Trends, extremes and future projections. International Journal of Climatology, 1–23. DOI: 10.1002/joc.8519

Jabeen, A., Huang, X., Aamir, M., 2015. The challenges of water pollution, threat to public health, flaws of water laws and policies in Pakistan. J. Water Resour. Prot., 7 (17), p. 1516. 10.4236/jwarp.2015.717125

Jamali, H., Rafiq, M., Hayat, S., An ecosystem valuation for enhanced transboundary water cooperation in the Kabul River Basin, *The Pakistan Development Review,* 62 (4), 521–537

Jan, M.Q., Kakakhel, S., Batool, S., Muazim, K., Chata, I.A., 2017. Global warming: Evidence,Causes, Consequences and Mitigation. J. Development Policy, Res. & Practice, 1, 61–81.

Kakakhel, S. and Mahmood, A., Papers written for LEAD Pakistan. [This paper draws considerably from the papers written by these authors. Regrettably, neither paper was accessed because of the closing down of LEAD Pakistan and its website].

Khan, N., Hung, T., Nguyen, T., Galelli, S., Cherubini, P., 2022. Increasing drought risks over the past four centuries amidst projected flood intensification in the Kabul River Basin (Afghanistan and Pakistan) –Evidence from tree rings. Geophysical Res. Letters, 49(24). https://doi.org/10.1029/2022GL100703

Lawrence, J.P., Babakarkhail, Z., (downloaded September 12, 2020). Sewage from US Embassy, NATO headquarters dumped into Kabul River due to aging infrastructure. (*Stars and Stripes*, Retrieved 2024).

Mack, T.J., Akbari, M.A., Ashoor, M,H., Chornack, M.P., 2016. Conceptual model of water resources in the Kabul Basin, Afghanistan. USGS, 2012, Last modified 22-9-2016. https://drive.google.com/file/d/0B1YNkm7TH0_PSXhfTGZ5czh2NGs/view?usp=sharig

Majidyar, W., 2018 (Dec. 15). Afghanistan and Pakistan's Looming Water Conflict. (Retrieved 2024). https//the diplomat.com

Malyar, I., 2024. A review of current and possible future relations in Kabul River Basin. Afghanistan Water Portal (retrieved 7 August 2024).

Matheswaran, K., Akhtar, T. 2023. Land and water use. In: Afghanistan-Pakistan shared saters: State of the Basins. Chapter 7, pp. 99–119. CABI Digital Library. http://doi.org/10.1079/9781800622371

Moorthy, R., Bibi, S., 2023. Water Security and Cross-Border Water Management in the Kabul River Basin. Sustainability, *15*(1), 792; https://doi.org/10.3390/su15010792

Nasir, A., Nasir, M.S., Nasir, I., Shauket, S., Anwar, I., Ayub, 2016. Impact of Samanduri drain on water resources of Faisalabad. Adv. Environ. Biol., 10 (1), 155-160.

Noor, S., 2024. Navigating the Kabul River Dispute for Regional Stability. Policy Watcher - Tracking Policies, Empowering Change

Porter, J., Raulfs-Wang, C. 2017, Oct, 11. A River Runs Through It: Scientific Border Tales from Afghanistan and Pakistan. Informing humanitarians worldwide 24/7 — a service provided by UN OCHA

Rehman, S.S., Sabi, M.A., Khan, I., 1997. Discharge characteristics and sediment load from rivers of northern Indus Basin. Geol. Bull. Univ. Peshawar, 30, 325-336.

Shah, M.A.A., Lautze, J., Meelad, A., (Eds). 2013. Introduction. In: Afghanistan-Pakistan shared waters: State of the Basins. pp. 1–8. CABI Digital Library. http://doi.org/10.1079/9781800622371.0001

Shokory, J.A.N., Schaefli, B., Lane, S.N., 2023. Water resources of Afghanistan and related hazards under rapid climate warning. Hydrological Sci. J., 68(3), 507-525. https://doi.org/10.1080/02626667.2022.2159411

Sidiqi, M., Shrestha, S., Ninsawat, S., 2018. Profile of climate change scenarios in the Kabul River basin. Current Sci., 114(06), 1304. DOI: 10.18520/cs/v114/i06/1304-1310

Wikipedia, 2024, August 5. Water supply and sanitation in Pakistan.

Wilde, A. 2012. “KABUL RIVER,” Encyclopaedia Iranica, XV/3, 322-324. http://www.iranicaonline.org/articles/kabul-river (accessed on 30 December 2012)

World Bank, 1960. The Indus Waters Treaty 1960 between the Government of India, The Government of Pakistan and the International Bank for Reconstruction and Development. Signed at Karachi, on 19 September 1960, UN Treaty Series No. 6032, 1962.

Additional References for interested readers on Kabul River shared waters.

In the following are listed some notable publications and documents received from CthatGPT which provide information, in-depth analysis and insights into the conflict between Pakistan and Afghanistan over the transboundary shared waters of the Kabul River System. These should provide a thorough understanding of the complexities surrounding the Kabul River water conflict and offer insights into potential pathways for resolution and cooperation between the two neighboring countries with historic ties.

1. "Transboundary Water Management between Afghanistan and Pakistan: Prospects for Cooperation" by the Stockholm International Water Institute (SIWI): (This report explores the potential for transboundary water cooperation between Afghanistan and Pakistan, highlighting the challenges and opportunities in managing the shared waters of the Kabul River)
2. "Hydropolitics in the Kabul River Basin: A Historical and Political Perspective" by the United States Institute of Peace (USIP) (This publication delves into the historical and political dimensions of water conflicts in the Kabul River Basin, providing a comprehensive overview of the issues and potential solutions.)
3. "Water Resource Conflicts in South Asia: Managing Water Scarcity and Regional Stability" edited by Major General (Retd) Vinod Saighal: (This book includes a chapter on the Kabul River Basin, discussing the broader context of water resource conflicts in South Asia and the specific challenges faced by Afghanistan and Pakistan.)
4. "Water Management in Afghanistan: The Issues and Challenges" by The World Bank: (While focusing on Afghanistan's water management issues, this report also touches upon the transboundary water concerns with Pakistan, including the Kabul River.)
5. "Environmental Peacebuilding and Shared Waters: Lessons from the Kabul River Basin" by the International Union for Conservation of Nature (IUCN): (This document explores how environmental peacebuilding initiatives can address the water conflict between Afghanistan and Pakistan, offering case studies and practical recommendations.)
6. "The Kabul River Basin: Water Resources and Challenges" by the Asian Development Bank (ADB): (This comprehensive report provides detailed information on the water resources of the Kabul River Basin, including the challenges of shared water management between Afghanistan and Pakistan.)
7. "Water Conflict Management and Cooperation between Afghanistan and Pakistan" by the Afghanistan Research and Evaluation Unit (AREU): (This research paper

examines the conflict over shared waters, focusing on the management and cooperation strategies that can be employed to resolve disputes.)

8. "Transboundary Water Conflicts in South Asia: The Way Forward" by the Observer Research Foundation (ORF): (This publication discusses various transboundary water conflicts in South Asia, including the Kabul River, and suggests policy measures and frameworks for conflict resolution and cooperation.)