



Pathways to water conflict transformation: Comparing North Crimea Canal and Kabul River Basin

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ABSTRACT

This study explores pathways to transformation through a focus on water relations among states, examining the intersection of water resources management, political conflicts, and historical grievances: (1) Ukraine and Russia regarding North Crimea Canal; and (2) Afghanistan and Pakistan in Kabul River Basin. Using these cases to support water conflict prevention, this study explores water interactions (disputes, arrangements, and agreements) from the time of respective sovereign statehoods: Afghanistan (1919), Pakistan (1947), and Ukraine and Russia (1991) through to 2022. The design of this study incorporates the Transboundary Waters Interaction Nexus (TWINS) framework to assess past water interactions; with the Four Stages of Water Conflict Transformation framework, used to assess 2022 state-level relations to determine collaborative skills to cultivate water transformation. Findings indicate that while Ukraine-Russia water relations are adversarial, and Afghanistan-Pakistan are in the reflective negotiation stage—territorial disputes and political economic dynamics hamper cooperation, though points of leverage (such as neutral third-party mediation, shared environmental and economic interests, and water diplomacy and legal frameworks) exist. This research provides value through broadening preventative and transformative strategies in politically sensitive and geopolitically unstable regions—showing that water can be a catalyst for equity and regional securitization.

ARTICLE HISTORY

Received: February 18, 2025

Accepted: June 19, 2025

Published: June 26, 2025

KEYWORDS

water conflict transformation,
water cooperation,
transboundary basins, North
Crimea Canal, Kabul River
Basin

1. Introduction

Three hundred and thirteen (313) river basins are shared by two or more states covering almost half of the Earth's land surface. These transboundary basins are inhabited by 52% of the world's population (TFDD, 2025a; Turgul et al., 2024). With increasing water demands, climate change, and deteriorating ecosystems—managing transboundary waters provides opportunities and challenges, especially considering there is a point at which water resources management fails to meet socioecological needs, impacting quality of life and heightening tensions. In search of transformative opportunities, this paper examines transboundary water interactions between contentious states. To this end, the research questions this paper addresses are: (1) How have transboundary water interactions between Ukraine and Russia regarding the North Crimea Canal (NCC), and Afghanistan and Pakistan in the Kabul River Basin (KRB), developed from sovereign statehood into 2022, with independence marked in 1919, 1947, and 1991 for Afghanistan, Pakistan, and Ukraine and Russia, respectively; (2) Do any of these past interactions provide any insight or points of leverage towards advancing conflict transformation?

This study informs the dynamics of countries sharing waters (transboundary waters), and what needs to happen to transform conflicts. Here, water conflict transformation is defined as efficient, effective, and sustainable water management, taking into consideration the political aspects of parties (Delli Priscoli & Wolf, 2009). Past water interactions are assessed through the lens of the Transboundary Waters Interaction Nexus framework to give precedence and political context. For recent perspectives and future trajectories, present water claims, and negotiation stages are assessed based on the Four Stages of Water Conflict Transformation framework to determine collaborative skills that would be needed to approach a more constructive outcome - towards greater equity and harmony. These frameworks are applied to two case studies, NCC and KRB.

The Ukraine-Russia and Afghanistan-Pakistan case studies were picked because of their commonalities—both are in politically sensitive and geopolitically unstable regions with complex water dynamics among neighboring countries; are deeply rooted in historical territorial disputes; and are of significant relevance, particularly in light of current regional and global events. Both case studies sit at the intersection of water resources management, political conflicts, and historical grievances making these cases highly appropriate for this comparative analysis of how water disputes can be shaped by different political contexts. In this respect, the findings may assist with broadening preventative and transformative strategies in regions prone to political volatility and geopolitical conflicts.

These case studies are assessed from the time when significant political and social changes occurred, marking sovereign statehood and independence that shaped the modern era—capturing Ukraine’s independence from the USSR in 1991, and Afghanistan’s early reforms after its independence in 1919, coupled with the creation of Pakistan in 1947. The scope of this study was defined by project timeframes, which covered research up to 2022, making it a natural stopping point.

This study begins with a description of the frameworks, followed by its application to the case studies. The results are presented followed by reflections and conclusions.

2. Methods

Transformation in the context of water conflicts is about raising consciousness through relationships, which not only explores the interconnectivity and boundaries of the relationship as a system but also analyzes the outward appearance of the conflict (de Silva & Maser, 2022). In this regard, transformational processes help build a foundation to strengthen relationships through time that go beyond the immediate issue. This case study uses the Transboundary Waters Interaction Nexus (TWINs) framework and the Four Stages of Water Conflict Transformation (Four Stages) framework in tandem to analyze water events in the NCC and KRB. The water events analyzed in this study are drawn from several sources referenced in this paper. These include the Transboundary Freshwater Diplomacy Database (2022a, 2022b, 2022c), which contains information on treaties, water interactions, and river basin organizations (RBOs); documented interactions from Atef et al. (2019); and news reports from 2021 and 2022 (Schaeffer, 2022; Altingoz & Ali, 2022).

The TWINs and Four Stages frameworks are specifically designed for analyzing transboundary water interactions and to illuminate state-level water governance arrangements. Many of the water decisions, treaties, transactions made by countries inform not only transboundary relations but also regional and local operations (such as hydroelectric power access and flood mitigation plans). So, looking through the lens of these water frameworks at state-level operations can provide insight and transformational opportunities (Zeitoun et al., 2020). Among the perceived strengths of this approach is the in-depth look at water interaction among states. The Four Stages framework lays out current water dynamics; and practical, realistic actions to opportunities for constructive change. Some of the weaknesses of only using the TWINs and Four Stages methods include that these approaches provide only a preliminary assessment. When this approach is blended with for example political ecology perspectives, analysis is strengthened through critical economic and political analysis of socioecological realities. Also, this transformational analysis is not a

panacea, “in the sense that anticipated changes will occur and that transformation targets those intended”—there are no guarantees (Zeitoun, 2020, p. 153).

2.1 The Transboundary Waters Interaction Nexus (TWINs) framework

The TWINs framework suggests that (1) cooperation and conflict coexist, and that a deeper insight and understanding can be gained by considering them together in terms of interaction, and (2) transboundary water interaction is associated with political process. The TWINs framework maps the transboundary water interaction on the cooperation and conflict intensity axes (see Figure 1).

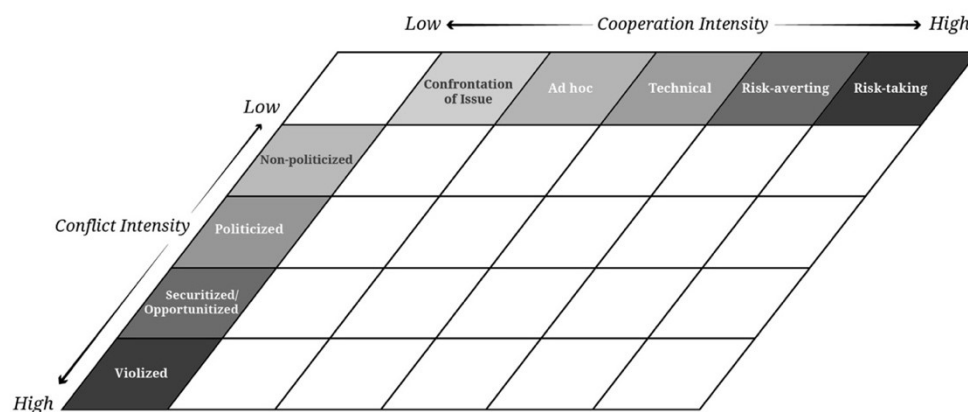


Figure 1. A TWINs matrix of conflict and cooperation (Zeitoun & Mirumachi, 2008).

Along a vertical axis from low to high conflictive interactions, ‘non-politicized’ is categorized as a discreet issue that has not risen to the level of public or government interests; ‘politicized’ is an issue that is of state concern requiring government involvement and resource distribution; ‘securitized/opportunitized’ is an issue that is viewed as a risk or prospect, demanding urgent action beyond political processes; and ‘violized’ are violent actions over an issue. Likewise, on the horizontal axis from low to high cooperative interactions, ‘confrontation of issue’ refers to parties recognizing the issue but lacking mutual objectives and coordinated activities; ‘ad hoc’ means coordinated activity among parties with no mutual objectives; ‘technical’ implies that parties have mutual objectives, but no coordinated activity is taken; ‘risk-averting’ is categorized as parties having mutual objectives and coordinate activities, but do not fund unanticipated future expenditures; and ‘risk-taking’ means parties have mutual objectives, coordinated activities and joint arrangements. This classification is a modified and adapted description of the works of Mirumachi (2015); Zeitoun and Mirumachi (2008); and Mirumachi and Allan (2007).

Applied to NCC and KRB, the TWINs framework offers a rigorous and pragmatic approach to unpacking the degree of intensity of conflict and cooperation, spatially and temporally between countries over subnational and international water issues. Through plotting hydropolitical interactions (such as joint projects, water disputes, and establishment of treaties) between stakeholders across levels of cooperation and conflict intensity, analysts of transboundary water politics can: (1) help remove value judgments, “particularly about any admixture of conflict and cooperation being ‘good’ or ‘bad’” (Zeitoun et al., 2020, p. 89); (2) question the political context that allows differing intensities of conflict and cooperation to coexist; and (3) gain insight into what can be learned from past experiences about the root of conflicts and paths to peace (Zeitoun & Mirumachi, 2008).

To plot a hydropolitical interaction using the TWINs framework, first identify a water event between nations; as an example, consider the signing of the Indus Water Treaty, in 1960 (TFDD, 2022a), between India and Pakistan, or another noteworthy international water-sharing agreement. For the chosen agreement, review the TWINs conflictive and cooperative interactions to determine which descriptors best describe the ‘water agreement.’ For instance, if a water agreement meets the description of an issue that ‘is of state concern requiring government involvement and resource distribution’, then this example would be classified as a politicized, conflict intensity. Note, this same water agreement, might meet the description in which ‘parties have mutual objectives, coordinated activities and joint arrangements’, which classifies this description, as risk-taking, on the scale of cooperative intensity. These coordinates are plotted as one point on Figure 1, politicized on the conflict intensity axis and risk-taking on the cooperative intensity axis. All other relevant events would follow this same method of plotting hydropolitical interactions between the same parties before, during and after the water agreement in 1960. This would result in a collection of points on Figure 1. Chronologically, a line would join point-to-point, displaying hydropolitical interactions over time.

2.2 Four stages of water conflict transformation framework

The Four Stages of Water Conflict Transformation (Four Stages) framework draws on the works of Jay Rothman (1989, 1995, 1997), Kaufman (2002), and Wolf (1999). In Table I, this framework categorizes the stages of negotiation as follows: (1) Adversarial stage in which stakeholders display antagonistic engagement. Stakeholders refuse to listen to each other, framing the rhetoric by claims to authority, supremacy, and geographic location. Past events inhibit constructive interactions and give way to legal authority. Often, the outcome is a zero-sum game emphasizing one party’s interests rather than gaining mutual understanding. Recommendations at this stage emphasize building trust and listening; (2) Reflexive stage where stakeholders shift

from the antagonistic interaction and start engaging in nonjudgmental listening. This stage is dedicated to skills-building to gain an enhanced perspective of one another's interests and needs; (3) Integrative stage is when stakeholders' water claims focus on benefits and working together. This stage is dedicated to building consensus, stimulating creative thinking and establishing stronger bonds for a more compassionate future with mutual values of sharing knowledge, ideas, resources, and water; and (4) Action stage is about implementation and joint gains through building capacity for dividends that extend beyond the negotiated resource, broadening economic corridors across regions and political borders (Delli Priscoli & Wolf, 2009, Chapter 6).

Table I. Four Stages of Water Conflict Transformation. This table is modified from Figure 6.1 in Jerome Delli Priscoli and Aaron T. Wolf (2009).

Negotiation Stage	Common Water Claims	Collaborative Skills	Geographic Scope
Adversarial	Rights	Trust-building	Nations
Reflexive	Needs	Skills-building	Watersheds
Integrative	Benefits	Consensus-building	"Benefit-sheds"
Action	Equity	Capacity-building	Region

The Four Stages framework is an effective approach to address a wide array of water resources management concerns at the national, state, and local levels (de Silva & Maser, 2022). This tool not only divides negotiation processes into phases, but also identifies skillsets needed to move through each stage of the conflict. The stages do not necessarily have to operate sequentially, more than one can occur simultaneously. The application of this framework uses reports, articles, news releases, and open-source data as units of analysis.

To determine which stage in the Four Stages framework, two stakeholders (nations) might be in, the first step is to clearly describe the current water claim (rights, needs, benefits or equity) and the levels of engagement between parties (dialog and exchange). For example, consider a water agreement that can be described as incorporating a shared understanding of each party's needs, along with sharing water data and knowledge, that incorporates a plan for regional prosperity beyond a single nation. Using this example, determine which of the four descriptors for the negotiation stages, best characterizes this water interaction. For this example, of the four stages, integrative seems to best fit, because there is mutual respect and consideration among parties that go beyond their own interests, though no specific benefits may have been actualized, yet. Recognizing the negotiation stage as integrative, one then would read collaborative skills for that stage of the negotiation process, which emphasizes consensus-building. The next step would then

be for the parties to explore consensus-building approaches that seem applicable to their collective needs.

With the two frameworks introduced, the case studies follow. The NCC is presented first, followed by the KRB study, both sections open with an introduction to give geographic context.

3. Case study: North Crimea Canal

The NCC is a human-made waterway designed to address freshwater needs across the Crimea Peninsula. The water source of the NCC is the Dnieper River (Figure 2), internationally shared by Ukraine, Russia, and Belarus known as Dnipro, Dnepr and Dnyapro, respectively in each country. The headwaters of the river are located in the Valdai Hills, central Russia and its mouth is Dnieper Delta, in Ukraine at the Black Sea. This river is regarded as the fourth longest river in Europe (Domanitsky & Micklin, 2025). Within the Dnieper Basin, 19.5% of the water catchment area is within Russia (99,685 km²), 23.2% within Belarus (118,703 km²), and 57.3% within Ukraine (292,995 km²; TFDD, 2025b). The Dnieper River system has an extensive network of tributaries, draining an area of 511,383 km² (TFDD, 2025b).



Figure 2. Map of the North Crimea Canal. (Transboundary Freshwater Diplomacy Database, 2023)

During the post-World War II era, when the whole basin was part of the Soviet Union, freshwater supplies could not meet the growing demands of this arid region with relatively low precipitation, so the NCC was constructed (Arnfield, 2025). The

needs included water to address regional population growth, tourism, and industry, in particular agricultural development (Kayukova & Yurovsky, 2018). This engineering feat is the longest and most complex of its kind in Europe, comprised of a series of dams, locks, reservoirs, and pumping stations that transports freshwater from the Dnieper River at the city of Tavriysk, Ukraine, to the far reaches of eastern Crimea. The length of the main channel exceeds 402 km, and the total length of all pipelines and branches is 11,000 km (Vynogradova, 2020). The canal's depth extends to 7 m, and the maximum width of the full NCC extends to 150 m (Tymchenko, 2014). When operating at full capacity, it produces up to 380 m³/s of freshwater, enough to supply over 2 million people and irrigate 4,000 km² of farmland (Kayukova & Yurovsky, 2018).

The intermountain reservoir supplied 50 million m³ of water to the Crimea cities of Simferopol and Sevastopol; while Feodosiya, Leninskoye, Zelenoyarskoye, and Kerch reservoirs supply water to Kerch, Feodosiya, and Sudak (Kayukova & Yurovsky, 2018). In addition, the canal facilitated the development of rice production in Crimea; as well as new sectors that include fish farming, orchards, and vineyards. As a result of hydraulic engineering, new urban-style villages arose, and rural population grew.

The territory of Crimea has been recognized as a strategic strong hold to the Black Sea and the Mediterranean region as early as 1783 for the Russian Empire, when the Russian Empire seized Crimea from the Ottoman Empire (Popovici, 2018). However, in the most recent geopolitical history, after World War I, in 1922, Ukraine became part of the Union of Soviet Socialist Republics. Then in 1954, the Soviet government transferred Crimea from the Russian Soviet Federative Socialist Republic to the Ukrainian Soviet Socialist Republic, a move that would later influence post-Soviet territorial claims, leading to annexation of Crimea by Russia in 2014 (Kravchenko, 2014). The official decision to build the NCC was made by the USSR leadership in 1950, with construction beginning in 1961, and its completion in 1971. Following the USSR collapse in 1991, Ukraine became independent with Crimea as part of its territory. By 2013, the NCC provided 85% of the peninsula's water (Altingoz & Ali, 2022).

Here, it should be noted that in the case of NCC, while the Dnieper River is an international watercourse shared by Russia, Ukraine, and Belarus; the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses (UN Convention) does not regard canals as natural systems because canals are man-made. Furthermore, the NCC is a conduit for water flowing beyond the Dnieper River Basin boundary, though not beyond Ukrainian jurisdiction. As such, the NCC is not regarded as an international or transboundary watercourse (A. T. Wolf, personal communication, November 14, 2022). Despite this case study not fitting the strict definition of a transboundary watercourse, the authors believe there is merit

in applying the TWINs framework to the NCC case study because: (1) this unique waterway still requires regional water sharing, (2) the NCC is a bone of ‘water’ contention, especially in light of the annexation of Crimea, which is proclaimed by Russia as its territory¹, de facto making it a pseudo-international canal and (3) the TWINs framework still provides a systematic way of looking at past water interactions.

Given the waterway dynamics, water management and the political history of the region, the following section will examine water interactions among these states. Through this assessment, mechanisms for transforming conflict into cooperation will be explored.

3.1 Results and analysis

The TWINs and the Four Stages frameworks, as applied to the NCC case study, are presented and described. The dynamics of the Ukraine-Russia water conflicts and the potential for cooperation are assessed.

3.1.1 Application of TWINs framework

From a general perspective, Figure 3 shows how the interaction between Russia and Ukraine over water resources changed over time—from stable relations during 1971-2004, due in part to both being union republics within the USSR until 1991, with cooperation continuing into the early post-Soviet years—to unstable relations during 2014-2022. The dynamics moved from high cooperation-low conflict to low cooperation-high conflict. This later period of instability further intensified existing tensions. The following section discusses this in greater detail.

In Figure 3, the line represents unilateral decisions made by the USSR (when Ukraine was part of the union), and the dashed lines represent interactions between Russia and Ukraine. Note that construction of the NCC in the 1960s was a USSR decision since Ukraine was part of the Soviet Union at the time. This project-related action might be categorized on the TWINs intensity scales as having low conflict (non-politicized) and relatively high cooperation (risk-averting)—interpreted as meaning that regional subgroups in Ukraine are participating in joint action to build the NCC with the national government that shared goals but are unwilling to commit to future plans.

The application of the TWINs framework shows that conflict intensity over the NCC increased from a discreet issue (non-politicized) in 1971 when it was constructed, to politicized in 1991 when USSR collapsed. Cooperation intensity at the same time decreased to mutual objectives (technical) from coordinate activities (risk-averting). The independence of Ukraine in 1991 meant that resources that were once part of

¹ Recognizing the strategic importance of Crimea, Russia annexed the region from Ukraine in March 2014, claiming it as its own territory. This move came after protests in Ukraine, when President Viktor Yanukovich refused to sign an agreement to strengthen ties with the European Union, amid growing public frustration with institutional corruption (Harding & O’Keefe, 2022; OSF, 2019).

the Soviet Union were now the resources of Ukraine, increasing the conflict intensity (politicized); with cooperative interactions (technical) in which Russia and Ukraine participated in some joint water action, such as water quality issues on the Dnieper River with other states.

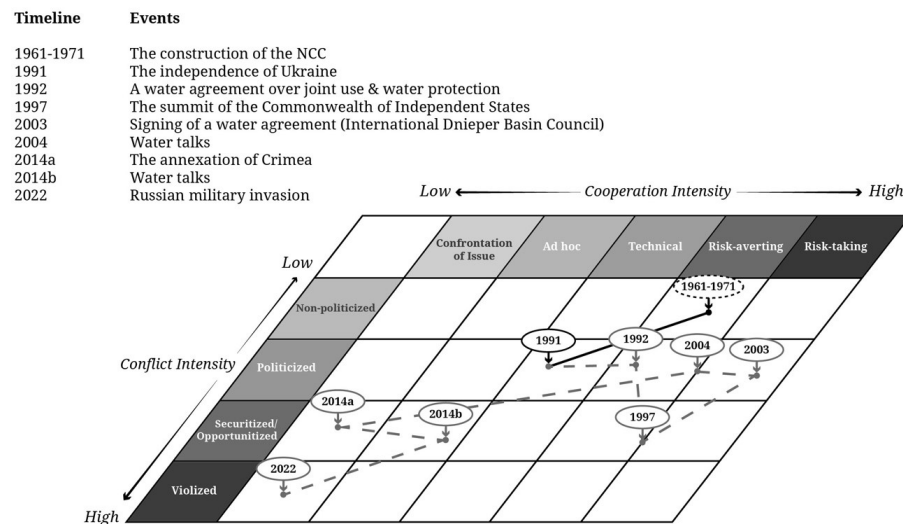


Figure 3. The TWINS Matrix of conflict and cooperation, applied to hydropolitical interactions between Russia and Ukraine regarding the North Crimea Canal.

Water quality issues were part of 1992, 1997, 2003, and 2004 water engagements—all of which are deemed as low conflict-high cooperation intensity events (see Figure 3). For example, one of the earliest agreements was the 1992 water quality treaty between Russia and Ukraine over the joint use and protection of transboundary waters (TFDD, 2022a). Another was the 1997 summit of the Commonwealth of Independent States (CIS) involving 12 nations including Russia and Ukraine to discuss joint management of the Dnieper River Basin involving water quality, ecological, and environment protection (TFDD, 2022b). This constructive encounter is seen as setting the stage for the 2003 establishment of a River Based Organization (RBO), the International Dnieper Basin Council (TFDD, 2022c). In 2003, environment ministers, signed a tripartite statement on the environmental rehabilitation of the basin of the Dnieper River—featuring joint activity with shared goals, seen as high cooperation (risk-taking), implying that states have set-aside resources for cooperative engagement. And in 2004, Russia, Belarus and Ukraine met to “discuss interregional environment and education cooperation” to protect an adjacent basin that drains to the Sea of Azov (TFDD, 2022b).

In late 2013, Ukrainian citizens started the 'European movement' protests as a reaction to institutional corruption and then Ukrainian President Viktor Yanukovich's refused to sign an agreement to align Ukraine with the European Union (Harding & O'Keefe, 2022; OSF, 2019). In February 2014, Russia invaded Crimea to "strengthen its sway over the new government in Kyiv" (Konończuk, 2014); and in April of the same year, the Donbas region of Ukraine was occupied by pro-Russian rebels (The Economist, 2015). This was followed on May 25, 2014, with Ukrainians electing a new President, Petro Poroshenko (OSF, 2019).

The military invasion by Russia in Ukraine in 2014, particularly the annexation of Crimea demonstrates intensifying conflictive interactions (securitized/opportunitized). This act of crisis places the relations on the TWINs cooperation intensity scale among its lowest (confrontation of issue; see Figure 3, labeled 2014a). In this mode, no joint action takes place, and there are no shared goals. A prime example of this is Ukraine blocking water to the Crimea through the NCC, regarded by some as an act of weaponizing water (Landay, 2022; Zimmermann, 2022). In the same year, there were talks between Russia and Ukraine regarding the purchasing of water from Ukraine for Crimea, these talks failed. During this same timeframe, Russia extracted groundwater in northern Crimea to address the needs of Russian settlers and their water demands (Bal, 2021). These activities are high conflict interactions (securitized/opportunitized) with low cooperative involvement (ad hoc) since countries are engaging but do not share the same mission and the activities are seen as benefiting Russia while threatening Ukraine (see Figure 3, labeled 2014b). And with Russia's full-scale military invasion of Ukraine in 2022, Russia gained control over the NCC, with both countries at war the interactions are at its highest conflictive intensity with violent acts, bombings and destruction of water infrastructure.

3.1.2 Application of Four Stages framework

To discern current water relations, the Four Stages framework is applied to the events of 2022. This places the actions between Russia and Ukraine over the management of the NCC in the adversarial negotiation stage (Table I), in which Russia is asserting both land and water claims. The geographic scope of this conflict is at the national/regional scale (Russia invading and bombing Ukraine), spilling into the international sphere (worldwide instability). To move towards more constructive outcomes requires the parties to 'want' to shift to another negotiation stage. Once war has stopped, the collaborative skills-building needed is trust-building and opening a constructive dialog (see Table I).

3.2 Synthesis and reflections

Generally, when unilateral decisions are made on international waterways, water quality and quantity are jeopardized, ecosystems are degraded, regions are

destabilized, and lives can be lost (Pohl et al., 2017). Such degradation continues until a flash point occurs that can bring about one of two approaches. One, a direct path to resolution because of the balancing of power. The other is the ongoing conflict where the imbalance perpetuates the conflict, until parties are ready to move towards conflict resolution. The silver lining is that ultimately all roads lead to conflict mitigation (Delli Priscoli & Wolf, 2009, Figure 2.3).

Either resolution happens directly, which in the case of Russia and Ukraine means that both parties come to the negotiation table and begin a dialog while finding avenues to build trust. Otherwise, Russia and Ukraine continue on their current trajectory until both parties are incentivized at some later date to resolve their differences. There is precedence for this latter approach. Delli Priscoli and Wolf (2009) cite water agreements brokered between India and Pakistan that resulted in the Indus Treaty taking 10 years to sign, Bangladesh and India concerning the Ganges River taking 30 years, and Israel and Jordan in the case of the Jordan River taking 40 years. The lesson is that resolution can take decades.

In answer to the research question of how have transboundary water interactions between Ukraine and Russia regarding the NCC, developed from the time of Ukraine's statehood (1991) into 2022—the TWINs framework confirms a spiraling trajectory with both countries engaging in full-scale war and explosive interactions. The Four Stages framework categorizes the relationship as adversarial, and very stuck in historical and lived narratives—in which all aspects of the structural, relational, and cultural connections need work. Regarding the question as to whether past interactions provide any insight or points of leverage towards advancing conflict transformation, balancing power and addressing common concerns seem critical. What is required is power symmetry through a neutral broker, facilitating constructive talks and engagement towards low conflict-high cooperative interactions (mutual objectives, coordinated activities and joint arrangements).

Through the TWINs framework, Ukraine and Russia for the 2014-2022 timeframe, fell in the 'unstable relations' quadrant. Mirumachi and Allan (2007, p. 11) state that such relations involve coercive power that is, “most easily observed at higher levels of conflict. This is because material power such as military force is used,” and that adaptation can be possible through strengthening political economy. This requires an economy that is robust and diverse to balance asymmetric dynamics. Such shifting of influence helps with transforming international relations, especially regarding water. Furthermore, joint threats, like climate change issues can result in adversaries working together. Such challenges can galvanize adversaries to address common concerns and possibly improve securitization (Zeitoun et al., 2020). Consider for example the unprecedented military destruction of Ukraine; when Russo-Ukrainian peace talks eventually resume, joint opportunities exist to revitalize the ecosystem, increase biodiversity, build new infrastructure, and restore water quality.

4. Case study: Kabul River Basin²

The Kabul River originates from the Hindu Kush, the central mountain range of Afghanistan, from there it flows a total length of 700 km to meet the Indus River near Attock (Figure 4), Pakistan. Eighty percent of the Kabul River length is in Afghanistan and the rest is in Pakistan. Among these countries, the Kabul River is the water resource for an estimated 20 million people (Iqbal, 2020; Atef et al., 2019; King & Sturtewagen, 2010). The major tributaries are Logar, Panjshir, Alingar, Surkhab, Kunar, Bara, and Swat Rivers (Iqbal, 2020). “The basin coverage within Afghanistan is 76,908 km² while it covers 14,000 km² areas in Pakistan before it joins Indus River” (Iqbal, 2020, p. 2). A fourth of Afghanistan's freshwater comes from the Kabul River (Kakakhel, 2017), contributing almost 21 billion cubic meters of water annually to Pakistan, free of charge (Shams & Muhammad, 2023). In Pakistan, the Kabul River is augmented by the Swat River and its tributaries before it merges with the Indus River in Pakistan, which flows to the Indian Ocean (Rango et al., 1977).

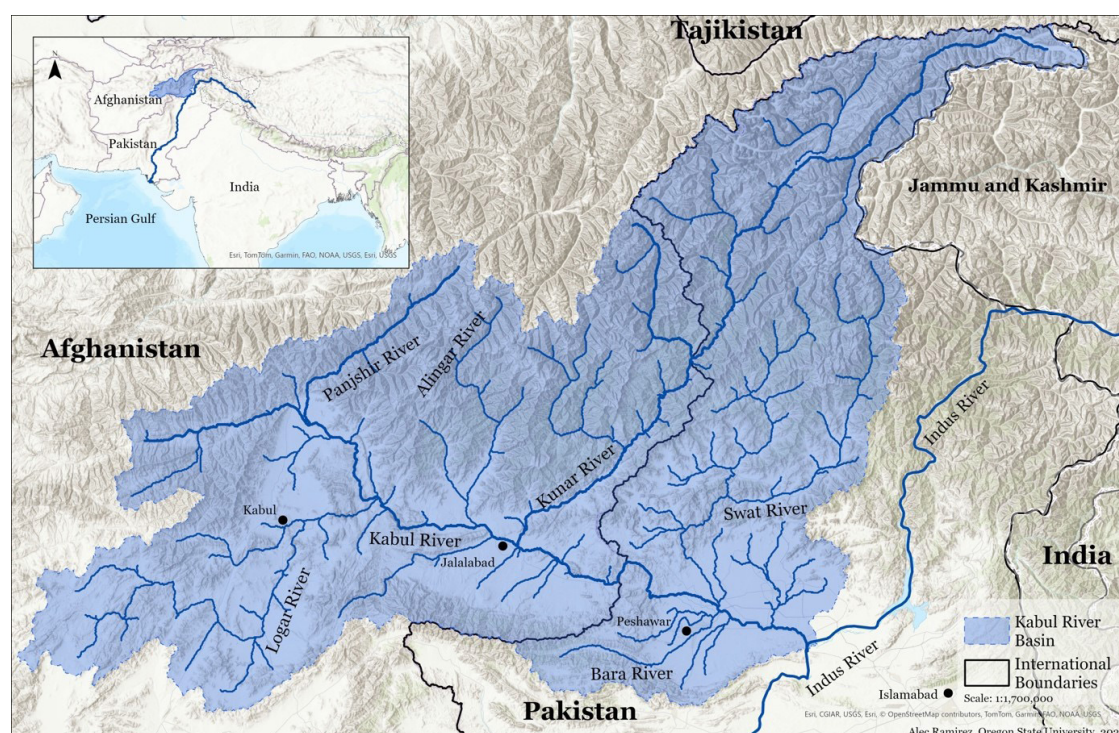


Figure 4. Map of the Kabul River Basin. Created by Alec Ramirez, Oregon State University. 2025.

² In the case of KRB, one of the authors of this study, Jalal Naser Faqiryar, former Director-General of Kabul River Basin for Afghanistan, provided firsthand information to this study. His accounts make him a primary source for the Afghanistan perspective. This access provided critical insights.

The physical geography of the basin is a unique hydrologic arrangement in which Afghanistan and Pakistan are both upstream and downstream states of each other (Iqbal, 2020). “The Kunar River, a tributary of Kabul River, originates from the northwestern part (Chitral) of Pakistan and flows into the eastern part of Afghanistan (Kunar Province) and joins Kabul River at Jalalabad and then come[s] back to Pakistan” (Iqbal, 2020, p.7), making neither country an absolute territorial water resources sovereignty (Iqbal, 2020) of this tributary. Both Afghanistan and Pakistan rely heavily on the Kabul River for municipal, agricultural, and hydropower needs (Shams & Muhammad, 2023). A total of 3,000 km² of high-value agricultural crops are irrigated by this river in Afghanistan and approximately 500 km² in Pakistan (Iqbal, 2020). Afghanistan’s total energy demand amounted to 3,086 gigawatt hours in 2011, of which 19% was generated by the Kabul River and other internal sources (Casale et al., 2020). “On Pakistan’s side, the river powers the 250-megawatt Warsak Dam built in 1960, which generates 1,100 gigawatt hours of electricity per year and provides irrigation for the fertile Peshawar valley [in Pakistan]” (Iqbal, 2020, p. 19). In keeping with national sovereignty, Afghanistan claims the right to use water resources within its territory. Meanwhile, Pakistan asserts its historical use of the water, preventing Afghanistan, either directly or through proxies, from using these waters to meet current and future needs (Verma, 2021).

Historically, Afghanistan did not face water conflicts with its southern neighbor over the Kabul River, as there was cooperation between Afghanistan and Great Britain, given that the region now known as Pakistan was part of British India. Pakistan became a sovereign state in 1947. However, a territorial dispute emerged between Afghanistan and Pakistan over the Durand Line, which seems to color the regional narrative. This delineation is a 2,640-kilometer line between Afghanistan and Pakistan, agreed upon in 1893 by the governments of British India and Afghanistan. Over three quarters of the length of the Durand Line follows hydrologic and topographic features. It is a political demarcation that physically divides a major ethnic group in the region, the Pashtuns who predominately reside in Afghanistan, but find themselves on both sides of the line. They were governed by the former Islamic Republic government of Afghanistan and the current de facto Taliban regime on the Afghan side; and by Pakistan’s federal government, dominated by Punjabi political and military leadership, on the Pakistani side. This separation displeases them (Schons, 2022), because it undermines their 5,000-year-old cultural identity and allegiance (Tainter & MacGregor, 2011). Regionally, the Pashtuns are a population of over 40 million people. In Pakistan, the primary ethnic group is the Punjabis. “The conflict between the Taliban, the Afghanistan government, the Pakistani government...in the area is often violent. The Durand Line endures suicide bombs, air strikes, or street fighting” almost daily (Schons, 2022).

Given the complex interplay of river dynamics, water resources management and territorial disputes, the following section will examine water interactions among the riparian states. Through this assessment, mechanisms for transforming conflict into cooperation will be explored.

4.1 Results and analysis

The TWINs and the Four Stages frameworks, as applied to the KRB case study, are presented and described. The dynamics of the Afghanistan-Pakistan water conflicts and the potential for cooperation are assessed.

4.1.1 Application of TWINs framework

Overall, the KRB water interaction among stakeholders after Afghanistan statehood (1919) to 1934 was stable, characterized as low conflict-high cooperation. Overtime cooperative intensity lessened. From 2003-2022, Afghanistan-Pakistan water interactions are described as low conflictive-low cooperative dynamics.

Historically, changing regimes, political systems, and government priorities affect the pace and direction of KRB transboundary dialogues. The application of the TWINs framework shows that in 1921 and 1933-1934, the conflict intensity was politicized (see Figure 5, note the solid line represents decisions made before Pakistan was a sovereign nation, and the dashed lines represent interactions between Pakistan and Afghanistan). The intensity of cooperation shifted slightly from risk-taking in 1921 to risk-averting in 1933-1934 when the Afghan government and the state government of Chitral (formerly part of British India) signed an agreement on timber navigation rights in the Kunar River (HM Government in the UK [HMGUK] et al., 1934).

Afghanistan's civil war between various mujahideen groups from 1992-1996, halted collaboration between Afghanistan and Pakistan over KRB (Habib, 2014). Then, when the Taliban, a militia group supported by Pakistan's Inter-Services Intelligence, took over Kabul in 1996, transboundary water interaction froze (Riedel, 2021).

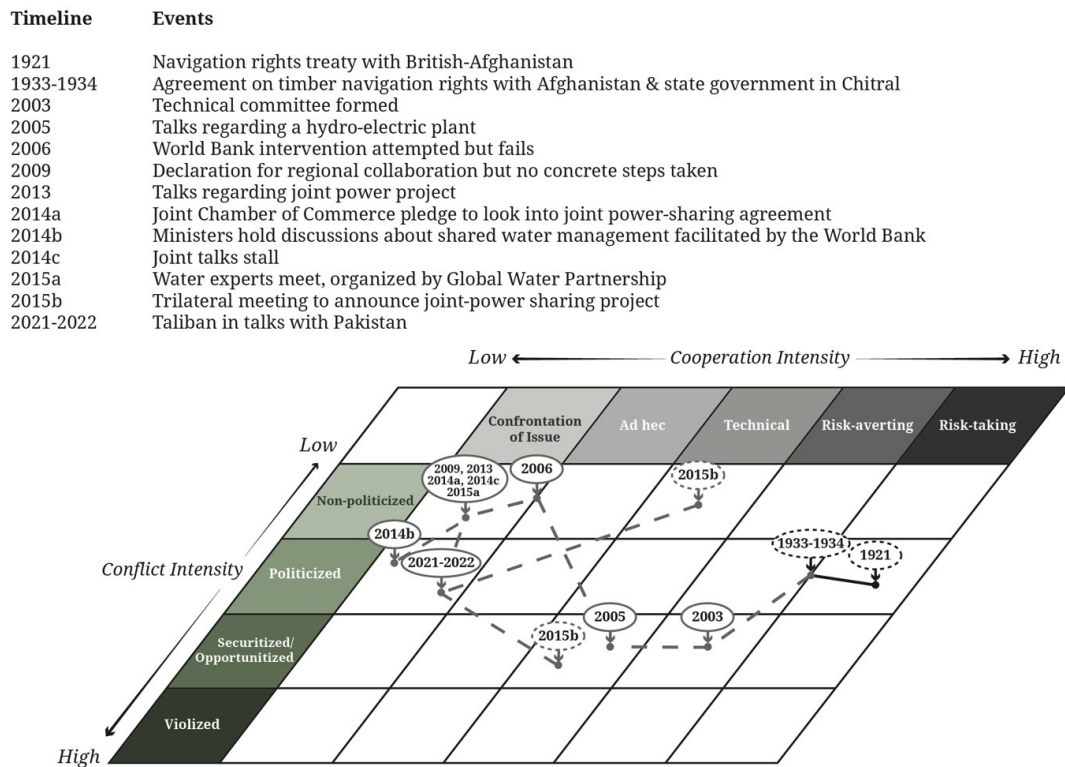


Figure 5. The TWINS Matrix of conflict and cooperation, applied to hydropolitical interactions between Afghanistan and Pakistan regarding the Kabul River Basin.

The political turmoil in Afghanistan prompted Pakistan to unilaterally form a nine-member technical committee in 2003 to draft the provisions of the river treaty with Afghanistan. This event is interpreted as opportunistic on the conflictive intensity scale and risk-averting on the cooperative spectrum (see Figure 5). Although water talks are plotted on the matrix, note that not all discussions are considered equal, as diplomats with decision-making authority do not always attend to these meetings.

In 2006, the World Bank stepped in to provide technical assistance to Afghanistan and Pakistan to draft a bilateral treaty over the Kabul River. This intervention failed due to a dispute over the Durand Line and power asymmetry (IUCN, 2010). This event is interpreted as non-politicized on the conflictive interactions scale and between confrontation of the issue and ad hoc within cooperative dynamics, indicating that groups are participating in joint action but do not share mutual objectives (see Figure 5).

There are several events between 2009-2015, characterized as low conflict-low cooperation intensity. One example is the 2009 event, in which Afghanistan and

Pakistan signed the Joint Islamabad Declaration to reaffirm the historical, cultural, and religious ties between the two countries (Pakistan Ministry of Foreign Affairs, 2011); another example is an August 2013 breakthrough, when finance ministers discussed building a joint hydropower plant on the Kunar River (Vick, 2014) and agreed to move forward with the KRB Management Commission.

An interesting event led to two separate data points labeled 2015b on Figure 5. This occurred because: (1) government officials from China, Afghanistan, and Pakistan proposed a hydropower-sharing project on the Kunar River—a technical and non-politicized initiative (Shams & Muhammad, 2023); and (2) the same event ultimately failed to secure financial commitment from China due to ongoing civil war in Afghanistan, and Afghanistan-Pakistan tensions—reflecting securitized/opportunized and technical dynamics.

In August 2021, U.S. forces withdrew from Afghanistan, marking the end of its military presence after nearly 20 years (Schaeffer, 2022). With this exodus, the Taliban regained control of the country, cross-border Pakistan-Afghanistan clashes are more prevalent, and trust undermined to the degree of more tenuous dynamics—characterized as politicized and confrontation of issues (see Figure 5).

4.1.2 Application of four stages framework

The application of the Four Stages framework applied to 2022 activities places Afghanistan-Pakistan transboundary Kabul River management in the reflective stage (Table I). In this stage, more trust-building is necessary, while water negotiations shift from individual country entitlement to basin-wide needs; parties focus on skills-building, hydro-meteorological capacity strengthening, among others. If not given attention, differences among co-riparians in terms of socio-economic development, environmental sustainability, infrastructure development, and the maturity of governance structures may prove daunting for consensus-building.

4.2 Synthesis and reflections

Between 1978 to 2001, Afghanistan and Pakistan's collaboration over shared water resources was characterized as zero-sum. As domestic stability in Pakistan improved, the country began making moderate shifts in its foreign policy toward Afghanistan through regional peace talks initiated in 2005. Negotiations between riparians moved from the adversarial to the reflexive stage, as parties began to define their needs. With U.S. forces withdrawing from Afghanistan in 2021, Afghanistan-Pakistan ties deteriorated (Kaura, 2022). To gain influence over Pakistan (India's rival), the Taliban reestablished friendly relations with India and encouraged India to reopen their embassy in Kabul, to exploit Pakistan-India tensions. This strategic maneuvering jeopardizes Afghanistan-Pakistan cooperative relations (Worden,

2022), particularly because mutual respect for sovereignty is foundational to building trust and capacity for the sustainable management of shared transboundary water resources (Shah, 2000). Although in recent years Afghanistan and Pakistan progressed from having no trust to acknowledging each other's needs, the adoption of a water-sharing agreement might not work unless comprehensive benefit-sharing principles are implemented, where "the optimization of benefits should be more robust and more flexible than the optimization of physical water resources." Creative benefit-sharing could include "granting of rights to use water, financing of investments, or the provision of non-related goods and services." (Sadoff & Gray, 2002, p. 397).

Answering the question of how transboundary water interactions between Afghanistan and Pakistan in the KRB developed from sovereign statehood (Afghanistan in 1919 and Pakistan in 1947) into 2022, the TWINs framework reveals that while hydro communications do take place between Afghanistan and Pakistan, cooperation over time has been superficial. Among the factors that may have contributed to this shallow engagement are a lack of trust, as outlined in the Four Stages framework; and the lack of data that could be shared. In particular, in the basin, Afghan sites are sparse with inconsistent data—even though Afghanistan has more monitoring stations than Pakistan (Hashmi, Bhatti, & Azizi, 2023). Interruptions in data collection during periods of civil war and the Soviet invasion in 1979 are also an important consideration (Campbell, 2014). Regarding the question as to whether past interactions provide any insight or points of leverage towards advancing conflict transformation, there is some insight to be gained—simply recognizing that data gaps have hampered constructive information sharing is helpful to know.

To achieve transformative outcomes, building trust and having mutual respect for sovereignty is essential; along with building capacity through strengthening water resources accounting and understanding across all scales, including hydrology is paramount. Parties should consider reframing water accountability in terms of improving quality of life, regional political stability, and economic growth. Working through country-level commissions; and RBOs that hold scientific workshops, facilitate water data-collection, and provide pathways for sharing information should prove helpful. This includes filling in data gaps through satellite imagery at the macro-scale, and local and traditional knowledge at the micro-scale. And though neither Pakistan nor Afghanistan are signatories to the UN Convention, most known for embodying provisions related to transboundary waters, this customary law addresses data and information sharing that can facilitate equitable and reasonable water use, environmental protection, and water planning and development, along with conflict resolution provisions which could prove helpful.

5. Conclusion

This research confirms several commonalities between the Ukraine-Russia and Afghanistan-Pakistan water interactions. Both cases are shaped by complex histories and political tensions. Both have water disputes tied to broader issues of sovereignty and identity, with water cooperation intensity lessening over time.

This research reveals that transboundary water interactions between Ukraine and Russia have followed a spiraling trajectory, shifting from minimal tensions (1991-2004) to volatile relations (2014-2022) that have since become unstable and destructive. The ongoing conflict has placed Ukraine and Russia in an adversarial negotiation stage, where historical grievances and deep-rooted narratives persist. When parties are ready to initiate a peace process, neutral third parties can mediate. To move towards conflict transformation, building trust, addressing historical claims, and exploring creative solutions will be key. Furthermore, balancing power dynamics through diversified economies and focusing on mutual interests, such as water sustainability and climate change action, can open opportunities for cooperation and incentivize securitization.

This research shows that Afghanistan and Pakistan's cooperation over the Kabul River Basin was a zero-sum approach from 1978 to 2001. After 2005, Pakistan shifted its foreign policy toward Afghanistan, but cooperation remained superficial. Following the U.S. withdrawal in 2021, relations deteriorated, with the Taliban's reestablishment of ties with India adding tension. With Afghanistan-Pakistan water relations in the reflective negotiation stage, it is essential to prioritize trust-building, mutual respect for sovereignty, and a balanced distribution of power. Strengthening water resources accounting and facilitating data-sharing through RBOs will be crucial. Potential cooperation, such as combining Afghanistan's hydropower needs with Pakistan's flood management, could address regional issues (Atef et al., 2019), while reframing the dialogue around regional stability and economic growth may promote collaboration.

The limitations of this study include its preliminary scope and the constraints of the project's timeframe, which restricted the analysis to events and data available up to 2022. Future research could address these limitations by combining the two frameworks used with other approaches like political ecology to provide critical economic and political analysis of socioecological realities and extending the study to include the most recent events. Overall, this study contributes to the existing literature by broadening perspectives regarding the intricacies of transboundary water relations and the potential for meaningful peace. The integration of both frameworks provides insights into how conflict and cooperation evolve and provides

pathways to building trust, collaboration and consensus. This approach contributes to policy recommendations, while advancing water transformation frameworks.

With artificial intelligence (AI) on the horizon, integrating this tool into water conflict management could be a game-changer in how water management is conducted. Future research could focus for example, on how AI can be used to optimize data collection and resource allocation, provide machine learning models for scenario analysis to refine our understanding of nuanced transboundary water dynamics, and foster transboundary cooperation.

In closing, conflict transformation takes time because it is relationship-centric and built on each encounter (de Silva, 2023; Lederach, 2003). This relational approach is fundamental to fostering constructive transboundary water interactions because water can serve as a key to peace and regional prosperity (Delli Priscoli & Wolf, 2009; Sadoff & Grey, 2002; Turgul et al., 2024). As such, water conflict transformation is not only a matter of resource management—it also serves as a practical pathway for fostering trust between countries and long-term cooperation.

Acknowledgements

We thank Dr. Nancy Boyer and Dr. Saleem Ali for inviting us to contribute to this research project, and for their invaluable guidance and insightful feedback. Being part of the Delaware Team with Dr. Gabriela Mundaca and Ms. Shaghayegh Jabalameli was informative, productive and illuminating. We acknowledge and thank Dr. Monica Giannone for her exemplary leadership in effectively coordinating all the teams, thereby ensuring the project's success. We extend our appreciation to Dr. Aaron Wolf for his thoughtful and constructive comments. We express our sincere gratitude to Dr. Alex Turgul and Mr. Alec Ramirez for the expertly generated maps, and to Ms. Galina Hasanova for the high-quality graphics. Sincere thanks to Ms. Chiara de Silva for her meticulous work in formatting this paper.

The original research was conducted as part of the research project, "Why It Worked: Research-Driven Model for Conflict Resolution," a project devised and funded by Bridging Insights, Inc. and designed and led by Harvard Kennedy School's Negotiation and Conflict Resolution Collaboratory. Bridging Insights, Inc. is a registered nonprofit organization seeking to build a research-based model for conflict resolution to provide new ideas, paradigms, and methods of engagement applicable to practitioners in diverse conflicted areas. Between 2021 and 2023, Bridging Insights worked with five universities on a large-scale, multi-case comparative, interdisciplinary study of political conflicts.

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