Journal of Peace, Development and Communication

Volume 07, Issue 01, January-March 2023
pISSN: 2663-7898, eISSN: 2663-7901
Article DOI: https://doi.org/10.36968/JPDC-V07-I01-18
Homepage: https://pdfpk.net/pdf/
Email: se.jpdc@pdfpk.net

Article:	**Environmental Threats to South Asia's Basins (Indus and Ganga); Treaties Analysis**
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Published:	21th March 2023
Publisher Information:	Journal of Peace, Development and Communication (JPDC)
To Cite this Article:	Bibi, B., Jian, K., Hussain, A., & Sohail, A. (2023). Environmental Threats to South Asia's Basins (Indus and Ganga); Treaties Analysis. *Journal of Peace, Development and Communication* , *07*(01), 220–230. https://doi.org/10.36968/JPDC-V07-I01-18
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ABSTRACT

The article aims to provide insights into the effectiveness of international water treaties in addressing environmental challenges in river basins. The Ganga and Indus River basins, encompassing a vast expanse of 2.20 million square kilometers, serve as the lifeblood for roughly one billion inhabitants of the South Asian region. However, the escalating challenges of water scarcity, climate change, over-extraction, pollution, and reduced flow that stem from burgeoning population growth, urbanization, industrialization, and agricultural activities, have critically endangered the water quality and quantity of these basins. The Ganga and Indus Water Treaties were created to promote collaboration and address water-related environmental issues. However, their limitations in addressing these threats make it necessary to review their effectiveness and examine their gaps and inadequacies. The study examines treaties related to the Indus and Ganga River basins regarding environmental threats, identifying gaps that need attention. A comparative analysis with the UN Watercourse Convention will be conducted to assess their effectiveness and adherence to global standards.

Key Words: Environmental threats, IWT, Ganga treaty, UNWC

Introduction:

This study aims to present an overview of the Indus and Ganga River basins, identify the environmental threats facing them, such as overutilization, scarcity, pollution, and climate change, and analyze the Indus and Ganga water treaties, and compare them with the United Nations Watercourses Convention.

South Asia's Basins are home to millions of people and are a vital water source. Indus and Ganga's basins are home to the world's most populous countries, including India, Pakistan, and Bangladesh. The IGBs are important for the region's social, agricultural and economic development. The IGBs, covers a massive area of 2.2 million square kilometers and are home to millions of people. However, cumulative population, speedy economic evolution, and climate change put enormous pressure on these basins. The cultivation and irrigation of the IGBs date back to as early as 5000 B.C., with the Indus Basin experiencing a surge in farming activities through extensive resource development, particularly in recent times. However, these basins are facing significant environmental threats threatening water sustainability. The region has adopted several treaties and agreements regulating water resource use to address these challenges.

The Indus Basin's climatic and topographic features offered ideal conditions for creating an irrigation system. As a result of growing population densities and unsustainably high usage, Indus states are under tremendous pressure to achieve their water resources efficiently, reducing per capita water availability. Urbanization and industrialization compete with traditional agricultural water users, exacerbating the situation. Indus Basin water sharing between Pakistan and India poses great challenges and problems ahead. Geologically, both sides of the borders face a daily shortage of pure agricultural water, food grains per capita, urbanization, and other environmental challenges. This has worsened the already stressed political and geological tensions between the countries. Urban centers have experienced a decline in the water table due to excessive groundwater extraction. Water quality has deteriorated due to the introduction of chemicals such as fertilizers, pesticides, municipal sewage, and industrial waste. Additionally, the upper catchment areas' glaciers are melting at an alarming rate due to climate change, leading to increased occurrences of droughts and floods.

The Ganga Basin is grappling with a grave scarcity of water resources. Population growth, economic development, and changing climatic patterns have led to a dwindling of the basin's water resources. The pollution of the Ganga Basin has also emerged as a major concern, with industrialization, urbanization, and agricultural activities contaminating contaminants such as heavy metals, pesticides, and fertilizers into the basin's rivers and groundwater.
Furthermore, the challenge of climate change looms large over the Ganga Basin. The rising temperatures, alterations in precipitation patterns, and melting glaciers are projected to impact the basin's water resources significantly. These changes will severely impact agriculture, food security, and water availability and have extensive significance for human and environmental health.

Complex cross-border challenges in the Indo-Gangetic Basin, combined with inadequate water governance institutions and local, national, and regional policies, significantly obstruct the application of basin-wide policies. Additionally, the changing patterns of snow and glacier melting and the heightened occurrence and severity of droughts

and flood resulting from climate change could impact agricultural yields, production systems, water resources, and livelihoods in the region, calling for sustainable water resource management.

This study relies on two approaches. First, examine the theoretical rules and principles outlined in international legal instruments regarding the peaceful management of shared watercourses. Second, a review of current literature on transboundary water rights using databases. The research was conducted through resources such as the Central Library of Wuhan University and websites of international organizations like UN, which promote equitable and sustainable management of transboundary water sources, to gather relevant information.

Research Questions:

1. How have the Indus and Ganga basins been affected by environmental threats over time?
2. What are the weaknesses and strengths of the Indus Water Treaty as well Ganga Water Treaty in managing water resources among IGBs?
3. How does the United Nations Watercourses Convention compare to the Indus and Ganga treaties regarding managing transboundary water resources?

Overview of basins

The Indus Basin

The Indus basin's water is unquestionably the inhabitants' source of life. (Adeel & Wirsing, 2016,) The basin is source of freshwater for almost 300 million people. The Indus Basin, the region's lifeline, originates in the Himalayan mountains through Indian-controlled Kashmir (Sattar, Robison, & McCool, 2017).The basin covers an area of 1.12 km², of which 47% lies in Pakistan's territory, 39% in India, 8% in China, and 6% in Afghanistan (Khalid & Iram, 2010).The basin embraces the main Indus river and its tributaries, including the Kabul, Jhelum, Ravi, Beas, and the Chenab (Rahman, 2015). Originating from Tibetan Himalayas, the Indus river empties into the Arabian sea (McCaffrey, 2019). IRB is a source of noteworthy crop irrigation, that is why the Indus Basin is of key significance to Pakistan and India (Qureshi, 2017). Both states, therefore, need to collaborate to reap the common basin's shared benefits.
The Indus Basin faces various challenges today, including water scarcity, pollution, and climate change. The region's rapidly growing population and expanding economies are putting pressure on the already scarce water resources, leading to conflicts over water allocation between different sectors and countries.

Efforts are being made to address these challenges through water cooperation, improved irrigation practices, and the development of alternative water sources. However, the Indus Basin remains a complex and challenging region that requires continued attention and investment to ensure sustainable development and the well-being of its people.

The Ganga Basin

The Ganga is the largest river of the Indian subcontinent, which is rooted in the ice cave of Gaumukh; with an altitude of 4100m, it is discharged into the Bay of Bengal after crossing several plains for over 2525 km. Around 400 million people live beside the basin and rely on it for their basic needs (Geograpgy of Ganga). In India, the river Ganga is considered the most sacred and is personified as a divine goddess, deserving the reverence and adoration typically reserved for a mother (Rai, B, 2013). The soul is supposed to be purified and has antimicrobial and medicinal properties (Rai, B, 2013).

Ganga covers 8, 61,404 km2 of the drainage basin in the country (Chaudhary, & Walker, 2019). Ganga receives major tributaries in the middle plains. Gandak, Ghaghara, Yamuna, and Kosi, Himalayan; Burhi Gandak and Gomati, Himalayan hill or terai; and Tons, Sone, Punpun. These rivers increase the quantity of water in the Ganga basin. It provides water for irrigation and other uses, and is an important transportation route for goods and people.
However, the Ganga Basin faces significant environmental challenges, including industrial and domestic waste pollution, deforestation, and soil erosion. The Indian government and various organizations have launched initiatives to address these issues, including the Clean Ganga Mission, which aims to clean and rejuvenate the river and its ecosystem.

Environmental threats to Indus and Ganga basins:

Overutilization and misuse:

The Indus basin is suffering from overutilization. Irrigation infrastructure has begun to decline in the basin. Over-utilization of agricultural activities accompanied by industrialization, population growth, and economic development have stressed the basin. Groundwater anarchy drives the rural economy and meets large domestic and industrial water requirements. The unsustainable exploitation of groundwater persists, leading to a significant regional deficit in the water balance despite its continual expansion (Sharma, 2013). The Millions of people dip in the Ganga River daily, especially on auspicious occasions, with the Kumbh Mela being the largest event where billions of individuals congregate at a specific section of the river. Many devotees and ascetics also reside on the riverbanks during the Kumbh Mela. However, improperly disposing of detergents, polythene bags, discarded clothes, food waste, flowers, leaves, and various offerings such as milk, curd, ghee, and coins during these events results in severe degradation the river's water quality. India has many religious celebrations yearly, with Durga Puja being one of the most prominent festivals. Many idols of various sizes are formed each year at these festivals and immersed at the end of the event in Ganga (Bhattacharya, 2014). Additionally, worshippers use over 1000 tons of flowers and garlands as offerings during Ganga worship, many of which are discarded into the river.

In India, there is a widespread belief that cremating a person's body along the Ganga River can release their soul from the cycle of rebirth and enable them to ascend directly to heaven. Consequently, numerous dead bodies are cremated on the river's banks daily. Unfortunately, these practices are devastatingly impacting the sacred river's health.

Water Scarcity

The predominant water use in the Indus basin is for agriculture, which accounts for 91% of the total water usage. The basin is amongst the most overstressed basin on the planet (Khan & Adam, 2019). During specific times of year, the water does not even touch the sea, making Indus a closed basin (Shaheen, & Shan 2017). Unfettered usage and shift from surface to groundwater is another challenge, resulting in the fast exhaustion of groundwater resources(Rahman, 2015). The Indus Basin is listed among the "top ten most vulnerable in the world, with inflows forecast to decline by 27% by 2050."(IPCC, 2001. Kundzewicz, 2007)

On the other hand, the Ganga basin, which contributes over 33% of India's surface water is also facing challenges due to reduced river water volume (Koshy, 2019). In the preceding three eras, the water flow of the Ganga River has declined by about 50-60% during the summer (Mukherjee, & Wada, 2018). During the low-flow period, there is nearly no water in some parts of the Ganga basin (Amarasinghe, Muthuwatta, 2018). These issues have

significantly impacted the diversity and health of fish in the Ganga river, with various species, including the Ganga River Dolphins, being threatened (Sarkar, Nautiyal, Singh, 2012).

Water scarcity is a significant challenge in the Indus and Ganga River basin. It is essential to adopt sustainable water management practices, such as efficient irrigation systems, water reuse, and conservation measures, to address this issue. Additionally, countries in the basin must work together to ensure fair and equitable regional distribution of water resources and resolve political tensions over water sharing through dialogue and cooperation. This can ensure a sustainable and adequate water supply for the people of the Indus River basin.

Overall, it is critical to recognize that addressing water scarcity in the Indus and Ganga basins requires collective efforts from all stakeholders. By adopting sustainable water management practices, improving water infrastructure, and promoting dialogue and cooperation among countries, we can ensure a sustainable and adequate water supply for the people living in these regions.

Pollution

Due to the gradual environmental deprivation, a significant ratio of health concerns is being generated for the population, especially the ones surrounding the Indus River. The pollution in the Indus basin is worsening the water quality (Gilani 2007). The effluent water from agricultural waste is the major source of water pollution in Indus, which also contains nitrates, sodium, phosphates, and some pesticides. Moreover, the industrial and sewage water which is not treated or incompletely treated is liquidated in the Indus River (Rahman, 2015). The rise in the surface water temperature due to installing thermal power plants impacts aquatic life. The toxic effect of the water pollution flows in the ecosystem cycle has affected the mangroves in the lower delta of the Indus, which were an important source of food for the population living at the coast and were abundant with marine life.

Pollution from the Ganga watercourse is a variety of organic and inorganic substances, mainly from the agricultural, business and municipal sectors. The major pollutant of the Ganga, followed by agricultural run-off and industries, are municipal waste products (Dwivedi, Mshra, 2018). The watercourse is a website for non-secular activities, animal washing and watering, body disposal and incineration, etc. Thus, pollution sources in Ganga are; industrial effluents, agricultural run-off, pollution of waste products and spiritual activities (Dwivedi, Mshra, 2018). Water in the Ganga does not comply with the rules for drinking water. The water in the upper region of the Ganga is suitable for various activities, whereas bathing is not even safe in the middle and lower regions. The major contributor to Ganga's pollution is sewage discharge. Several liters of sewage are produced daily in the cities along the Ganga (Chaudhry, & Walker, 2019).

Many industrial units in Uttar Pradesh, 956 in number to be specific, discharge various types of waste into the Ganga River. Around 2500 million liters per day (MLD) of industrial wastewater is believed to be produced in the Ganga basin. The Ganga River is polluted with various materials such as sweets, milk, flowers, leaves, lit lamps, and the discarded remains of old holy books and idols, brought in by devotees. Additionally, certain communities in India practice the tradition of disposing of dead bodies and bone remains into the Ganga as a final ritual (Rai, 2013).

Climate change

The greater Himalayas is particularly delicate to climate change (Xu, Grumbine, 2009). Climate change has already impacted the Himalayan cryosphere, as evidenced by the retreat of glaciers, reduction in ice mass, earlier snowmelt, and higher stream flow during winter. These changes are particularly concerning because approximately 70% of the summer flow in the Ganga and Indus River basins is sourced from the glaciers and snow in the Himalayan region (Xu, Grumbine, 2009). In the "third pole" region, snow and ice sheets have shrunk since the end of the 19th century. In the last three decades, most glaciers in the Himalayan region have been waning significantly faster than other parts of the planet (IPCC, 2001). The reduced surface run-off will decrease groundwater recharge and affect the region's groundwater availability. The abnormal change in the river water flow, either increased or decreased, could result in inundation or floods in the surrounding regions. "The Indus basin is extremely sensitive to climate change because snowmelt and glacier melt from the Western Himalayas comprise a significant portion of its water supply."(Sattar, &Robison, 2017). Climate change is predicted to severely hit the Indus basin because of the outsized population and high dependence on agriculture and meltwater (Divya, & Shirish, 2009). This is causing significant challenges for farmers and communities in the region who rely on the Indus River for their livelihoods. In addition, changing precipitation patterns are causing more extreme weather events, further exacerbating the challenges people face in the Indus River Basin face.

The Ganga river basin is also facing severe impacts of climate change. The Ganga basin is listed among the most susceptible to climate change (Bharati, Luna & Sharma, 2016). In the Ganges Basin, "climate change is expected to increase temperatures, resulting in the retreat of glaciers; increased alteration in the precipitation pattern, which will result in a greater degree and rate of recurrence of droughts and floods; and even lead to a sea-level rise."(Cruz, Harasawa, &CO, 2007). The changing climate also affects the agriculture-dependent livelihoods of millions in the basin, leading to food insecurity and socio-economic challenges. To mitigate the adverse effects of climate change, it is crucial to implement sustainable water management practices, reduce greenhouse gas emissions, and promote ecosystem conservation in the region.

Analysis of IWT:

The Indus Waters Treaty (IWT) can be cited as a bilateral accord that aims to facilitate collaboration between two parties for the effective sharing and utilization of the Indus River and its five tributaries (the Sutlej, Beas, Ravi, Indus, Chenab, and Jhelum) (IWT, 1960). between two nations with a history of conflict (IWT, 1960). The IWT between Indus states is a noteworthy triumph in resolving disputes and distributing water (Van 2003). The IWT provides mechanisms for cooperation and utilization of water, with its preamble consisting of 12 articles and eight annexures (IWT, 1960). For example, IWT Article VI requires both states to share data on their water storage projects regularly (Rai, 2013). Similarly, The "Permanent Indus Commission was established based on the provisions outlined in Article VIII of the Indus Waters Treaty." Its primary responsibility is to resolve water storage disputes while enabling information exchange between the parties involved (Sarfraz, 2013).

Regardless of being a shining example for dispute resolution, it is today's focus of dispute. The treaty that functioned admirably earlier may not smoothly work in coming years as climate change variated the circumstances of the environment of the watercourses. Climatic variability and uncertainty have led to an unpredictable water supply, which has impacted the

water-sharing mechanism between Indus states. Groundwater management is another challenge, as both countries have exploited groundwater resources beyond sustainable limits. Additionally, the IWT does not address environmental flows, which has led to the degradation of the river ecosystem.

Furthermore, lack of data sharing and the absence of supervision by international guarantors has made it difficult to enforce the sharing mechanism. Specifically, the IWT would appear to have turned out to be insufficient in its capacity to address climate change and hydrological vulnerability (GWT, 1996).

Analysis of the Ganga Water Treaty

The Ganges Water Sharing Treaty was a significant step toward the conclusion of a long-standing Ganges water-sharing conflict (Muhammad, 2006). The treaty states, "the flow would be shared between India and Bangladesh during the dry season (January–May), further divided into fifteen 10-day cycles, based on a unique sharing formula." The treaty includes an indicative schedule that determines the share of water for each country based on Farakka's total average historical flow between 1949 and 1988. One of the significant aspects of the treaty is that it imposes a condition that applies during the most crucial periods, which involves "March 11 and May 10, each country is guaranteed to receive 35,000 cusecs (equivalent to 991 m3/s) of flow in alternative 10-day cycles" (Kazi, Zahidul, 2019).

The Ganga Water treaty serves as a noteworthy illustration of transboundary water sharing and coopeartion. However, despite introducing a unique formula for water allocation, the treaty's effectiveness has been interrogated numerous times. However the Ganga water treaty does not address the environmental concerns to the basin (Kazi, Zahidul, 2019). The treaty between India and Bangladesh, which has operated for 30 years to share water resources, does not address water quality issues, climate change effects, and flood control. Ganga river pollution is one of the threats, with high levels of industrial effluents, sewage, and agricultural runoff affecting the river's water quality and the health of people who rely on it. Furthermore, climate change is altering the flow and availability of water in the Ganga river basin, leading to water scarcity and conflicts between the two countries.

However, the current term of the agreement is set to end in 2026. The current situation demands the re-enactment of the treaty to meet environmental threats.

Comparison of UNWC with the Indus and Ganga treaty:

In 1997, the United Nations formed the "United Nations Convention on the Law of Non-Navigational Uses of International Watercourses" to address the gaps in legal frameworks about international waterways. The UNWC is an internationally recognized instrument that provides a legal agenda for managing transboundary water resources. The convention outlines principles and rules for managing and conserving transboundary water, including rivers, lakes, and groundwater that cross international borders. Its goal is to promote cooperation and peaceful resolution of conflicts between countries sharing water resources, ensuring equitable and sustainable use (UNWC, 1997). The convention offers wide-ranging principles that put forward the essential standards for transboundary water administration, including "equitable and reasonable utilization" and "obligation not to cause significant harm." (McCaffrey, 2019). The UNWC underlines the "protection, preservation and management of transboundary ecosystems." (McCaffrey, 2001). It levies a compulsion on watercourse states to " prevent,

reduce and control the pollution of an international watercourse that may cause significant harm to other watercourse states or their environment." (McCaffrey, & Denoon, 2019).

In South Asia, several transboundary rivers flow through multiple countries, including the Indus and Ganga rivers. Sharing water resources from these rivers has often led to disputes and tensions among the countries involved. The UNWC can provide a platform for these countries to negotiate and develop cooperative measures to sustain these water resources. In South Asia, to strengthen the existing transboundary water regime, UNWC can create enabling conditions (Qureshi, 2018).

Compared to UNWC, the Indus and Ganga water treaties are water distribution treaties rather than a context of benefit sharing and collaboration. While comparing the UNWC and Indus and Ganga treaties, the obvious shortcoming is environmental protection, pollution and management of the international water sources. Indus and Ganga's treaties treat this issue fleetingly, and the UNWC addresses environment protection, pollution and management of international watercourses comprehensively (UNWC, 1997). The Indus and Ganga treaties do not focus on "environmental impact assessment," while UNWC references the EIA procedure (Mcintyre, 2016). Under the UNWC, states can establish joint management bodies and share data on water resources, such as water quality, flow rates, and usage patterns. This can help promote transparency and cooperation among the countries managing transboundary water resources.

The UNWC provides a framework for resolving disputes about managing transboundary water resources. This can help to prevent conflicts and tensions that arise from disputes over water resources. In order to identify gaps and address environmental threats to the Indus and Ganga basins, both treaties need to be amended to meet the principles of UNWC. In light of UNWC, provisions related to climate change, pollution, hydrogeology, and glaciology should be added.

Conclusion

The region comprising Pakistan, India, Bangladesh and Nepal, which share the Indus and Ganges basins, currently has the highest numeral of impoverished people worldwide. Given this situation, it is accurate to state that the Indus and Ganges basins face immense pressure. The Indus and Ganga are listed among the world's most scarce and polluted basins. Geopolitical tensions further complicate these issues, as seen in the Indus and Ganga Water Treaty. The existing transboundary water treaties cannot address the environmental pressures on the basins. Reviewing of legal governance regimes will facilitate growing threats.

The UN Watercourses Convention provides a comprehensive framework for transboundary water management, but it has yet to be adopted by India, Pakistan, or Bangladesh. Adopting and implementing such international agreements could help mitigate environmental threats and promote sustainable water management in the region. Protecting these vital water resources requires a coordinated effort between governments, civil society organizations, and local communities to ensure a secure and sustainable future for the millions of people who rely on these river basins.

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