

Cross-border hydro-politics and resource security in the Yarlung Tsangpo-Brahmaputra basin: Challenges and policy imperatives

Dileep Kumar ^{1*} , Ajay Kumar Yadav ² , Uma Shankar Yadav ¹ , Anand Kumar Mishra ¹ , Atul Kumar ³ 

¹School of Liberal Art, Chandigarh University Uttar Pradesh, Unnao, Uttar Pradesh, INDIA

²Registrar Chandigarh University Uttar Pradesh, Unnao, Uttar Pradesh, INDIA

³Department of CSE, Chandigarh University Uttar Pradesh, Unnao, Uttar Pradesh, INDIA

*Corresponding Author: dileepyadavjnu@gmail.com

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ABSTRACT

Hydropolitics between China, India, and neighboring South Asian nations, especially concerning shared water resources along the Yarlung Tsangpo River (Brahmaputra in India), is a significant concern. This study examines political, economic, and environmental interactions within the basin across China, India, Bangladesh, and Bhutan. It assesses China's hydropower projects' impacts on downstream regions, notably in India, emphasizing challenges like water availability, ecological balance, and livelihoods. While China delays its water diversion plans, midstream dam construction poses challenges. The paper advocates cooperative frameworks for effective water resource management, underscoring transboundary water issues' role in regional geopolitics. It explores broader consequences of water insecurity on socio-economic development and environmental sustainability, contributing to understanding Yarlung Tsangpo River hydro-politics amidst growing water scarcity and competition in Asia. This research highlights four major dam projects which cumulatively exceed 1500 MW in capacity and threaten more than 20 million people living downstream. The results have practical implications for developing cooperative models and pre-emptive systems for managing trans-boundary rivers in South Asia.

Keywords: Transboundary river management, hydropolitics, hydro-hegemony, Yarlung Tsangpo–Brahmaputra, Sino-Indian relations, climate-induced water scarcity

INTRODUCTION AND LITERATURE REVIEW

In a world increasingly marked by shrinking resources and unpredictable weather, freshwater has moved beyond a simple survival need to a key tool in global politics. Worsening droughts, floods, and shifting rainfall patterns make rivers and lakes that cross borders hotter points of tension and chances for nations to work together. As Kofi Annan warned, the struggle to secure reliable supplies could easily spark serious disputes-even wars-in coming years. Sociologist John Waterbury first framed hydro-politics in 1979 as the study of how nations negotiate and contest power over shared waters. In South Asia the Indus, Ganges and Brahmaputra do more than quench thirst; their currents shape claims of sovereignty, drive development plans, and, at times, frame arguments about national survival.

Tension is evident along the Yarlung Tsangpo-Brahmaputra, which sweeps through China, India and Bangladesh, and links the three countries in a web of

competing interests. Its passage through politically sensitive stretches such as Tibet and Arunachal Pradesh only deepens the diplomatic, military and legal hurdles that now impede cooperative management of the basin.

Waterbury in his book, *"Hydro-politics of the Nile Valley"*, analysed how the availability of water resources would impact water politics, a resource fundamental to all life forms and human development (Waterbury 1979). Water bodies transcend political borders, making river riparian states interdependent on each other. Riparian states are linked by the hydrology of an international river basin and consequently share a complex network of interdependencies related to the environment, economy, politics, and security (Dinar et al., 2011). Elhance (1999) identifies interstate conflict triggers and cooperation chances amidst interdependencies, aiding strategic foresight.

A growing body of scholarship now addresses the politics of water conflict in South Asia. **Table 1** presents details of major planned dams, including their location and capacity. Chellaney (2011) argues that China's position as the upper riparian state sharpens power imbalances, while Zeitoun and

Table 1. Planned construction of dams on Yarlung Tsangpo

Dams name	Distance from Zangmu	Capacity
Dagu	18 km upstream	640MW
Jiacha	Downstream of Zhagmu	320MW
Jiexu	11 km upstream	560WM

Warner (2006) introduce the term hydro-hegemony to capture the reality of upstream control exercised without mutual agreement. Mirumachi (2015) adds that weak formal institutions of the Brahmaputra basin magnify vulnerability to flood and drought. Nevertheless, the literature largely fixes stalled negotiations or technical breakdowns and overlooks how ecological danger, shaky collaboration, and slow policy reform in the Yarlung Tsangpo basin reinforce one another.

This paper takes on a notable research gap: although scholars have critically examined China's large-scale infrastructure push, few have looked step-by-step at how its hydropower dams connect with regional tensions, ecological harm, and weak governance. It is exactly in this less-charted territory that the present study sets its questions.

This study asks two core questions.

RQ1 In what ways does China's control of headwater resources shape political relations in the Brahmaputra basin?

RQ2 What ecological, diplomatic, and institutional consequences flow downstream to Indian and Bangladeshi communities?

Drawing on qualitative geopolitics, the article argues that integrating hydropower projects, environmental risk, and uneven power patterns reveals fresh, real-world connections in one of the world's most heavily disputed river corridors.

GEOPOLITICS AND REGIONAL DYNAMICS

This paper takes up China's development of the hydropower project along the Yarlung Tsangpo River and the imperative to consider downstream water requirements, which have significant implications for the diplomatic relationship between India and China. Both China and India are major powers in Asia, competing for water resources and their utilisation. Many Chinese scholars and hydropower lobbyists have commented on Chinese water diversion projects. In an interview with The Guardian, Zhang Boting, Deputy General Secretary of the China Society for Hydropower Engineering, expressed that the construction of a hydroelectric project on the Yarlung Tsangpo River would yield significant global benefits by saving 200 million tonnes of carbon annually. He said:

We should not waste the opportunity of the biggest carbon emission reduction project. For the sake of the entire world, all the water resources that can be developed should be developed.

(Watts, 2010)

China depends on the concentration of water hubs on the Tibetan plateau for its concentrated agriculture in the northeastern arid region. China focuses on reducing the northern arid problem through two most important measures. First, it has focused on constructing the Yarlung Tsangpo River basin dams. The second measure is the transfer of Tibetan water through the projected big south-north water transfer project, which would fill the Northern Chinese arid region gap.

The interaction between countries sharing transboundary water resources significantly influences their diplomatic

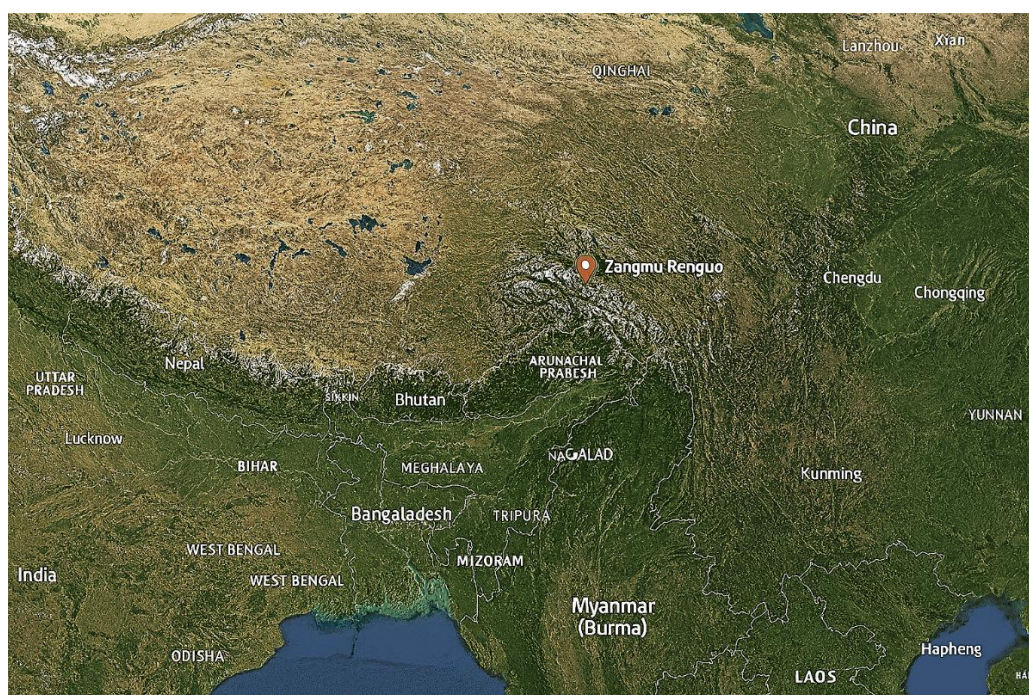


Figure 1. Location of Zangmu. The map displays the precise location of the Zhangmu dam along the Brahmaputra River, situated close to upcoming dam projects in Dagu, Jiacha, and Jiexu. This area lies adjacent to the India-China border within Arunachal Pradesh, as illustrated on the map (Source: Satellite image)

relations. The Yarlung Tsangpo River, originating in Tibet, is a prime example of a transboundary river, traversing multiple political boundaries within nations and internationally. The precise location of the Zangmu dam, situated close to upcoming projects at Dagü, Jiacha, and Jiexu, is illustrated in **Figure 1**.

The Yarlung Tsangpo River basin is one of the largest river basins in the world. The Yarlung Tsangpo, originating in the glaciers of Mt. Kailash in Tibet, is known as the 'Brahmaputra Himalaya Range River' in India. The Yarlung Tsangpo River flows with an average discharge of 20,000 cubic meters per second, and its vast basin spans across 651,335 square kilometres, linking China (50.5%), India (33.6%), Bangladesh (8.1%), and Bhutan (7.8%) (Immerzeel et al., 2008).

Citing technical difficulties, the government of China has postponed the diversion plan of Yarlung Tsangpo's waters to the arid north region. The long-discussed plan is part of the proposed Western route of the massive South-to-North Chinese diversion project. Chinese officials and analysts say the rugged terrain and technical problems have made the diversion plan unlikely. However, four hydropower projects would now be built on the middle reaches of the Brahmaputra under the energy plan, each located a few kilometres from the other. The draft outline of the five-year plan (2021-2025) has given the green signal that construction has commenced on three new dams since 2015 (Krishnan, 2021). According to Mr Yan, the 50-kilometer section at the Great Bend alone has the potential to generate 70 million kWh, which is equivalent to more than three times the power output of the Three Gorges Dam. He also stressed the importance of this project in China's efforts to peak carbon emissions before 2030 and achieve carbon neutrality by 2060 (Krishnan, 2021).

Tibetan plateau freshwater resources are integral to many South Asian countries. According to the Institute of Defence Studies and Analysis report in 2010, India and China would need per capita water availability of 1700-2100 cubic meters by 2025. Therefore, water security is becoming a significant source of conflict in 21st century Asia. Approximately one in every five individuals lacks access to clean freshwater. China and India are neighbouring countries and share extended boundaries. These two countries have a significant dispute about water sharing in the Yarlung Tsangpo River basin. The construction of dams by China in the upper reaches of the Yarlung Tsangpo River basin has resulted in the obstruction, diversion, and decrease in water flow to downstream states such as India and Bangladesh, located in the lower Brahmaputra region, thereby leading to a range of adverse consequences for both countries. The diversion has severely impacted on its water resources, affecting its ecology, biodiversity and human life.

Yarlung River Basin and Issues with Shared Borders

The Yarlung water resources are an issue for all riparian states sharing these resources, and the diversion project would affect the sustainability of the environment, food security, health, and social and economic progress of these states. Being a transboundary river, it is imperative that all Riparian states cooperate to share the water resource. Concerns and objections have been growing strong against Chinese projects that have little concern for downstream states and have

violated the rights of these countries. Downstream countries have raised the question of diversion with the Chinese government. The diversion of this water resource has led to the displacement of people and a decline in water quality in India and Bangladesh. Addressing this dispute requires building institutional frameworks that would assist in maintaining the flow of water in all riparian states. In his book, '*Water: Asia's New Battleground*', (Chellaney, 2011) mentions that China is increasingly directing its focus on water reserves of the Tibetan plateau to fulfil water demands of intensive farming. As a developing country with a high population, India requires more water for its development programs to ensure sustainable and inclusive growth. While all riparian states must have equal water distribution, the river water flow to downstream states depends on upstream states and their cooperation. India has signed various treaties regarding water distribution with its neighbouring states. However, the dispute is acute in the case of India and China as they do not share an institutional framework to manage the water distribution of the Brahmaputra River basin. For instance, India has no treaty with China concerning rivers in the North-East Indian region that would direct both to share water according to non-navigation uses of internal waters law. As a result, compared to China, India has been facing an acute crisis of fresh water supply in many of its states. Freshwater water resources are scarce, as is evident in the estimates of the World Bank, according to which China possesses only 6% of the world's total freshwater resources to cater to 21% of the world's total population (World Bank, 2018). Water shortage is magnified by the dropping aquifer levels, disappearing lakes, and polluted rivers. In addition to such pressures, the misuse and mismanagement have intensified the water shortage problem. Hence, the Brahmaputra River basin has been a central issue in the relations between Asian countries.

World Bank Vice President Ismail Serageldin warned in 1995 that:

Many of the wars of this (twentieth) century were about oil, but the wars of the next century will be about water.

(IDSA, 2010)

On a similar note, in 1998, the UNESCO director-general Federico Mayor said:

As (water) becomes increasingly rare, it becomes coveted, capable of unleashing conflicts. More than petrol and land, it is over water that the bitter conflict of the near future may be fought.

(Chellaney, 2011)

Scholars predict that the water crisis and the vicious national competition over water resources will be a source of violent political conflicts in the future. The UN Secretary-General, Kofi Annan, addressed the potential of water resources for future conflict on World Water Day in 2002. He said:

If the entire world's people work together, a secure and sustainable water future can be ours.

(United Nations, 2002)

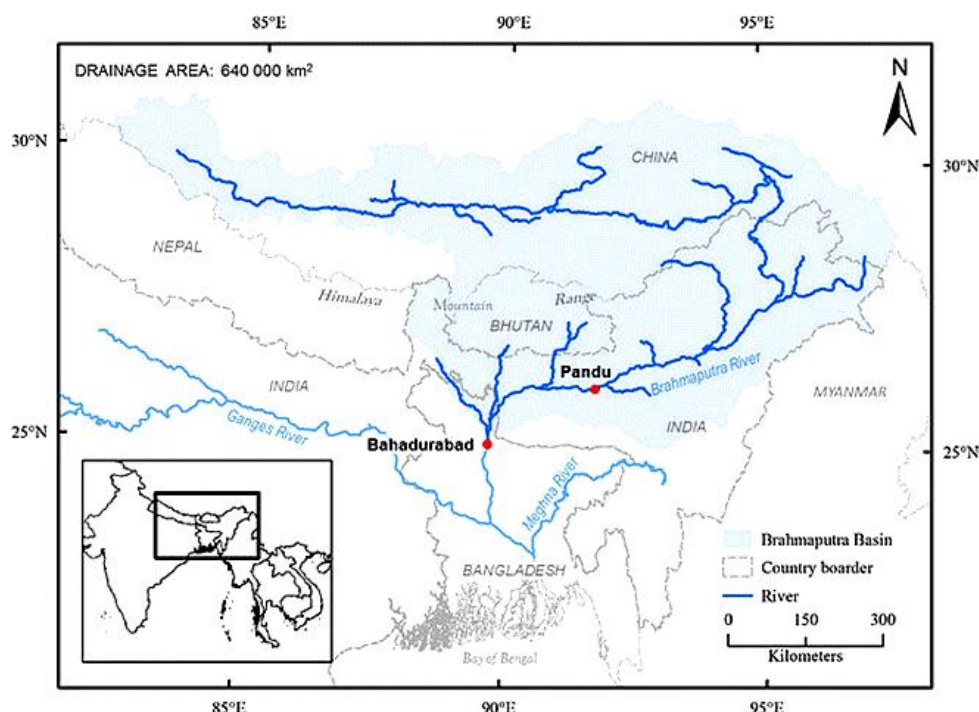


Figure 2. The Brahmaputra River Basin, which begins in Tibet, China, boasts a rich landscape ranging from lofty glaciers to jagged mountains and vast plains. Initially known as the Yarlung Tsangpo in Tibet, it winds through India, touching Arunachal Pradesh, Assam, and eventually Bangladesh. Along this journey, it supports vital ecosystems upon which countless people depend on livelihoods (Fischer et al., 2016)

Table 2. The volume of river waters flowing out of the Tibetan plateau to countries other than China

River system	Direct destination	Mean annual runoff volume out (km ³)
Brahmaputra (Yarlung Tsangpo) and tributaries	India	165,400
Rivers of southwestern and western Tibet	India	181,620
Rivers from southern Tibet	Nepal	12,000
Salween (GyalmoNgulchu, or Nu)	Burma (Myanmar)	68,740
Mekong	Laos and Burma	73,630
Tibetan rivers flowing out from western Yunnan	Burma	31,290

Brahmaputra/Yarlung Tsangpo River Basin

Article 2 of the Helsinki Rules defines an international drainage basin as:

The geographical area determined by the watershed limits of the system of waters, including surface water and underground waters, following into a common terminus.

(The Helsinki Rules, 1966)

In **Figure 2** is the map of the Yalung Tsangpo/Brahmaputra River basin.

Table 2 shows the status of Brahmaputra and other rivers originating in the Tibetan region.

Growing Demand for Water in China

In the years ahead, China will face its most significant demand for water resources. Freshwater reserves decreased by 13% between 2000 and 2009 (Cho, 2011). The economic development that China covets about itself has not matched the requirement for water as surface water in China. The amount of surface water in China is one-quarter of the global average and is distributed unevenly. The water crisis in China lies in groundwater availability and distribution. One of

China's most basic water problems is the lack of accessibility to surface water. Compared to the national average, this region's per capita water resources amount to approximately 20 - 25% for China and just five to six percent of the global standard.

Meanwhile, the North China Plain receives only 10 - 15% of the per capita water supply for the country, representing less than four percent of the global average; on top of that, the North China Plain has high seasonal fluctuations in the water supply. China uses dams primarily for hydropower and storing water for the dry parts of China (Rai & Patnaik, 2012). China is currently undertaking the ambitious \$62 billion South-to-North Water Diversion Project (SNWDP); by its projected completion year of 2050, the SNWDP aims to connect the Yangtze, Yellow, Huaihe, and Haihe rivers (**Figure 3**), facilitating the annual diversion of 44.8 billion cubic meters of water from the southern regions to the water-scarce northern areas (Cho, 2011).

Water consumption in China will increase by one percent annually, according to the Chinese Ministry of Water Resources. Its water resources are diminishing, making it dryer and dryer over time. In 2009, freshwater reserves decreased to 2.42 trillion cubic meters, marking a decline of 353 billion

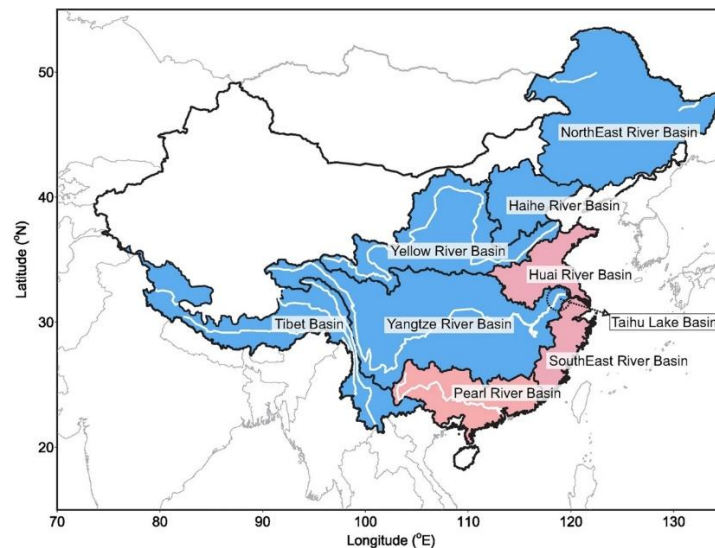


Figure 3. The Yellow River Basin, known as the birthplace of Chinese civilisation, covers expansive areas in northern China that are crucial for farming and industry but are vulnerable to floods. The Huaihe River Basin, which runs through Anhui and Jiangsu provinces, grapples with water scarcity and pollution issues. Meanwhile, the Haihe River Basin, with Beijing and Tianjin at its heart, is wrestling with water management problems due to fast-paced urban growth and industrial development (Liu et al., 2022)



Figure 4. The Chinese administrative map illustrates China's political boundaries, highlighting its provinces, autonomous regions, and municipalities. Notably, it showcases the majestic Yangtze River, which flows from the west to the east, and the iconic Yellow River, symbolising China's rich civilisation, as it meanders across the northern regions from west to east (Wang et al., 2023)

cubic meters compared to 2000, equivalent to a 13 percent reduction (Rai & Patnaik, 2012). In 2018, China's total water resources amounted to 2796 billion cubic meters, with a per capita availability of 2007.57 cubic meters per person; this marked a decline from 2016 figures of 3246.640 billion cubic meters and 2354.90 cubic meters per person, respectively, indicating a decrease in per capita water resources (Zhang & Lin, 2022). Notably, China's per capita water resources fell below 25% of the global average. For instance, the Yangtze River supplies 80 percent of the country's water resources yet

only covers 36 percent of its land area. As shown in **Figure 4**, the Yangtze and Yellow rivers play a central role in China's political and environmental landscape.

In contrast, with 60 percent of the nation's cultivated land and 40 percent of its population, North China has access to just 20 percent of the country's water resources (Global Water Partnership, 2015). China's skewed water scenario has compelled the Chinese state to prepare for future challenges. To meet the demand-supply mismatch of water, China is interested in diverting Tibetan water resources to fulfil their

demand. The expected diverts of water by China affect India and Bangladesh. China generates electricity in the Brahmaputra basin through these dams and maintains its hydro-hegemony in Asia. Diverted water is also used for strategic interest in Western Chinese development programs. China is the foremost industrial water consumer in today's economic landscape, utilising a staggering 120 billion cubic meters annually (Svensson, 2012; Thomson, 2003). Notably, a significant portion of this consumption—roughly one-fifth—is attributed to China's coal mining, processing, and electricity generation sectors. While the arid northern provinces such as Gansu, Ningxia, Shaanxi, Shanxi, Xinjiang, and Inner Mongolia boast substantial coal reserves, the water-rich southern regions hold the key to unlocking the potential of these reserves. The western line of the South-North Water Transfer Project (SNWTP), known as the Nan Shui Bei Diao Project, plays a crucial role in this equation. This initiative sustains the energy-rich region by directly supplying water to the parched Yellow River, facilitating its continued development and growth (Thomson, 2003).

Chellaney (2011) rightly puts China as the world's most 'dammed' nation today. The utilisation of water in China is very high due to its growing industrialisation, high economic growth and growth of urbanisation. Hence, water is one of the critical factors for the development of China. All these factors corroborate the fact that China has enormous water scarcity. China is focusing on large-scale water works like the south to north water diversion project to augment its capacity and manage future challenges. It is a must for China to execute these projects to match the expected rate of economic development. Given this context, China is considering a proposal to reroute the Yarlung Tsangpo River. This move could profoundly affect the flow of water in the Brahmaputra and potentially precipitate a water shortage in India's northeastern region (Saikia, 2022). Through dams, China will control the Himalayan advances of the principal rivers of India and Southeast Asia that deliver wherewithal to the agriculture and energy of these immense territories, which can lead to future water conflicts. Although attention has been paid to the problem of "peak oil", geopolitical implications of water shortage have rarely been recognised. China manages water scarcity and asserts territorial claims with India, Russia, and Vietnam for future needs (Bolton, 2010). China constructed the Zangmu Dam on the Brahmaputra River, bringing power to Northern and Western China. It is designed as a "run of the river" dam, and many proposals have been planned by the Chinese government. As water plays a critical role in India and China's diplomatic relations, it will have severe consequences as the dam will directly affect India's water share.

Diversion of Brahmaputra River

In 1952, Mao Zedong articulated his vision for the south-to-north water diversion project, encapsulating his vision with the famous words, "The South has plenty of water, the North lacks it, so it's okay to lend a little water." Mao's ambitious proposal addressed the water disparity between China's flood-prone southern regions and the arid North (Chellaney, 2011). The diversion project aims to transfer water through three routes from the southern to the northern areas. While the central and middle routes, unaffected by India, will channel

water from the Yangtze River to Beijing and Tianjin in the North, the western course, originating from the Brahmaputra, holds significant implications for India and Bangladesh. This route involves constructing a dam at the 'great bend' of the Brahmaputra, where the river flows eastward towards India (Krishnan, 2011). It seems that for Chinese dam builders, the Brahmaputra holds a significant allure, given its annual cross-border discharge of 165.4 billion cubic meters, surpassing the combined transboundary water flow of other rivers from China to Southeast Asia (Chellaney, 2015). It's reasonable to anticipate the construction of mega dams, similar to those seen on the Mekong, as China embarks on dam-building projects along the Brahmaputra.

South to north water transfer project

The diversion of the South to North water project is paramount in balancing China's development and harnessing the Northern region's potential. There are three rivers in China that are part of the south to north diversion project: Yellow River, Huaihe and Haihe River basins. These river basins face problems with water supply and water demands. The main problem of water scarcity exists due to this region's lack of water resources management (Zhang, 2009).

The water transfer project from the southern part of China to the northern part of China is proposed to resolve the demand-supply mismatch. Three routes of water transfer: western, middle, and eastern routes are planned in this considerable water diversion project linking the Yangtze, Yellow, Huaihe and Haihe Rivers through these three transfer routes. The water resource shortage in the middle and northern parts of China is expected to be reduced, and the severe flood threats in the southern part of China can be alleviated. China diverts water from the upper, middle, and lower reaches of the region's south to the northern and northwestern parts of China. By rerouting, China aims to acquire the target of 45 billion m³ of water volume by the year 2050 (Svensson, 2012). The eastern route is 15 billion m³, the middle path is 13 billion m³, and the western route is 17 billion m³ (Kattel et al., 2019). It is apparent that through these diversions, China wants to improve its water supply.

Issues and concern

China controls and uses Brahmaputra water resources without consulting any downstream states (India and Bangladesh). China has built a dam on the Brahmaputra River basin, which has affected the livelihood and ecology of the downstream region. The concern of downstream countries, especially India, centres on the fact that the downstream countries suffer from water shortages if a dam is built by upper riparian countries to divert the flow to their benefit without having a proper sharing arrangement. China's decision to unilaterally divert resources without adequate consultation, negotiation, and sharing agreements could spark prolonged disputes among nations and pose environmental risks like desertification. The fact remains that the Brahmaputra water is a tactical resource for social and economic development in the Asian region. It is vital for energy generation, human security, and environmental sustainability of food production in China and the whole area.

China's Diversion Policy of Brahmaputra

China's upcoming mega-hydro engineering projects on the transnational river Brahmaputra threaten India's and Bangladesh's internal security. China has been actively building numerous dams on international rivers like the Brahmaputra. These constructions pose significant barriers, particularly for countries downstream, such as India and Bangladesh. The geopolitical implications of these actions are substantial, leading to heightened tensions and risks among the co-riparian nations. Brahmaputra serves as a lifeline to millions of people in India, especially in Assam, irrespective of their occupations. It helps the agrarian society in cultivation by irrigation and supplying essential nutrients to their fields. It also serves as the means of transport for men and materials. The livelihoods of the majority rely directly or indirectly on the river Brahmaputra. Apart from these positive impacts on the lives of many, they also have widespread negative implications in various ways. The Brahmaputra River is infamous for its destructive annual floods and erosion, wreaking havoc on the region and undermining its delicate agro-economic foundation. This recurring natural disaster devastates the valley's banks and engulfs thousands of acres of fertile land under sand deposition, rendering it barren and unsuitable for farming. This often makes the farmers landless and becomes the reason for their migration to other parts of the country in search of a substitute source of maintenance. The Brahmaputra causes frequent violent floods, causing property damage, destruction of community houses and infrastructure and loss of human and animal life as well. Due to its overexploitation, mining, and increasing construction of hydro-engineering projects, it has turned out to be a cause of untenable socio-economic, cultural, and environmental development. Though specific measures are taken for its management, many adverse impacts remain unaddressed and are unsatisfactory. To reduce these negative impacts and devastating effects, all relevant stakeholders should take sustainable measures, including the government and the industrial houses, affected communities, NGOs, and civil society. Therefore, a holistic multi-stakeholder-based approach to mitigation is required. China justifies its diversion policy of Brahmaputra (200 billion m³) by claiming that:

A partial deflection of Brahmaputra would help control flood damage in downstream states like India and Bangladesh and would not adversely impact them.

The diversion would prevent fresh water from flowing into the ocean and become wasted. However, contradictory to the Chinese claim, the ground reality reflects the severe damage the diversion project has done to the river basin of Brahmaputra.

Adverse Impacts of China's Diversion Policy of Brahmaputra

- Variations in the overall pattern of rainfall on the Tibetan Plateau.
- The diversion of water would change Brahmaputra's annual flooding cycle, resulting in the loss of nutrient profiles suitable for agricultural activities in India and Bangladesh.

- This will also block silt and nutrient-rich sediments of the river on its upstream side. This would result in fluvial imbalance upstream and loss of nutrients in agricultural and fishing activities downstream.
- Reduction in the quality of water.
- Flooding of side plains in the upstream.
- On the downstream side, it would result in a drought situation.
- Irrigation causes salinity to increase salt levels in the upper-middle basin because of widespread farming.
- It may result in a decrease in agricultural production levels in downstream regions.
- It would also result in extreme weather conditions in the downstream region.
- Drying of other smaller streams in the northeastern region of India and some parts of Bangladesh.
- It may escalate poverty in the deltaic plains of Bangladesh.
- Widespread Ecological damage.
- Increased damaging impact on wetlands of the Sunderban forests.
- Overuse of groundwater resources will result in decreased groundwater levels and affect the aquifer system in the region.
- Other environmental problems include contamination of coastal areas with saline water, loss of land fertility, arsenic contamination, and water pollution.

Recently, it was reported that China is building a dam on a tributary of the Yarlung Zangpo, also known as Brahmaputra Tibet. It is one of the most expensive hydel projects, and it turns out that part of this diversion policy would create problems in India for various reasons:

1. It would result in the consolidation of Chinese claim over the territory of Arunachal Pradesh.
2. It would be challenging as it is not based on bilateral or multilateral treaties.
3. There is a fear of a reduced flow of water in India.
4. This project could result in a political weapon.
5. It would result in a northward change in the route of the river Yarlung Zangpo.
6. It would result in significant casualties in terms of either flooding of some parts or a reduction in the flow of water. So, the implications of this policy are going to be devastating for both the countries, i.e. India and Bangladesh.
7. Hugh's loss of lives and money was reported in 2001 as one of the constructed dams collapsed.

Projects Part of China's Diversion Policy of Brahmaputra

The Lallo project

The ongoing project on the Xiabuqu River near Xigaze, close to Sikkim, involves an investment totalling \$740 million (Patranobis, 2016). Xigaze, located just a few hours from the Bhutan-Sikkim junction, is a significant city where China plans to extend its railway network towards Nepal. In 2010, China

constructed its inaugural dam on the upper stretches of the Brahmaputra River at Zangmu, marking a pivotal development in the region's hydro-engineering efforts. Additionally, three more dams, namely Dagu, Jiacha, and Jeixu, are currently in various stages of construction, representing smaller-scale projects aimed at further harnessing the river's potential (Table 1).

In 2015, China officially opened the Zam hydropower station, marking the completion of the tallest dam ever built on the Brahmaputra River. Additionally, the Lalho hydel project, situated near the Xigaze region (also known as Shigatse) and involving the construction of a dam on the Xiabuqu River, a 195km tributary of the Yarlung Zangpo, commenced in June 2014 and is expected to be finished by 2019 (Press Trust of India, 2016). The Yarlung Tsangpo River has a mean discharge of 25.8 cubic meters per second (cumecs), representing less than 0.15% of the Brahmaputra's average discharge upon entering India. The reservoir aims to harness this flow, with a capacity to store up to 295 cumecs, facilitating irrigation across 30,000 hectares of land. Additionally, the reservoir will serve the dual purpose of flood control and power generation.

Various Challenges and Possible Implications for India

Ensuring water security is crucial for a large nation like India to meet the needs of its growing population. Supporting economic growth through industrial expansion and urban development is equally vital. According to estimates from the Union Ministry of Water Resources, India's water demand is projected to reach 1093 billion cubic meters (BCM) by 2025 and 1447 BCM by 2050. These figures underscore the urgent need for proactive measures to manage water resources effectively and sustainably (IDSA, 2010). India, home to approximately 17% of the global population, grapples with a significant water scarcity issue, possessing less than 4% of the world's water resources. Compounding this challenge, the nation relies heavily on rivers from foreign territories to meet around a third of its surface water needs. Water scarcity will increasingly burden India's economy and society as its population and demand for water continue to increase (World Bank, 2017).

As a result of this project, the demand and supply of water resources affect the downstream settlement. It would lead to the depletion of water resources in India and Bangladesh, consequently threatening the region's biodiversity in both countries. India and Bangladesh rely on water resources originating from the Tibetan plateau. However, China's extensive construction of numerous dams along the Brahmaputra River basin is evidence of its exploitation of this vital water source for electricity generation and agricultural needs. Furthermore, China's plans to redirect water from this region to the Great Bend area of the river, known as the Great Bend Diversion of Brahmaputra River, pose significant risks. Such actions threaten to adversely impact economic growth, societal advancement, food security, ecological balance, and public health in downstream regions.

Adding dams to the Brahmaputra River will profoundly alter the ecosystem of the Indo-Burma region, which hosts two out of the 34 recognised biodiversity hotspots worldwide (Pradhan et al., 2021). There is a severe potential threat to Kaziranga National Park, Manas National Park and Sundarban

delta. There is imminent fear that the species dependent on the Brahmaputra River will be depleted once its water is diverted. It will have severe ecological and strategic repercussions in the region, leaving aside the livelihood and agriculture concerns. The diversion issue will be creating a problem for two economic powers in the Asian region, India and China. China is the financial hub, and India is also growing as an economic power. Both countries are facing water scarcity problems; water diversion of Brahmaputra will play an essential role in interstate relationships in the coming years. In addition to that, balance of power is critical for regional security. The lack of institutional cooperation between China and India could become a significant problem. If not addressed promptly, it may have adverse effects on the security of the Asian region. These escalating tensions and their possible consequences for regional security are illustrated in Figure 5.

Managing Yarlung Tsangpo (Brahmaputra) River Basin: An Urgent Concern

It is essential to highlight the gap in the institutional mechanism of water sharing of the Brahmaputra River. The growing concern over the international river basin can be traced to the fact that China overuses the water of the Brahmaputra River, which has affected the livelihoods and ecologies of both downstream countries, India and Bangladesh. The dense population in this region has further intensified the scarcity of water, forcing populations to migrate to other destinations and, as a result, causing conflicts. The strategic importance of dams over Brahmaputra is reflected in how the hydrological infrastructures such as dams are used as "*defensive and offensive weapons during wars*" (Rai & Patnaik, 2012). Dams regulate water but are also used to deny water to downstream countries and create conflict. In 2010, China's actions in the river basin renewed the dispute between China and India on Brahmaputra's water (Rai & Patnaik, 2012). The river headwaters in Tibet, controlled by China, provide water to Arunachal Pradesh, which China claims. In 2010, tensions flared in the region when China attempted to obstruct an Asian Development Bank loan for India's proposed dam in Arunachal Pradesh to assert control over the territory. Subsequently, both nations escalated their military presence in the area (Rai & Patnaik, 2012). The absence of institutions relating to transboundary water resources management of Brahmaputra water makes it challenging to integrate water management in the Brahmaputra River basin of riparian countries. As there is a lack of coordination among nations on the banks of the Brahmaputra River basin, they face the danger of possible consequences of the expansion plan of this river. There are multiple problems in these riparian countries, and such expansion of the Brahmaputra River would become a challenge. Some of those problems are:

1. There is no regional treaty between India, China, and Bangladesh regarding water sharing in Brahmaputra.
2. The geographical location of these countries where they are situated very densely along with the vast population, etc.

Suppose the data on flood water and its rising level can be provided to states like Northeast India and Bangladesh, which are vulnerable to floods. In that case, the issue can be solved

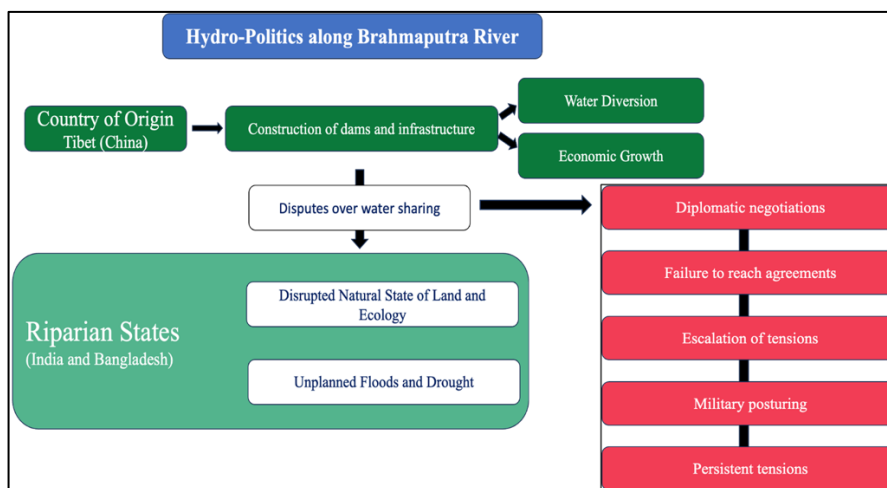


Figure 5. This diagram visually represents the possible chain of events and interactions between China and India concerning their ongoing disputes over water resources. As these two nations grapple with their differences, the situation grows increasingly intricate, fuelling tensions along their borders. This heightened state of disagreement jeopardises diplomatic relations and poses significant risks to the well-being of both people and ecosystems downstream. The failure to reach a mutual agreement exacerbates these tensions, potentially leading to adverse impacts on human communities and the delicate balance of the surrounding environment (Source: Authors' own elaboration, based on secondary literature)

efficiently. To do so, a regional water management body is urgently needed, which different countries can coordinate.

Without any institutional body that can provide authentic data regarding the flood, the situation in Bangladesh becomes more tense. China, which is in a suitable position to provide valuable data to those downstream states, denies access to water-related information. By not signing the 1997 UN Convention on the Law of the Non-Navigational Uses of International Waterways, China makes its stand very clear when it expresses its unwillingness to pass any information related to the Brahmaputra. Such a rigid position causes adverse repercussions for the other countries downstream of the river, where various damming works by China are hardly known.

However, China, India, and Bangladesh have taken a few steps to achieve hydropower cooperation. However, despite those small steps, the required outcome couldn't be achieved due to the absence of the institutional framework. The signing of a memorandum of understanding (MoU) between India and China in 2013 regarding providing data on the Tsangpo River is one example of how both countries seem to be coming closer to cooperation in the hydro field. However, as there isn't a proper, legitimate institutionalised body between both countries, the problem remains unresolved.

The other important factor in this domain is Climate change. The world is facing the existential threat of climate change. Those countries on the banks are primarily in significant danger because of the climate change issue and its major repercussions. In such a situation, the sharing and management of water has become a substantial need for these countries. The possibility of international cooperation among the countries that share water is the focus of this work.

When addressing this mutual concern, many of China's actions seem more symbolic than focused on finding real solutions. In late 2006, during a visit by former Chinese President Hu Jintao to New Delhi, there was an agreement to establish a joint expert-level mechanism to discuss interstate

river waters. This move gave the impression that China was genuinely committed to resolving the issue. China's response to this matter underscores its lack of genuine commitment. Despite India's acknowledgement of China's authority in the water dispute stemming from its control over Tibet, China has been hesitant to engage in meaningful discussions or agreements, whether bilaterally or multilaterally, to address these issues. Since Tibet comes under an upper riparian state, according to the Customary International Law, China gets the first right over available water resources.

China has the upper hand in claiming Brahmaputra waters and justifying its diversion policies due to the non-existence of a coherent water-sharing treaty between India and China. In addition, the principles of customary international water laws that remain in force bolster China's claims.

In such a scenario, India can do little to challenge Chinese dominance by deploying water as a political tool. In 1966, the Helsinki Rules were established to ensure fair use of international rivers and prevent significant harm to neighbouring states. India joined as a signatory to these rules in 1973, demonstrating a commitment to their principles. However, China chose not to participate. Despite not being legally binding, these rules align closely with established norms in international water laws, emphasising the importance of equitable water usage and preventing harm to downstream nations.

Recent Developments in Management of the Brahmaputra River Between India and China

In 2018, the Chinese Foreign Ministry announced that it has now agreed to share the data concerning the Brahmaputra River with India, which it had withheld in 2017 after the Doklam military standoff in the eastern part of India. Beijing is bound by bilateral agreements to share the river data with India but withheld this exercise from 2017 after both armies had a 73-day face-off at Doklam. While Beijing cited renovation of data sharing stations as the reason for not

sharing, experts argue that it was a form of 'water war' by China sparked by the Doklam issue. The announcement in 2018 followed India-China talks over the trans-border rivers in the 11th edition of the India-China Expert Level Mechanism Meet (ELM) (Press Trust of India, 2018). To improve their bilateral relations, both countries have agreed to continue with river data sharing and cooperation of hydrological information. In the case of India, hydrological data helps predict and prepare in advance for floods in northeast states.

DISCUSSION

The relationship regarding water between India and China is quite complicated. It's not just about cooperation or conflict; there are shades of both. However, conflicts have often outweighed cooperation. China's plan to redirect the Brahmaputra River northwards has caused tension. India, China, and Bangladesh rely on this river for irrigation, energy, and livelihoods, which adds to the complexity. China's need for water due to agriculture, industry, urbanisation in the North, and water scarcity in the Southwest drives their interest in diverting the river. This affects India's people and their reliance on the river for various needs, making cooperation crucial for both countries' development and health. India is worried about the Brahmaputra River because it affects its safety. China's dams on the river can be used as weapons in wars. China controlling the water can hurt countries downstream. As in Arunachal Pradesh, China is trying to stop India from building dams. The possible changes to the Brahmaputra River could have severe effects on nature. The Indo-Burma region in India is rich in biodiversity. If China alters the river's course without an agreement, it could harm this area and parks like Kaziranga and Manas. The yearly floods bring nutrients for growing rice, which is crucial for India and Bangladesh. India is concerned about these changes and negotiates with China. Despite ecological impacts, China sees benefits in diverting the river, especially in Tibet. This relates to China's control over Tibet and the exploitation of its resources. Despite concerns, China may reconsider due to international pressure and improving relations with India. Cooperation between the two countries could shape the future of river politics. The management of the Yarlung Tsangpo River basin poses a significant challenge, as it is closely linked to international tensions. At present, there is no available water-sharing treaty signed for Brahmaputra. China isn't interested in sharing data or agreeing to essential conventions.

The relationship between China and India regarding water resources is crucial. China's approach affects not only India but also other nations. Despite being a primary water source, China hasn't signed any water-sharing treaties. To improve cooperation, downstream countries should focus on diplomacy rather than power struggles. Water, especially from Tibet, holds significant geopolitical importance in Asia due to its role in agriculture, industry, and urbanisation. China aims to utilise water from the Tibetan plateau, including the Brahmaputra River, which is vital for India and Bangladesh. Freshwater is essential for development, health, and economic growth, particularly in populous and developing nations like China and India. However, managing water resources sustainably,

especially from the Tibetan plateau, presents a significant challenge. China is building dams on the Brahmaputra River, which is causing issues in India. Their water project aims to divert water from Tibet to Northern China, affecting river ecology and causing unpredictable flow, leading to flash floods in India. India faced floods in 2000 - 2005. Both nations need a mediator to resolve this crisis.

CONCLUSION

The research elucidates the criticality of the China-India water relationship and the broader implications for regional stability and sustainable development. The absence of a water-sharing treaty exacerbates uncertainties, emphasising the urgency for diplomatic solutions over unilateral actions. This study underscores the imperative for collaborative frameworks to address the complexities of transboundary water governance, which is crucial for fostering peace, security, and prosperity in the region. The intricate relationship between India and China concerning water resources underscores a complex interplay of cooperation and conflict, with conflicts often overshadowing cooperative endeavours. China's proposed diversion of the Brahmaputra River has emerged as a focal point of tension, given its significance for irrigation, energy, and livelihoods in India, China, and Bangladesh. This underscores the imperative for cooperative frameworks to navigate shared water resources for mutual development and sustenance. India's apprehensions regarding the Brahmaputra's diversion stem from concerns over security, ecological impacts, and downstream consequences. China's interests in diverting the Brahmaputra are rooted in addressing water scarcity and supporting agricultural, industrial, and urbanisation needs in its northern regions, with implications for controlling Tibet's resources. However, the unilateral approach raises ecological and geopolitical concerns, necessitating diplomatic engagements and cooperation mechanisms. Sustainable water management, particularly in the Tibetan plateau, is a pressing concern, necessitating international cooperation and mediation. By prioritising ecological integrity, socio-economic development, and collaborative governance, India and China can chart a course towards a more equitable and prosperous future for the Brahmaputra River basin and beyond. This requires a concerted effort to transcend political differences and embrace a shared vision of sustainable water management, benefiting present and future generations.

These findings hold important lessons for local cooperation and the wider diplomatic arena. The absence of a basin-wide agreement on Brahmaputra waters thus emerges as both a warning and a rare opening. By bringing China's upstream influence and downstream vulnerabilities into the same analytical frame, the paper lays groundwork for fresh institutional blueprints. Lawmakers and planners could translate this reading into push for open data, tamper-proof ecosystem monitoring, and a South Asian River authority echoing the Mekong Commissions structure. From a scholarly angle, the work advances hydro-hegemonic conversation by trying it explicitly to climate pressures and shifting power

maps. Future studies may include wet-season simulations, AI field sensors, and integrated regional decision exercises.

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