



Research

## Beyond the Border: Exploring the Complex Dynamics of Water Tensions Between India and China

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### Abstract

This paper explores the historical context and current dynamics of the transboundary water issues between India and China. Both countries share multiple transboundary river basins, with the Brahmaputra River being one of the most significant. The importance of the Brahmaputra River to both nations goes beyond just providing resources. It has implications for national security, regional stability, and human livelihoods. However, China's upstream control over the river and its extensive dam-building projects have raised concerns in downstream India and Bangladesh about potential impacts on water availability, agriculture, and livelihoods. The river system is critical for the socioeconomic well-being of millions of people, yet the competing demands for water resources have led to geopolitical tensions. The paper highlights China's strategic use of water resources, including plans for large-scale dams, which India views as a potential threat to its water security. It also underscores the importance of a nuanced understanding of hydrogeopolitics, emphasizing the need for human security, particularly water security, in addressing these challenges. It argues that while "water wars" are unlikely, "water tensions" are significant and must be addressed through comprehensive bilateral agreements and collaborative efforts.

**Keywords** Himalayan waters · Brahmaputra river · India-China cooperation · Transboundary

## 1 Introduction

The Brahmaputra River originating in the Kailas range of the Himalayas, flows 2,300 miles through China, India, Bangladesh, Nepal, Bhutan and Burma. This River is known by different names in different regions, along its course Yarlung Zangbo in Tibet, Brahmaputra in India and Jamuna in Bangladesh, while collectively it is regarded as the Yarlung Zangbo-Brahmaputra-Jamuna River System. This River basin is mainly known for its bone of contention between India and China. Apart from Brahmaputra River Basin, China and India also shares other major transboundary river basins in South Asia: the Indus Basin, and the Irrawaddy Basin. These river systems are crucial for both nations, not only for their ecological and hydrological significance but also for their geopolitical and socio-economic implications. As Water is considered as the universal resource that transcends national boundaries and also serves as a catalyst for both cooperation and conflict [1]. In this context, the transboundary river basins are both a source of potential conflict and an opportunity for cooperation between China and India, depending on how both countries choose to manage and share these critical resources. The Yarlung Zangbo-Brahmaputra-Jamuna River system, in particular, is a focal point of these tensions due to

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its strategic significance and the competing interests of the nations it traverses. This river system is critical for millions of people's socioeconomic well-being across these countries. However, the competing demands for water resources have led to significant geopolitical tensions. China, being the upstream country, holds substantial control over the flow of the river, which has raised concerns in downstream India and Bangladesh about potential impacts on water availability, agriculture, and overall livelihoods. The historical context of the tensions, particularly related to border disputes and strategic rivalries, could have been further explored to provide a deeper understanding of why the management of transboundary rivers like the Brahmaputra remains such a contentious issue. The problem of water resources takes on significant relevance in the heart of Asia, where two rising giants, India and China, share intricate relationships and simmering tensions. This paper adopts a discursive approach to explore the current discourse on the Yarlung Zangbo-Brahmaputra-Jamuna issue, aiming to provide a comprehensive analysis of the various dimensions of the problem. It will not argue for a single solution but will rather present a broad spectrum of perspectives, focusing on the impetus for collaboration and the need for a formal treaty between India and China.

## 2 Context and empirics

The problem of water resources takes on a significant relevance in the heart of Asia, where two rising giants, India and China, share intricate relationships and simmering tensions [2]. India shares eight transboundary basins with six neighbouring states (Bangladesh, Bhutan, China, Myanmar, Nepal, and Pakistan) and one non-bordering State Afghanistan). Whereas China shares 17 transboundary basins with 14 neighbouring states (Afghanistan, Bhutan, India, Kazakhstan, Kyrgyzstan, Laos, Mongolia, Myanmar, Nepal, North Korea, Pakistan, Russia, Tajikistan, and Vietnam) and three states further downstream (Bangladesh, Cambodia, and Thailand). Both China and India share three transboundary basins: The Ganges–Brahmaputra–Meghna Basin is considered as one of the largest river systems in the world spanning from China, India, Bangladesh and Nepal. The Ganges–Brahmaputra–Meghna Basin is particularly significant for North-eastern India and Bangladesh as it is the major source of water for agriculture, drinking water and hydropower generation. The Indus Basin originates in Tibet and flows through India and Pakistan, making it a vital water resource from these countries, this basin includes the main river Indus and its tributaries such as Jhelum, Ravi, Beas, Chenab and Sutlej. These Rivers are considered as crucial for agriculture, especially in the States of Jammu & Kashmir, Punjab, Haryana and Parts of Pakistan, then finally the Irrawaddy Basin originates in the eastern Himalayas, primarily within Myanmar, but its headwaters are in China's Yunnan's Province. The Irrawaddy does not flow through India, but it has connections with the other transboundary water system that impacts the region [3]. These rivers play a vital role in connecting their water resources with profound significance.

The Yarlung Zangbo-Brahmaputra-Jamuna, the Brahmaputra River Basin (BRB), is one of the greatest rivers in South Asia, especially in Indian context, which begins its journey in the Tibet Autonomous Region (TAR) of China and then flows through four different countries, namely China, Bhutan, India, and Bangladesh, before culminating in the Bay of Bengal. Spanning a distance of 2,900 kms (1,800 miles) from its origin the expansive basin of the BRB, encompassing a total area of 580,000 square miles, and extends across various geopolitical entities, including the TAR (50 per cent), Bhutan (7 per cent), Bangladesh (7 per cent) and the Indian states of Arunachal Pradesh and Assam (36 per cent). In the Indian context, the drainage basin of the Brahmaputra River encompasses approximately 195,000 square kilometres, constituting 6 per cent of the nation's total land area [4]. It serves as a valuable source of economic advantages, including hydropower generation, irrigation support, and facilitation of inland water navigation. Additionally, it holds profound social and cultural importance for the communities' dependent on the river (See Table 1) [5].

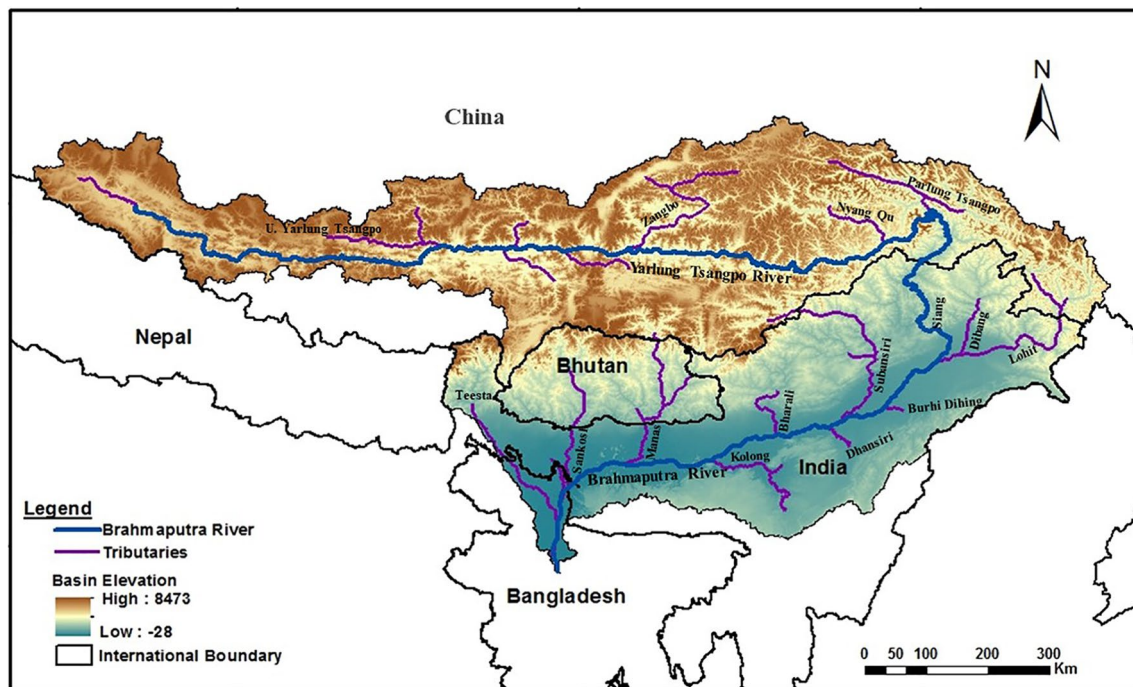
The Brahmaputra plays a crucial role in providing nourishment and financial assistance to a large population living alongside it [4]. The hydrological landscape of Asia is focalised around China, which serves as the origin of rivers extending downstream to several countries like India and Bangladesh. This dominance is a consequence of China's annexation of the water-abundant Tibetan Plateau. Commonly referred to as "The Third Pole," "The Water Tower of Asia," "The Roof of the World," and "The Barometer of Asia," as this region encompasses pivotal rivers such as the Indus River (Senge Tsangpo), Brahmaputra River (Yarlung Tsangpo), Mekong River (Zachu), Yangtze River (Drichu), Yellow River (Machu), Salween River (Gyalmo Ngulchu), and Ganges [6]. Approximately 2 billion people rely on major rivers originating from the Tibetan plateau in the southwest, underscoring its significance (See Fig. 1) [7].

As the current India–China border standoff in its current fourth-year winters, which is marked by territorial disagreements, profound distrust, border frictions, and a geopolitical competition [8]. It is facing a security conundrum, with

**Table 1** Key Transboundary Rivers Shared by India and China. **Source:** Author's Compilation

River Name	Origin	Length (km)	Basin Area (sq. km)	Countries Shared	Major Uses
Brahmaputra	Tibet (China)	2,900	580,000	China, India, Bhutan, Bangladesh	Hydropower, irrigation
Indus	Tibet (China)	3,180	1,165,000	China, India, Pakistan	Irrigation, hydropower
Ganges	Uttarakhand (India)	2,525	1,080,000	India, Bangladesh	Agriculture, hydropower
Mekong	Tibet (China)	4,350	795,000	China, Myanmar, Laos, Thailand, Cambodia, Vietnam	Hydropower, navigation
Yellow River	Qinghai (China)	5,464	752,000	China	Agriculture, hydropower
Yangtze	Qinghai (China)	6,300	1,800,000	China	Hydropower, navigation

Data by <https://doi.org/10.2166/wp.2016.103>



**Fig. 1** Map of Brahmaputra River Basin (BRB). Source: WIREs Water, Vol: 10, Issue: 2, First published: 02 December 2022, DOI: (10.1002/wat2.1626)

water difficulties potentially acting as a significant pressure point or catalyst in their relations [9] and impacting the lives of the people on both sides. Echoing the words of Mikhail Gorbachev;

“Water, like religion and ideology, has the power to move millions of people. Since the very birth of human civilisation, people have moved to settle close to it. People move when there is too little of it. People move when there is too much of it. People journey down it. People write, sing, and dance about it. People fight over it and all people, everywhere and every day, need it” [10].

Given this context, China's hydropower dam projects on the Yarlung Tsangpo-Brahmaputra, including plans to build the first downstream dam in Medog County, have sparked significant concerns in downstream India, more than in any other state [11]. As the Ananth Krishnan, Correspondent, The Hindu notes that, China's new proposed dam is likely to be a run-of-the-river hydropower project that will not divert water, but will be the first on the lower reaches [59]. China being the primary recipient of transboundary rivers originating in Tibet, and a potential competitor, India may perceive that China has a strategic incentive to exploit or redirect Tibetan river-water resources. This raises fears that China could use its control over these rivers to influence water availability in India [12]. Although, both countries water resources are governed by the two global water conventions: the 1997 Convention on the Law of the Non- navigational Uses of

International Watercourses (Watercourses Convention) and the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) [3].

In recent years, the Chinese government has embarked on an ambitious plan to harness its waters through a series of large-scale dam projects. The motivation behind these projects is multifaceted: aiming to generate substantial hydroelectric power to meet China's growing energy needs, attempting to control flooding, and providing water for irrigation and consumption [13]. According to the World Commission on dams, China had 22 large dams in the year 1949, and by 2000, this had increased to 22,000 dams. According to Loh Su Hsing mentioned in *Jakarta Globe* in 2011, "China has dammed every major river on the Tibetan Plateau-including the Mekong, the Salween, the Brahmaputra, the Yangtze, the Yellow, the Indus, the Sutlej, the Shweli and the Karnali." [14]. This includes proposals to construct a dam that exceeds the size of the "Three Gorges Dam" by more than twofold, known as the 38-gigawatt Motuo Dam, as well as the "Super Dam" on the lower levels of the Brahmaputra, along the Line of Actual Control (LAC) (See Table 2). The Chinese intentions are partially to alter the natural southward water course of the river by redirecting it towards northward [6]. To which Peter Bosshard, of the International Rivers Network said, "Rivers unite us, but dams divide us," [16]. He even points out that;

"India's disregard for Bangladesh's rights while addressing China's assertion over the river. The concern is raised that the competitive rush to construct dams on the Brahmaputra by both China and India could result in cumulative environmental impacts surpassing the river's ecosystem limits. This, in turn, poses a threat to the livelihoods of over 100 million people who rely on the river."

China's ongoing dam construction initiatives along the Brahmaputra are progressively advancing towards the Great Bend region, which represents the primary concentration of water resources [10]. It is significant for hydroelectric capacity, ranking among the largest globally. However, India proposed hydropower 12 [17]. The objective of this project, reported by Ministry of Power, that it is pivotal, to produce a cumulative installed capacity of about 11,517 MW [60]. This project is strategically significant for India, not only for meeting its growing energy demands but also as a countermeasure to China's expansive water diversion and damming initiatives on shared river systems like the Brahmaputra. Both nations are engaged in extensive dam construction, a phenomenon that has far-reaching implications for water security, ecological balance, and regional stability. According to Dr Medha Bisht, Professor at the South Asian University, added in her interview at the *South China Morning Post*;

"Over the past two decades, dams have been constructed on the Yarlung Zangbo River in Tibet. There is apprehension regarding China's current emphasis on the lower stretches of the river, raising concerns about potential ecological and strategic consequences. The ecological impact encompasses land degradation, alterations in sedimentation dynamics, and the risk of flash floods leading impact on millions of people. On a strategic level, there are worries about the potential use of dams to redirect water eastward."

The strategic significance of water resources in India and China extends beyond mere population concerns, though the sheer scale of demand does exacerbate existing challenges. Both countries face increasing pressure on their water resources, driven by a combination of factors including economic growth, industrialization, and agricultural needs [15]. The Brahmaputra River, in particular, has become a focal point of concern for India due to China's upstream damming activities and potential water diversion plans [18]. These actions could severely disrupt the natural flow of the river, leading to increased salinity, silting, and changes in flood and drought cycles in downstream regions. Such disruptions would have profound effects on agriculture, fishing, and the livelihoods of millions in India's northeastern states [7]. This underscores the broader issue of water being treated as a strategic commodity, with China's control over the Brahmaputra posing significant risks to India's water security [17].

Additionally, it is also witnessed in the case of China-India "upstream" and the "downstream" countries when their relations are good, they enter into bilateral agreements, engage on the issues and share data, but when they have any issue at the border, then it becomes a problem and always lead a huge impact on the displacement of the people residing near the transboundary rivers (See Tables 3 and 4) [19]. According to Dr Amit Ranjan, a Research Fellow at the National University of Singapore's Institute of South Asian Studies;

"Water-sharing discussions are often entangled with broader diplomatic relations is well-founded, as evidenced by historical events. For instance, during the 2017 Doklam standoff between India and China, China halted the sharing of hydrological data on the Brahmaputra River, citing technical reasons such as the destruction of monitoring stations due to floods. However, many analysts believe that this suspension was a direct consequence of the heightened tensions between the two countries" [61].

This disruption had significant consequences for India's flood forecasting capabilities, particularly in the northeastern states where the Brahmaputra's water levels are critical for managing flood risks. The data, which is usually shared twice daily from May 15 to October 15, was not provided during a crucial period, thereby increasing the vulnerability of millions

**Table 2** Major Chinese Dam projects and their potential impacts on India. Source: Author's Compilation

Project name	River	Location	Planned capacity	Impact on India
Three Gorges Dam	Yangtze River	Hubei Province	22.5 GW	Although not directly impacting India, it serves as a model for China's mega-dam ambitions. The hydrological control might influence water-sharing talks
Motuo Dam	Yarlung Tsangpo (Brahmaputra)	Tibet Autonomous Region	38 GW	Significant impact on water flow into the Brahmaputra, affecting downstream regions in India, particularly Assam, with potential risks of reduced water flow, flooding, and altered sediment patterns
Super Dam(Lower Brahmaputra)	Brahmaputra River	Tibet Autonomous Region, LAC	Not specified	Direct impact on India, especially in Arunachal Pradesh and Assam, with concerns over water security, agricultural impact, and potential for geopolitical tensions
Zangmu Dam	Brahmaputra River	Tibet Autonomous Region	510 MW	Impacts the flow of the Brahmaputra, potentially affecting water availability and agriculture in the northeastern states of India. Concerns over unilateral control of water resources
Jinghong Dam	Mekong River	Yunnan Province	1.75 GW	While it affects countries like Thailand and Cambodia more, India views such projects with concern due to potential future impacts on shared river basins and precedent-setting
Nuozhadu Dam	Mekong River	Yunnan Province	5.85 GW	Similar concerns as with the Jinghong Dam, particularly regarding the precedent it sets for water control in transboundary rivers
Nansha Dam	Salween River	Tibet Autonomous Region	3.24 GW	Potential impact on water flow into Myanmar and indirectly on the Brahmaputra basin, affecting downstream flow and ecology
Lianghekou Dam	Yalong River (Yangtze tributary)	Sichuan Province	3 GW	Could affect the overall hydrology of the region, impacting water flow patterns and potentially influencing downstream regions, including India's eastern rivers

Data by <https://mcouts2.com/wp-content/uploads/2014/02/eia-3gorgesdam.pdf>

**Table 3** Mean monthly rainfall across five stations within the Brahmaputra Sub-basin.

**Source:** Nilanjan Ghosh, Jayanta Bandyopadhyay and Sayanangshu Modak, "China-India Data Sharing for Early Flood Warning in the Brahmaputra: A Critique", *ORF Issue Brief No. 328*, December 2019, Observer Research Foundation

Month	Shigatse (rainfall mm)	Lhasa (rainfall mm)	Tuting (rainfall mm)	Guwahati (rainfall mm)	Bahadurabad (rainfall mm)
January	1	3	29	10	10
February	1	13	44	4	13
March	4	8	78	25	33
April	13	7	84	145	88
May	19	25	71	236	283
June	24.5	53	66	312	439
July	41	122	98	312	428
August	34	89	112	261	370
September	21	66	73	167	306
October	8	13	49	71	164
November	1	3	32	14	15
December	2	0	31	4	2
Total	169.5	400	767	1561	2151

[https://www.orfonline.org/research/china-india-data-sharing-for-early-flood-warning-in-the-brahmaputra-a-critique1#\\_edn44](https://www.orfonline.org/research/china-india-data-sharing-for-early-flood-warning-in-the-brahmaputra-a-critique1#_edn44)

**Table 4** Discharge at Various Sites on the Yarlung Tsangpo, Siang, Brahmaputra, and Jamuna Rivers. Source: Nilanjan Ghosh, Jayanta Bandyopadhyay and Sayanangshu Modak, "China-India Data Sharing for Early Flood Warning in the Brahmaputra: A Critique", *ORF Issue Brief No. 328*, December 2019, Observer Research Foundation

Stretch	Observation site	Mean annual discharge (in BCM)
Yarlung Tsangpo	Nuxia	31.2
Yarlung Tsangpo	Point leaving China	135.9 / 78.10
Siang	Pasighat	185.1
Brahmaputra	Bechamara, Majuli	278.4
Brahmaputra	Pandu	526.1
Jamuna	Bahadurabad	605.49

[https://www.orfonline.org/research/china-india-data-sharing-for-early-flood-warning-in-the-brahmaputra-a-critique1#\\_edn44](https://www.orfonline.org/research/china-india-data-sharing-for-early-flood-warning-in-the-brahmaputra-a-critique1#_edn44)

of people living in the region to potential floods. Additionally, the credibility of data shared between the two countries has also been questioned. During periods of diplomatic strain, there is often skepticism about the accuracy and completeness of the information provided. This uncertainty further complicates water management and planning efforts, as the downstream country (India, in this case) may not fully trust the data it receives from the upstream country (China) [62].

### 3 Literature review

#### 3.1 General theory of hydropolitics and water security

The theory of hydropolitics is characteristics and changes in inter-state conflict and cooperation around shared water resources. Hydropolitics is the dominant body of political literature that focuses on conflicts over water resources that cross national boundaries. The procedures offered by the political viewpoint aim to overcome the limitations imposed by the political environment on transboundary water interactions, with the goal of facilitating the resolution of conflicts related to transboundary water issues. Julien (2012) offers a constructivist approach to hydropolitics, allowing for a more comprehensive understanding of water-related interstate relations. This approach emphasizes the socio-political contexts and the constructed nature of water conflicts and cooperation. Jankielsohn (2012) argues for a holistic approach to hydropolitics, which is crucial for addressing water shortages and reducing political unrest and instability [18, 19].

This approach integrates various factors influencing water management and security. Rogers and Crow-Miller (2017) highlight significant gaps in critical scholarship on hydro-politics in China. These gaps constrain the understanding of the inherently political nature of acute water challenges and their impacts beyond its borders. Grünwald, Feng, and Wang (2020) propose the TWINS framework to analyse interstate relations on water-related issues. This framework distinguishes between six intensities of cooperation and conflict and evaluates water events as a form of cooperation, conflict, or both. Warner et al. (2017) discusses the evolution of hydro-hegemony theory beyond state-centricity and negative hegemony. The theory now embraces various strands of international relations theory, promoting vibrancy in transboundary water conflict and cooperation. Zeitoun et al. (2019) propose an analytical method designed to support efforts to transform inequitable and unsustainable transboundary water arrangements. This transformative analysis leverages socio-ecological thinking to critically evaluate the processes that have established and maintained such arrangements, including hydro-diplomacy itself [20].

However, the term “water security” may also be considered as an integral part of “human security.” For this purpose, it is first necessary to take account of human security as has been defined by the United Nations General Assembly Resolution 66/290 that defines human security as “an approach to assist member states in identifying and addressing widespread and cross-cutting challenges to the survival, livelihood and dignity of their people.” In fact, in a similar report by the United Nations Development Program (UNDP), also outlined seven vital dimensions of human security, which is nothing but seven other securities associated with human life, which are economic security, food security, health security, environmental security, personal security, community security, and political security. Therefore, it is quite evident that water security is deeply linked with these human security aspects [21].

However, water has been a potential source of security and strife for a very long time, dating back to ancient times and continuing right up until the current day. Consensus exists over the projection that water-related stresses due to natural disasters and increasing competition over water will increase towards 2050 [22].

According to Ismail Serageldin, former vice president of the World Bank, said “The wars of the next century will be about water.” This is also the best way to summarise a viewpoint that is becoming more and more widespread regarding water and security. In the literature, water is described as a cause of acute international conflict both historically and, by extrapolation, in the future [23]. Linking Serageldin’s theory with the specific case of China-India water dynamics, one can argue that while outright “water wars” may not have occurred yet, the strategic manipulation of shared water resources can lead to significant international conflicts. The suspension of data sharing during the Doklam standoff and concerns over the construction of dams upstream by China are modern-day examples of how water can exacerbate existing tensions between nations. Therefore, Serageldin’s statement is not just a generalized prediction; it is directly applicable to the ongoing and future disputes between China and India over shared rivers. The literature on water conflict suggests that as water scarcity intensifies, so too will the potential for conflict, making it crucial for nations to develop cooperative frameworks that can withstand the pressures of geopolitical rivalry [24].

### 3.2 Hydro hegemony and transboundary water conflicts

A significant contribution to the field comes from Mark Zeitoun and Jeroun Warner’s framework of hydro-hegemony, which provides an analysis of power dynamics in transboundary water conflicts. According to Zeitoun and Warner (2006), hydro-hegemony occurs when one country, usually an upstream state, exerts control over shared water resources, often to the detriment of downstream states. This framework is essential for understanding the power asymmetries in water politics and how they shape interactions between riparian states [25]. Naho Mirumachi’s work in critical hydro-politics also offers valuable insights, focusing on the transformation of water conflicts and the role of socio-political contexts in shaping water governance. Mirumachi emphasises the importance of analysing water conflicts beyond mere resource disputes, considering the broader political and socio-economic factors that influence them. Similarly, another work by Warner, J., Mirumachi, N., Farnum, R., Grandi, M., Menga, F., & Zeitoun, M. (2017) examines, the Hydro-hegemony theory has evolved beyond state-centricity and negative hegemony, embracing various strands of international relations theory and promoting vibrancy in transboundary water conflict and cooperation [26].

Water resources play an important dual role in improving peace and triggering conflict around the world. While political instability and conflicts are generally not due to one single cause, water has, at times, been the primary reason for disputes among communities, among the population and the state, or among countries—not to mention its use as a possible “weapon” of war and water itself being a victim of attacks. However, according to the report “Water Conflict Pathways and Peacebuilding Strategies” by David Michel said that “there have been more than forty hostile and militarised international actions related to water since World War II, but there is no evidence of modern wars declared over

water." It has also been witnessed that the most common situation of transboundary water conflicts arises when water acts as a trigger due to a clash of interests between different users or when the actions of one party bring about a fall in the quantity and quality of water of the other [27].

Another study examined by the United Nations' report "Blueprint for Acceleration: Sustainable Development Goal 6 Synthesis Report on Water and Sanitation 2023," transboundary waters account for 60 per cent of the world's freshwater flows, while 153 countries have territory in at least one of the 310 transboundary river and lake basins. This "shared" water has been and still can be a trigger for conflicts, as shown by a study led by Lucia De Stefano, Aaron T. Wolf and many other researchers from around the globe. This study suggests that the most considerable indicator of transboundary tensions occurs when one party wants to build infrastructure without discussing the impacts on the neighbours downstream [28]. Therefore, in order to effectively manage transboundary water resources, it is necessary to take into consideration the various aspects of possible conflict.

Actions conducted in the upstream that result in adverse impacts downstream can be classified as economically antagonistic behaviours, which have the potential to instigate transboundary water conflicts [16]. First, there is the question of "hydro-hegemony" in which China, as the upstream country, exerts significant influence over the flow and utilisation of transboundary rivers by using its geographical advantage and infrastructural capacity. Hydro-hegemony refers to the power an upstream country, like China, wields over transboundary rivers, allowing it to control water flow and usage to the detriment of downstream nations. China's strategic location at the headwaters of rivers such as the Brahmaputra enables it to influence water availability and quality for countries like India. Through extensive dam-building and potential water diversion projects, China can leverage this control to assert its dominance in regional water politics, affecting the livelihoods and security of millions in downstream areas. This has resulted in uneven power dynamics, with India frequently finding itself at a strategic disadvantage. Second, there are no effective bilateral or multilateral water-sharing agreements between the two countries [29].

China's aggressive hydropower development is driven by its need to address water scarcity and secure renewable energy. As of 2020, China had constructed over 87,000 small dams, many of which are located on major transboundary rivers such as the Brahmaputra and Mekong [63]. These dams can significantly alter river flows, sometimes leading to water blockades or flood-like conditions downstream, as observed in the Mekong Delta and India's northeastern states. whereas in India, In India, the situation is particularly critical in agriculture-intensive regions, where any reduction in river flow could have severe consequences for food security and livelihoods [64]. The Brahmaputra and Ganges rivers, for example, are lifelines for millions of farmers, making the stability of their flow a national priority. The potential for these water disputes to escalate into broader conflicts underscores the need for cooperative water management and transparent data-sharing between the two countries [30].

### 3.3 Hydropolitical analysis and power dynamics in transboundary water governance

Hussein, H., Grandi, M., (2017) have conducted extensive research on the hydropolitical contexts of various river basins. Their work highlights the importance of local and regional political contexts in shaping water governance outcomes. For instance, their hydropolitical analysis of the Blue Nile and Yarmouk River Basins demonstrates how geopolitical factors and national interests influence water-sharing agreements and disputes. Water has always been political in nature and competing narratives of water rights and equity is not new. The governance and management of water is frequently contested by stakeholders and opinions are echoed in the media and throughout civil society. Academics have responded with extensive bodies of research into historical cooperation and conflict over water, arguing that cooperation is a more frequent outcome, and the notion of water wars is largely exaggerated [31].

Hussein, H., Grandi, M., (2015) in their paper investigates the intra-basin hydro-political relations in the dynamic contexts of Yarmouk and Blue Nile rivers. In both cases, the lack of a shared vision on the management of transboundary waters has resulted in unilateral initiatives rather than comprehensive and agreed legal frameworks. Adopting a broader problem- shed approach rather than a narrow watershed one, this paper captures the interests and reasons of such dynamic contexts, and analyses how recent changes impact on the transboundary water management of shared basins [32].

Talozzi, S., Altz-Stamm, A., Hussein, H., & Reich, P. (2019) in their paper evaluate the Jordan-Israel water agreement, established in 1994, is no longer equitable due to population growth and the availability of alternative water resources [33]. Cascão, A. (2009) talks about power relations in the Nile River basin have changed over the past decade, influencing political relations and water resource allocation [34]. Daoudy, M. (2009) said that asymmetries in power in the Euphrates



and Tigris water conflict have favoured bilateral or basin-wide arrangements, with bargaining power and time playing key roles in determining dynamics between riparians [35].

Wheeler, G., Hussein, H (2021) argues that while water policies often shape academic research, academia itself is not immune to nationalist influences and their article examines how narratives around water wars and resource nationalism influence both policy and research, often leading to biased academic outputs. For example, in the case of Jordan Basin and Nile River Basin, it illustrates how nationalistic agendas can shape water-related research and its discourses [36].

In context of India and China the lack of a formal water-sharing agreement further complicates the management of the Brahmaputra. Both nations have different priorities and strategies when it comes to water resource management, leading to mistrust and sporadic disputes. The political and socio-economic consequences of these water tensions underscore the need for a comprehensive bilateral agreement focused on equitable water sharing, real-time data exchange, and joint management of water resources [37].

### 3.4 Water tensions vs water war

The India-China power struggle over transboundary water resources presents two primary narratives: water tension and water war. The water tension narrative emphasises the ongoing diplomatic, political, and socio-economic conflicts that arise due to shared river systems, such as the Brahmaputra. Experts argue that water tension is characterised by mistrust, sporadic disputes, and competitive infrastructure development, like China's dam-building activities on the Yarlung Tsangpo. This narrative suggests that while these tensions are significant, they have not escalated into open conflict due to the mutual recognition of the catastrophic consequences of a water war [38].

In contrast, the water war narrative is more alarmist, positing that the strategic significance of water resources in the context of climate change and increasing scarcity could lead to militarised conflict between the two nations. Proponents of this view highlight historical tensions, the lack of a comprehensive bilateral water-sharing agreement, and the potential for China's upstream activities to significantly disrupt water availability in India. This perspective often draws on examples from other regions where water conflicts have contributed to broader geopolitical instability. As highlighted by Gleditsch and Wolf, while outright water wars are rare, water tensions are frequent and often exacerbate existing geopolitical tensions between nations like India and China. These tensions, influenced significantly by power dynamics and control over water resources, shape the strategic policies and diplomatic engagements of nations. Understanding these tensions in the context of global security and human development is essential for formulating policies that mitigate conflict and enhance cooperation [39].

However, it is been argued by the experts that a "water tensions" among the nations, which is interpreted hypothetically as "water war". The use of water as a weapon of war is another possibility. Additionally, Is the ability to acquire and manage water resources deemed to be "vital" enough to justify and justify war? On the other side, the argument against "water wars" is very distinct from the more general phenomenon of conflicts that are related to water. It is a "straw man" argument in the sense that talks of "water wars" are virtually always found in popular media rather than in scholarly assessments [40].

## 4 Methodology

The purpose of this study is to conduct an analysis on understanding the water tensions between India and China and their impact on the livelihoods of communities in both countries. This research is accomplished through a review of the existing literature and the use of content analysis. The research employs a qualitative technique involving two primary methods: semi-structured interviews and comprehensive analysis of secondary sources. The semi-structured interviews were conducted via email with experts from both India and China. These interviews covered various topics, such as the influence of the Brahmaputra River on water distribution between India and China, the socio-economic consequences for the populations of both countries, the analysis of the "water war" narrative, and potential opportunities for collaboration. The semi-structured nature of these interviews allowed for in-depth discussions and the exploration of new insights that emerged during the conversation.

In addition to the interviews, this study also utilised secondary sources. The secondary sources included scholarly articles, policy documents, and other relevant literature. The data was gathered by relevant documents and literature that provide information on the Brahmaputra River basin, hydropolitics, and transboundary water management between India and China. Furthermore, after systematically reviewing the collected documents were used to identify key themes,

patterns, and insights related to the research questions. This involved coding the data to categorise information and extract meaningful interpretations. Lastly, the integrating of results from the interviews and the content analysis to form a comprehensive understanding of the issue and to propose actionable recommendations.

## 5 Findings

The qualitative analysis of the semi-structured interviews and the content from secondary sources yielded several key findings. The experts from both India and China highlighted the significant impact of China's upstream dam projects on downstream water availability in India. The Indian experts expressed concerns over reduced water flow and potential flooding, while Chinese experts emphasised the benefits of hydropower and flood control. The interviewees pointed to the socio-economic impacts on communities dependent on the Brahmaputra River. However, the Indian respondents noted increased migration and poverty due to altered water flow, while Chinese respondents focused on the developmental benefits of improved water management infrastructure. The both sets of experts agreed on the need for enhanced collaboration but differed on the approach. Similarly, Indian experts advocated for a formal water-sharing agreement, while Chinese experts suggested more flexible, project-based cooperation. There was consensus on the potential role of international organisations in mediating and supporting cooperative efforts. Hence, the experts from both countries mentioned the importance of involving entities like the United Nations and the World Bank in facilitating dialogue and providing technical assistance.

## 6 Discussion

In hydro-politics, power dynamics shape transboundary water resource management interactions and outcomes. The power inequalities across riparian states often determine negotiation, conflict, and cooperation, affecting water resource sharing and use. The upstream state like China regulates water flow and distribution, and influence the downstream countries. In cooperative agreements and contentious disputes, the upstream state's activities affect downstream regions' socio-economic stability and environmental health. Understanding these power relations is crucial for hydro-political geopolitics analysis, conflict resolution, and sustainable water management methods.

### 6.1 General discussion of hydro-politics and water security

Understanding these power relations is crucial for hydro-political geopolitics analysis, conflict resolution, and sustainable water management methods. The political dimension of transboundary water conflicts underscores the significance of the political backdrop for interactions over shared water resources. Transboundary water conflict and cooperation among governments that share water resources are mostly driven by political geography. Nevertheless, the physical geography of a transboundary basin plays a crucial role in shaping the attributes of water supply, whereas economic geography identifies the elements that affect water demand within that basin.

### 6.2 Specific application to India-China relations

In the context of India and China, the hydro-political dynamics are marked by a combination of conflicts and cooperations. The nature of China's hydro-political relationship with its neighbours is determined by their willingness to disregard China's lack of clarity and inconsistencies, as well as their acceptance of practices that often have negative impacts on their own economies. China's dam construction initiatives on the Brahmaputra are seen as economically antagonistic behaviours by India, leading to water blockades or flood-like conditions downstream. This contentious issue has been a subject of prolonged debate, with actions pertaining to shared waterways displaying economic or verbal hostility.

### 6.3 Hydro-politics over hydro-stability

The field of hydro-politics literature is dedicated to the methodical examination of the characteristics and changes in inter-state conflict and cooperation around shared water resources. Hydro-politics is the dominant body of political literature that focuses on conflicts over water resources that cross national boundaries. The procedures offered by the

political viewpoint aim to overcome the limitations imposed by the political environment on transboundary water interactions, with the goal of facilitating the resolution of conflicts related to transboundary water issues [41]. In order to grasp the intricate political viewpoint about interactions involving transboundary water, it is crucial to consider the notion of critical hydro-politics. This concept challenges the conventional state-centric approach to hydro-politics, which focuses on analysing transboundary water issues solely from the standpoint of individual states. Both Hydro-politics and Critical Hydro-politics offer an analytical paradigm that centres on socioecological networks formed around transboundary water resources [42]. These resources can be confined inside a single nation-state or extend beyond state borders where water is shared. This paradigm integrates the components of political and human–environment geography to emphasise how a study focused on the state might oversimplify the socioecological networks and hinder attempts to address transboundary water conflicts.

Hydro-stability is derived from the stability that water provides to the structure and functions of a state. Water is crucial for the advancement of a state's people in terms of agricultural and industrial growth, societal expansion and intensification, cultural adaptability, and the establishment of identity [43]. Hydro-diplomacy refers to the conflicts or collaborations between sovereign states involving water resources. Water may serve as a catalyst, a tool, or a victim in a conflict. A battle arising from water scarcity seeks to establish dominance and security over the water supply, but a more extensive war in which water is used as a tool or suffers as a consequence may view hydro-stability as an additional long-term benefit. Riparian interactions beyond national boundaries or involving virtual water resources might be stable-dependent or stable-independent. Hydro-stability hierarchies depend on water, even when reciprocal overlap makes it inaccurate. Dependence causes hydro-stability when a riparian cannot satisfy its water infrastructure and development needs locally or worldwide. Hydro-stability excels above hydro-hegemony by shielding its hydro-politics and overflow effects from internal or external shocks like regional or global system shifts. Riparian nations may differ in hydro-political dynamics, dependency with surrounding states, and water security [44]. In the context of a globalised world, the influence of physical boundaries on international affairs has significantly diminished. In a worldwide world, hydro-stability, like other aspects of hydro-politics, is not confined to physical borders. Global efforts are being made to achieve hydro-political stability, as evidenced by the existence of a worldwide infrastructure network.

The hydro-political dynamics between China and its riparian neighbours are marked by a combination of conflicts and cooperations. The nature of China's hydro-political relationship with these neighbours is determined by their willingness to disregard China's lack of clarity and inconsistencies, as well as their acceptance of practices that often have negative impacts on their own economies [45]. The political dimension of transboundary water conflicts underscores the significance of the political backdrop for interactions over shared water resources. Transboundary water conflict and cooperation among governments that share water resources are mostly driven by political geography. Nevertheless, the physical geography of a transboundary basin plays a crucial role in shaping the attributes of water supply, whereas economic geography identifies the elements that affect water demand within that basin [46]. As, China being the dominant force in the field of hydro-power on the global stage, which contributes to the long-term stability of a particular country's water resources (See Table 5).

## 6.4 Upstream dilemma

When discussing the water resources of transboundary rivers, it is inevitable that both upstream and downstream riparian countries will be parties to the conversation. The "upstream dilemma" is a situation in which China, as an upper riparian

**Table 5** Major Hydropower Projects on Shared Rivers between India and China. **Source:** Author's Compilation

Country	Dam name	River	Installed capacity (MW)	Year of completion	Purpose
China	Three Gorges	Yangtze	22,500	2012	Hydropower, flood control
China	Zangmu	Brahmaputra (Yarlung Tsangpo)	510	2015	Hydropower
India	Subansiri Lower	Subansiri (Brahmaputra tributary)	2,000	Under Construction	Hydropower, irrigation
China	Baihetan	Jinsha (Yangtze tributary)	16,000	2022	Hydropower
India	Tehri	Bhagirathi (Ganges tributary)	1,000	2006	Hydropower, water supply, irrigation

Data by <https://doi.org/10.3389/fclim.2023.1302103>

state, the actions conducted in the upstream that result in adverse impacts downstream can be classified as economically antagonistic behaviours, which have the potential to instigate transboundary water conflicts [47]. As an illustration of this, consider the situation that occurred when China constructed dams on the Brahmaputra River upstream. These dams resulted in a water blockade or a flood-like condition if the pressure was increased, which had a severe impact on those living downstream [48]. The contentious issue of water resource conflicts, including the potential for violent confrontations, has been a subject of prolonged debate. This discourse has persisted despite the existence of numerous instances wherein actions pertaining to shared waterways have displayed economic or verbal hostility. Experts accept this situation. Cooperation is still extremely important, despite the fact that China has prioritized its upstream region.

## 6.5 Socio-economic impact

There are not many analysts who believe that water stress or environmental change directly generates conflict in a deterministic stimulus–response relationship. This means that situations in which there is a scarcity of resources will invariably result in violent conflict. It is more accurate to say that the nature and extent of impacts on societies are influenced by a variety of indirect factors. These factors include the timing and location of water tensions in relation to demand, the significance of water-dependent industries in the economy, and the existence of coping capacities, which include technical infrastructure, management mechanisms, and financial and material resources [49]. Amidst these realities, there is clear evidence that China's dam construction has had an effect on the hydrological patterns further downstream, which has further fuelled tensions [50]. Due to a lack of available water, geographical areas that are dependent on Himalayan rivers, both upstream and downstream, are confronted with substantial socio-economic issues [51]. The emergence of water tensions can be attributed to a myriad of factors, wherein socioeconomic considerations assume a pivotal position. Prominent contributors encompass a diverse array of factors, such as disparities in resource allocation and demand, socio-economic deprivation, endeavours aimed at fostering economic growth, disparities in social stratification, exclusionary practices, economic aberrations, and competing interests within local communities [52].

## 6.6 Strengthening collaboration to enhance bilateral relationship

The lack of a formal agreement between India and China complicates the management of the Brahmaputra. China's dam construction has altered hydrological patterns downstream, fuelling tensions and socio-economic issues such as worsening poverty, increased migration, and potential conflicts [53]. Throughout history, there have been multiple Military confrontations between both the nations, which is still not yet resolved. However, no military confrontations that have mainly been caused by disagreements over water resources. Rather of concentrating on the difficulties, there is a group of academics that advocate for the possibilities of collaboration [54]. They see water as a stimulant for collaboration rather than a source of disagreement. On the other hand, in addition to bilateral tensions, the ever-changing national interests, the dangers posed by climate change, and the socio-economic disparities all contribute to the complicated and long-lasting impacts that are felt all over the world [15]. So, in order to overcome the difficulties, both academicians and Practitioners believes in Establishing a comprehensive bilateral agreement focused on equitable water sharing, real-time data exchange, and joint management of water resources. Although the sharing of information has been characterised by inconsistencies in recent years. These inconsistencies have had a particularly negative influence on the ability of downstream regions to manage natural disasters that are related to water [55]. In order to reduce the impact of incidents of this nature, academics advocate for increased collaboration through the implementation of cooperative research projects, early warning systems, community involvement, and robust communication channels. For the purpose of addressing political inequalities, Both China and India being member of Shanghai Cooperation Organisation (SCO) has to focus on including water resource management as a key agenda in improving the regional cooperation mechanism as the concentrated effort [56].

## 7 Way forward

To move beyond the current impasse, we propose the following actionable recommendations:

*Joint Water Management Initiatives* By establishing a bi-national water management authority to oversee the equitable distribution and sustainable use of the river's resources. To develop the integrated water resource management plans that take into account the needs of all stakeholders, including local communities and industries.

*Real-Time Data Sharing Mechanisms* The Implementing the advanced monitoring systems that provide real-time data on water flow, usage, and quality. To create a transparent data-sharing platform accessible to both countries, ensuring that any discrepancies or concerns will be addressed promptly.

*Community-Based Water Conservation Projects* To involve local communities in conservation efforts through awareness campaigns and participatory decision-making processes. Also, promote traditional water management practices that have been effective in maintaining ecological balance [57].

*Multi-Disciplinary Approaches* To Understand the Yarlung Zangbo-Brahmaputra-Jamuna issue requires insights from multiple disciplines. The Political Science provides a framework for analysing power dynamics and negotiation strategies, while environmental science offers tools for assessing the ecological impacts of water management. Additionally, international relations theory helps us understand the broader geopolitical context and the potential for conflict or cooperation. By Combining these perspectives will lead to a more comprehensive understanding of the issue and more effective solutions.

*Trust-Building Measures* By building trust between India and China is crucial for any long-term solution. The confidence-building measures such as regular bilateral dialogues, joint research initiatives, and cultural exchange programs will help foster a sense of mutual understanding and respect. The transparency in water usage and management is also essential for reducing tensions and promoting cooperation. To establish the trust through open communication and consistent discourse will enable both parties to address their problems collaboratively and find mutually beneficial solutions [58].

## 8 Conclusion

The intricate dynamics of water tensions between India and China, particularly concerning the Brahmaputra River, underscore the complex interplay between geopolitical, socio-economic, and environmental factors. This paper's exploration of these tensions highlights the critical need for a nuanced understanding of hydro-politics and the significant impact on the lives and livelihoods of millions across both nations.

A key takeaway from this study is the vital importance of human security, particularly water security, in assessing and addressing the challenges posed by shared water resources. The empirical evidence underscores that the preservation of water security is fundamental to human security, emphasising the interconnectedness of these concepts. The examination of transboundary water management practices reveals the strained relations between India and China and the importance of distinguishing "transboundary water conflict" from broader economic and political disputes. The study highlights the economic antagonism resulting from upstream activities by China, which often lead to adverse impacts downstream in India. This situation exacerbates tensions and fuels socio-economic issues such as increased migration, poverty, and potential conflicts.

The concept of "water tensions" versus "water wars" is also crucial in understanding the India-China transboundary water relations. While outright water wars are rare, the tensions arising from competing interests and strategic priorities are significant and must be addressed through comprehensive bilateral agreements and collaborative efforts. The paper emphasises the necessity of establishing a formal water-sharing agreement between India and China. Such an agreement should prioritise transparency, equitable distribution, real-time data exchange, and robust conflict resolution mechanisms. Also, by building trust through consistent dialogue, joint research initiatives, and community participation is essential for fostering a collaborative approach to water management. By empowering local communities through participatory decision-making, capacity building, and early warning systems will help mitigate the impact of water scarcity and promote a sense of shared responsibility. By focusing on trust, collaboration, and community involvement, India and China will transform water tensions into opportunities for cooperation, ensuring sustainable water management and a secure future for both nations.

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**Data availability** There are no datasets were generated or analysed during the current study.

## Declarations

**Ethics approval and consent to participate** The present study involved semi-structured interviews conducted via email with experts. The need for ethical approval was waived by the Institutional Review Board (IRB) of The Maharaja Sayajirao University of Baroda in accordance with the national guidelines on social science research ethics, as the study posed no risk to participants and involved voluntary participation with informed consent obtained via email.

**Competing interests** The authors declare no competing interests.

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