

Brahmaputra River Basin: A Game Theoretic Approach to Cooperation and Benefit Sharing

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Doctor of Philosophy



By

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Declaration

I, Ms. Tanushree Baruah, hereby declare that the thesis entitled “**Brahmaputra River Basin: A Game Theoretic Approach to Cooperation and Benefit Sharing**” is the result of research work carried out by me in the Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati, under the supervision of Professor Anamika Barua, Professor of Economics in the Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati.

In keeping with the general practice of reporting scientific observations, due acknowledgment has been made whenever the work described is based on findings of other investigations.



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Certificate

This is to certify that the thesis entitled “**Brahmaputra River Basin: A Game Theoretic Approach to Cooperation and Benefit Sharing**” submitted by Ms. Tanushree Baruah for the degree of Doctor of Philosophy in Economics in the Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati, embodies bonafide record of research work carried out under my supervision and guidance. The collection of materials from secondary and primary sources has also been done by Ms. Tanushree Baruah herself. All assistance received by the researcher has been duly acknowledged.

The present thesis or any part thereof has not been submitted to any other University for the award of any degree or diploma.



Professor Anamika Barua

Thesis Supervisor

8 November 2023

Dedication

‘To my beloved father, Rathindra Kumar Baruah,

with gratitude

and

fond remembrance,

who would have loved to see me earn a doctorate in our same subject, Economics’

Acknowledgement

My reverence for the mighty Brahmaputra River, by which I was born and brought up.

As I pen down this acknowledgment note, I travelled down memory lane to vividly visualise the entire journey starting from the day of my PhD entrance examination to the date when I feel fortunate to be able to produce this thesis worthy of submission. First and foremost, my obeisance and thanks to the Almighty for granting my wishes to pursue doctoral research at the Indian Institute of Technology Guwahati, under the supervision of my most desired Professor.

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Miles to go before I sleep.

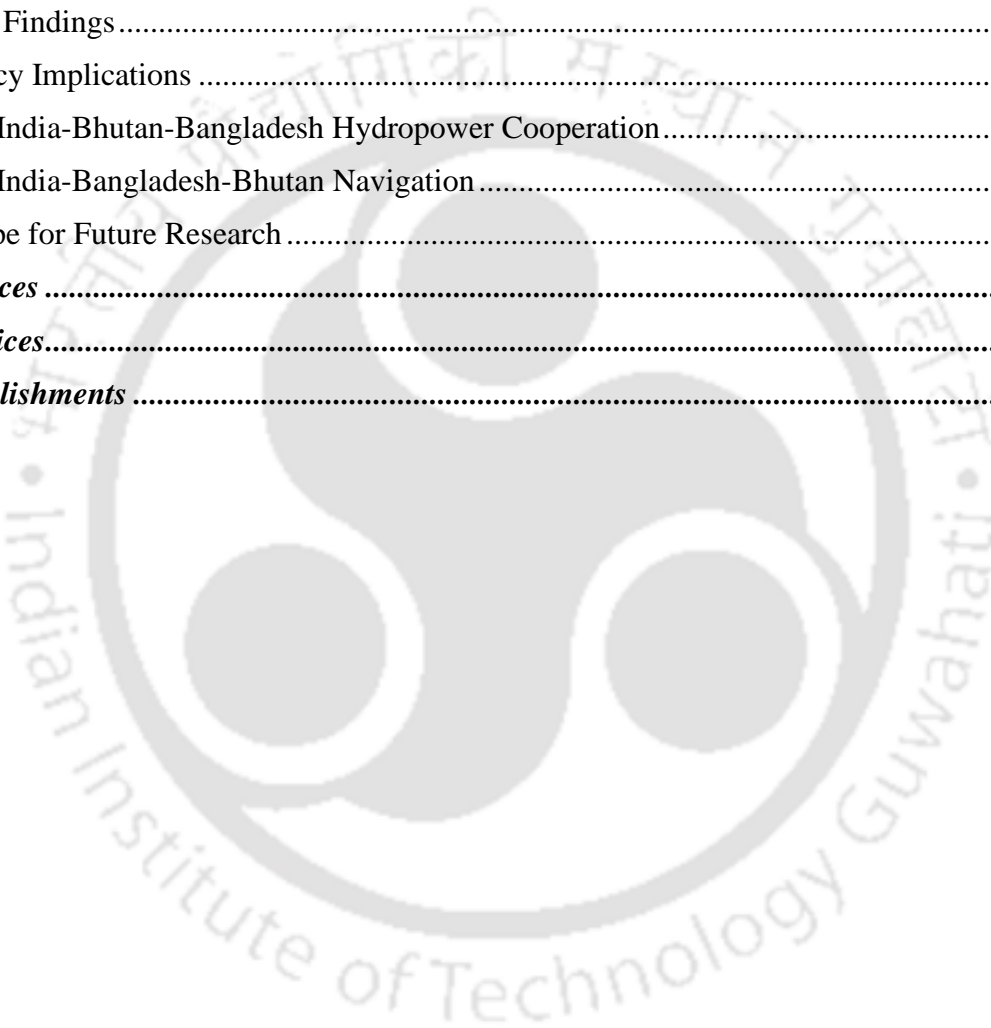
Tanushree Baruah

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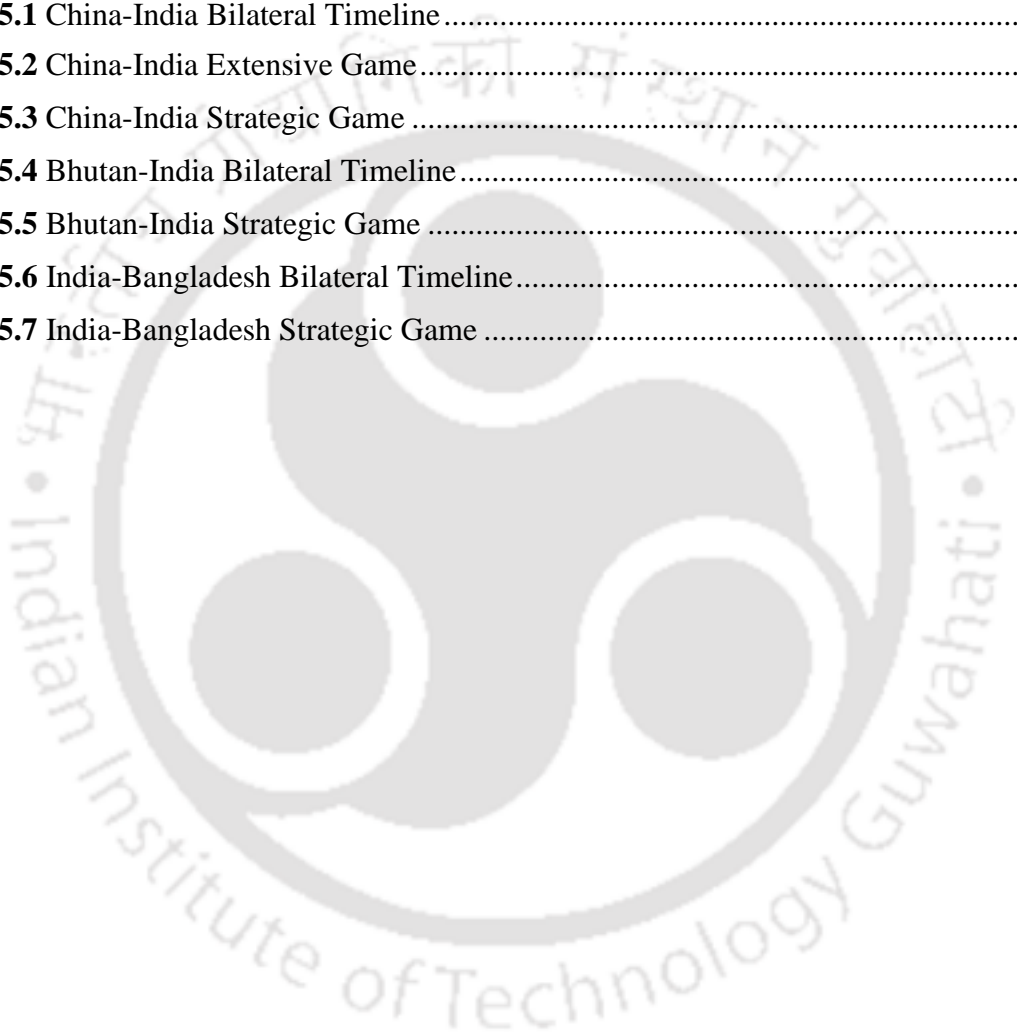
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List Of Abbreviations

AEP	Act East Policy
AL	Awami League
AR	Assessment Report
BAR	Basins At Risk
BBIN	Bangladesh, Bhutan, India, Nepal
BJP	Bharatiya Janata Party
BNP	Bangladesh Nationalist Party
BRB	Brahmaputra River Basin
BRI	Belt and Road Initiative
BTN	Bhutanese Ngultrum
CAA	Citizenship Amendment Act
CBM	Confidence-Building Measures
CBMP	Coordinated Border Management Plan
CEA	Central Electricity Authority
COP	Conference of the Parties
DHPS	Department of Hydropower and Power Systems
DGPC	Druk Green Power Corporation
ELM	Expert Level Mechanism
FYP	Five Year Plan
GBM	Ganges-Brahmaputra-Meghna
GDP	Gross Domestic Product
GNH	Gross National Happiness
GW	Gigawatt
HEP	Hydroelectric Project
IPCC	Intergovernmental Panel on Climate Change
IWAI	Inland Waterway Authority of India
IWT	Inland Water Transport
JRC	Joint River Commission
LAC	Line of Actual Control
LBA	Land Boundary Agreement
LWRG	London Water Research Group

MoU	Memorandum of Understanding
MU	Million Units
MVA	Motor Vehicles Agreement
MW	Megawatt
NDC	Nationally Determined Contribution
NDRC	National Development and Reform Commission
NRC	National Register of Citizens
NTGMP	National Transmission Grid Master Plan
NW	National Waterway
PIWTT	Protocol on Inland Water Trade and Transit
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RMB	Renminbi
ROR	Run-of-River
SAARC	South Asian Association for Regional Cooperation
SDF	Sustainable Development Fee
SDG	Sustainable Development Goals
SLR	Systematic Literature Review
SNWDP	South-North Water Diversion Project
TAR	Tibet Autonomous Region
TWINS	Transboundary Waters Interaction Nexus
UN	United Nations
UNWC	United Nations Watercourses Convention
VVP	Vibrant Villages Programme
WEF	Water-energy-food

Abstract

Freshwater is a critical natural capital that is non-substitutable at the interface of economy and environment. Globally, demographic and socioeconomic drivers, along with the impact of climate change, have created unprecedented water scarcity, with demand exceeding supply. Collaborative water management can strengthen resilience and cope with risks from imminent water crises, aiding the achievement of the Sustainable Development Goals (SDGs). However, management becomes increasingly complex for transboundary rivers, a global common good that flows without obeying borders. The complexity arises from the additional layer of political economy to the economy-environment interface, encompassing transboundary rivers. Transboundary interaction among power asymmetric riparians is influenced by overlapping state sovereignty and diverse strategic interests in river utilisation. Unilateral water interventions without internalising associated external costs strain international relations between nations. The non-cooperative behaviour exists because riparian nations equate transboundary negotiations with sovereignty bargains, interpreting lost autonomous control over the river. As the entire problem relates to water-sharing, an innovative principle called benefit sharing emphasises sharing the benefits derived from the water resource rather than the water itself. Despite hydro-political tensions, benefit sharing incentivises transboundary water cooperation as it overlooks sovereignty issues, producing win-win outcomes for riparians.

This thesis focuses on the relatively under-researched transboundary river basin- the Brahmaputra River Basin (BRB). The mighty river that originates in China and transcends three South Asian countries, India, Bhutan, and Bangladesh, needs more institutionalised water cooperation. Although the basin has not faced an acute water crisis to date, growing and competing water interventions have been underway since the millennium to use the river as a power consolidation mechanism, particularly by China and India. This has intensified the vulnerability risks for the basin communities. Existing literature is silent on the economic and political factors driving the interaction between power asymmetric BRB riparians. Therefore, this thesis aims to examine the existing and evolving bilateral water interaction among the BRB riparians and the prospect of benefit sharing. It deploys the state-of-the-art analytical framework of game theory to analyse riparians' strategic behaviour. Game theory is the science of rational decision-making for conceiving social situations among competing players and fits best to understand the economic and political dimensions of water management even without quantitative information. The primary objective is to promote basin-level cooperation for

sustainable water management. However, transboundary water cooperation being incremental, the main argument of the thesis is to induce bilateral cooperation through sharing economic benefits from the river to build the required trust and, eventually, inspire multilateral cooperation.

Against this backdrop, the thesis laid down three key objectives and raised related research questions to address those, using secondary and primary data sources. First, the scope of implementing benefit sharing was discussed by identifying the most preferred economic benefits from the river and the common strategic interests of the riparians. This revealed that despite the potential, the river benefits are sub-optimally utilised and development is impacted by basin geopolitics. The second objective is to examine if there is a correlation between hydropolitics and geopolitics in influencing Brahmaputra River interaction. It was found that hydropolitics and geopolitics are mutually reinforcing and lead to a status quo, hindering water cooperation at the basin level. Third, to see if benefit sharing can help break the status quo and create win-win outcomes, it was thought prudent to understand the factors framing riparian strategies. For this, the thesis conducted a two-player game theoretical analysis to explain and predict the strategic interests and payoffs of China-India, Bhutan-India, and India-Bangladesh Brahmaputra River interaction, based on riparian geographical configurations. The empirical game models constructed subsumes hydropolitics enmeshed in geopolitical dynamics within their respective diplomatic timeframes. The period of analysis for the China-India timeline is from 1950 to date, Bhutan-India is 1949 to date, and India-Bangladesh is 1971 to date.

Results showed varying forms of strategic interactions at the bilateral level. The power-infused payoffs or outcomes of riparian decision-making are sub-optimal, bearing a causal link with the type of bilateral relation shared. China-India interaction is on one extreme of the BRB continuum with a strictly dominant non-cooperative strategy due to the greater influence of geopolitics. Bhutan-India interaction is on the other extreme, with a strictly dominant cooperative strategy due to mutually beneficial hydropower trade and strong mutual trust. With a weakly dominant strategy, India-Bangladesh leaves scope for evolutionary cooperation through inland water navigation. Keeping with the main argument of promoting basin-level cooperation through sharing economic benefits of the river, the thesis concluded with the possibility of sub-basin cooperation between India, Bhutan, and Bangladesh in hydropower and inland navigation sectors. Given its emerging position, India can assume a leadership role in the BRB by initiating sub-basin cooperation with Bhutan and Bangladesh as a climate adaptation, water-energy-food security, and disaster risk mitigation strategy. The Brahmaputra,

for India, holds both interests like economic development and values of shared history and culture. Such a move by India can be instrumental in retaining the trust and confidence of its close South Asian allies, amidst geopolitical competition with China. India's more favourable bilateral relations with Bhutan, and Bangladesh, marked by warm diplomatic relations without any geopolitical complexities, increase the scope for such an arrangement. India and Bhutan already share a mutually beneficial relationship through hydropower cooperation. Besides, Bangladesh acknowledges India's wholehearted assistance to its independence, and both countries have always supported each other in every forum. Under its 'Neighbourhood-First Policy', India's water diplomacy holds significance for a better and secure future in South Asia.



Chapter 1 INTRODUCTION

1.1 Transboundary Rivers: Setting the Context

“Major Himalayan rivers like the Indus, Ganges, and the Brahmaputra will face flow reductions due to receding glaciers as a consequence of global warming” (Guterres, 2023).

Water is one peculiar resource bearing no substitute but multiple uses. Population growth, economic development, and climate change are increasingly creating conditions of global freshwater demand outstripping the supply (Leb, 2012; Giordano & Wolf, 2003). The IPCC AR6 Report (2021-2022) found increasing evidence of changes in the hydrological cycle due to human-induced climate change, affecting water security and exacerbating water-related vulnerabilities¹. The centrality of water security for climate resilient development makes it one of the UN SDGs (Goal 6), Target 6.5 “Water resources management”, and in particular, Indicator 6.5.2 “Transboundary cooperation”. Degrading surface and groundwater quantity and quality is a pressing environmental concern requiring adequate management. With around 60 percent of global freshwater rivers being transboundary and covering almost half the earth’s land surface area, transboundary water management is imperative (Earle et al., 2010; Delli Priscoli & Wolf, 2009; Van der Zaag, 2007). Transboundary is defined as water crossing any boundary, including those of states, provinces, and smaller jurisdictions (McCracken & Wolf, 2019). Owing to frequent changes in political borders and improved data availability, the number of transboundary river basins has been updated to 310 in 2019 from 276 in the year 2010 (McCracken & Wolf, 2019). The complex nature of transboundary rivers makes management increasingly challenging as water interventions transcend political and administrative boundaries, posing as triggers or stressors in international relations between nations (Dinar, 2004; Wolf, 1998). In transboundary rivers, hydraulic infrastructure such as hydropower dams and irrigation projects are often proposed or developed to optimally exploit water-specific economic benefits or address water-related challenges such as flood management (Sehring et al., 2022). Such decisions, being highly technocratic in nature, management and protection were considered an exclusive domain of river engineering to be handled only by technical experts. The growing importance of global environmental politics as a non-traditional security approach since the late 1990s, in contrast to traditional state security

¹<https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-4/>

from military threats, brought a paradigm shift in the transboundary water discourse. Water security came to be viewed as an element of national security resulting in politicisation² and securitisation³ of transboundary rivers. Negotiations over transboundary rivers are considered bargaining with state sovereignty (Alam et al., 2009). The emergence of the “water or hydro-diplomacy” concept recognised the embedded political intricacies of water and the more important role of diplomats and policymakers responsible for negotiating win-win solutions for riparian nations (Sehring et al., 2022). Rethinking water over sectoral and disciplinary structures, the science-policy interface is a prerequisite for informed decision-making on effective transboundary water management (Barua, 2018; Islam & Susskind, 2018; Wolf, 1997). This transition from management to participatory governance through water diplomacy produces benefits beyond the water sector, contributing to regional development, peace, and stability.

Scholarships on transboundary water are broadly divided into two schools of thought. It begins with the proponents of ‘water wars’ or water leads to war thesis who believed that water scarcity triggers prior appropriation rights competition among nations, making water access a matter of national security. The corollary between transboundary water and conflict is mostly evidenced by the Middle Eastern rivers- the source of political and military conflicts (Butts, 1997; Remans, 1995; Frey, 1993; Gleick, 1993; Starr, 1991; Westing, 1986; Cooley, 1984). The proponents of the water war thesis consider several drivers of hydro-political tensions and potential conflict among riparian nations. These include physical factors like water availability, and variability, political factors like interstate armed conflict, territorial and power imbalance, and socioeconomic factors like upstream infrastructure projects (Farinosi et al., 2018; De Stefano et al., 2017). However, ‘water war’ critics argued that hydro-diplomacy enables even the most hostile nations to find many more issues of cooperation than conflict (Delli Priscoli & Wolf, 2009; Wolf, 2001, 1998). According to Wolf, (1998), “*War over water seems neither strategically rational, hydrographically effective, nor economically viable*”. Water as a catalyst for cooperation is observed between riparians in the European rivers like the Rhine (Dieperink, 2000), and Danube (Liska, 2015) for water quality protection; Middle Eastern rivers like the Jordan (Beaumont, 1997), and Euphrates-Tigris (Kibaroglu & Unver, 2000) for water allocation amongst other transboundary river basins.

²The act of wielding water as a political tool by the more advantageous riparian actor to serve its own strategic interests (Chellaney, 2008).

³The process of declaring an issue to be an “existential threat”, usually in the form of ‘speech acts’ (Biba, 2014).

Historically, cooperation along shared rivers outnumbered conflictive events, as shown by the Basins At Risk (BAR) study (McCracken & Wolf, 2019; De Stefano et al., 2010; Wolf, 1999). However, the quality of these cooperation matters as water-sharing treaties often lead to zero-sum outcomes due to unequal bargaining power of riparian countries, as in the cases of the Jordan, Nile, and Ganges water treaties (Zawahri & Mitchell, 2011). Although water treaties ensure resilient cooperation (the Indus Treaty withstood the India-Pakistan war), inequitable water allocation and the inability to adapt to changing climates in the absence of an enforcement mechanism leaves at least one party dissatisfied with consequent asymmetric outcomes and the treaty becomes a source of political discord (Wolf, 1998). The problem is more acute in multilateral basins governed by bilateral treaties because of the upstreamer's preference, high transaction cost of negotiations, fear of moral hazard, and free-riding (Zawahri & Mitchell, 2011). This indicates that hydro-diplomacy is power-blind or power-shy, often producing situated goal-oriented understandings instead of focusing on the practical process of negotiation (Sehring et al., 2022; Vij et al., 2020).

Given the shortcomings of international water law (Leb, 2012), transboundary water justice, meaning ensuring equitable outcomes, matters for the fairness of negotiations and treaties (Zeitoun et al., 2014). The realisation of water agreements, unless accounted for all forms of a token, narrow and coercive cooperation is an erroneous benchmark of cooperation (Zeitoun & Mirumachi, 2008). In the words of Zeitoun & Warner, (2006), "*The absence of war does not mean the absence of conflict*". The binary classification of conflict or cooperation infused value judgements to transboundary water management such that any conflict was termed 'bad', and cooperation as 'good', manipulated to advance one's interests (Zeitoun & Mirumachi, 2008). The conflict/cooperation debate was enriched by the London Water Research Group (LWRG), which developed the hydropolitics concept using analytical tools like hydro-hegemony⁴ and TWINS to explain varying intensities of transboundary water conflict and cooperation (Zeitoun et al., 2011; Zeitoun & Allan, 2008; Mirumachi & Allan, 2007; Zeitoun & Warner, 2006). The complex nuances of hydropolitical tensions over shared waters cannot be classified as either conflict or cooperation but to be understood as water interaction (Hanasz, 2013). Transboundary water interaction is inherently a political process determined by power relations within the broader political context, causing management to be a wicked problem (Mirumachi, 2015; Zeitoun & Mirumachi, 2008). This is how the transboundary water discourse developed

⁴Hydro-hegemony is hegemony at the river basin level, achieved through water control strategies such as resource capture, integration and containment, enabled by the exploitation of existing power asymmetries (Zeitoun & Warner, 2006).

from a polarising to a continuum analysis, encompassing overlapping sovereignty, power, autonomy, control, and political relations. Given all these issues, genuine transboundary water cooperation requires political will and self-enforcing commitment of riparian nations and the realisation of current and future hydro-interdependencies.

One productive approach to developing transboundary rivers is to examine the basin benefits from a regional approach (Delli Priscoli & Wolf, 2009; van der Zaag, 2007). The benefit sharing principle shifts focus from physical water-sharing to sharing the benefits derived from water development and management in the typology of ecological, economic, political, and catalytic benefits (Sadoff & Grey, 2002). *Ecological benefits*, such as improved water quality and biodiversity preservation, and *economic benefits*, such as hydropower, navigation, and increased agriculture, arise from improved water management, whereas *political benefits*, such as reduced tensions and diplomatic stability, and *catalytic benefits*, such as regional integration arise from enhanced trust due to cooperation. These four types of benefits, varying greatly between basins based on scale, feasibility, and relative importance of each type, neither maintain any hierarchy nor follow a particular sequence (Sadoff & Grey, 2005). Cooperation initiated through any of these benefits assures linkage effects to other types. By internalising upstream-downstream externalities, benefit sharing bypasses the contentious issue of property rights over water and easily motivates riparians to cooperate without sovereignty compromise over the water resource (Qaddumi, 2008). It incentivises power-asymmetric riparians with varying national interests to collaborate and maximise mutual benefits. Implementation of benefit sharing ushered in win-win outcomes for riparians in the Columbia River Basin (Swainson, 1986), Senegal (Alam et al., 2009), Nile (Tawfik, 2015), and Mekong (*Mekong Annual Report*, 2002). Despite differing interests and political ideologies, these riparians shared hydropower, irrigation, navigation, and flood control costs-benefits through joint water management. As a caveat, practical implementation of benefit sharing requires countries' political willingness and agreement on the type of benefits to be shared.

Different approaches like economic, statistical, machine learning, and game theory have been used to analyse transboundary water interaction (Farinosi et al., 2018) and benefit sharing among riparians. *Game theory* is a fairly realistic conflict resolution tool for applying benefit sharing principle. Unlike engineering approaches or conventional optimisation techniques assuming a deterministic relationship of actors, game theory is a comprehensive explanatory and predictive economic mechanism, also embodying political dimensions of water management even in the absence of quantitative information (Tayia, 2019; Oye, 1986). Game

theory enables the study of strategic behaviour in interactive decision-making where one player's decisions affect the other player (Zürn, 1993). Game theory has been applied to decisions on water/cost and benefit allocation, and management of groundwater aquifers, irrigation projects, hydropower facilities, transboundary water disputes, and hydro-diplomacy (Dinar & Hogarth, 2015; Madani, 2015; Madani, 2010). A detailed discussion of game theory and its application in benefit sharing is given in Chapter 2, Section 2.3.

1.2 South Asia and Transboundary Rivers

South Asia is one of the least integrated regions in the world concerning transboundary river cooperation, owing to political tensions, power dynamics, and historical mistrust emanating from intrinsic traditional security challenges (Huda & Ali, 2018; Prasai & Surie, 2015; Biswas, 2011). Despite the existence of SAARC, an intergovernmental regional grouping of 8 South Asian countries, it is not very proactive concerning transboundary river management and water security (Pulla et al., 2018). South Asian transboundary rivers display similarities in three respects- originate in China's Tibet Autonomous Region (TAR), binding size, and power asymmetric countries that could not overcome geopolitical impasse (Siwakoti, 2011). China's upstream status on these rivers and unilateral actions with a reluctance for formal multilateral agreements make downstream riparians highly vulnerable (De Stefano et al., 2017). China and India remain non-signatory to the 1997 United Nations Watercourses Convention (UNWC) due to fear of the Convention encroaching on their national priorities and sovereign rights (Pandey et al., 2020; Zhang & Li, 2018). The downstream riparians of China and India facing water crises heavily depend on transboundary rivers, making water issues highly politicised and securitised in South Asia (Hill, 2015; Prasai & Surie, 2015; Uprety & Salman, 2011). As an implication, information and data sharing, and disaster management is more complex and limited (Rasul, 2014; Akanda, 2012).

1.3 Brahmaputra River Basin

One of the important transboundary rivers of South Asia, the Yarlung Tsangpo-Brahmaputra-Jamuna (henceforth, Brahmaputra River Basin (BRB)) sustains the highly water-centric lives and livelihoods of four countries: China, India, Bhutan, and Bangladesh. The BRB has a drainage area of 5,80,000 sq. km (Figure 1.1) and travels a total distance of 2,900 km. The river originates from glaciers in the TAR in southwest China where it is known as the Yarlung Tsangpo (Zangbo in Chinese). After flowing for 1,625 km through various elevations in TAR, the river makes a sharp U-shaped bend (known as the Great Bend) at Namcha Barwa or the

Shuomatan Point and enters India. In India, the river begins as Siang from Korbo in northern Arunachal Pradesh state in Northeast India and flows to the lower reaches as Dihang in a south-westerly direction through the Assam Valley where two other tributaries, Dibang and Lohit join the main flow. The combined flow then becomes the mighty Brahmaputra upon entering Assam state. Further joined by many tributaries (65 on the north and 38 on the south bank) such as Subansiri, Jia Bharali, Dhansiri, Kapili, etc. within Assam and a few from Bhutan (Manas, Sankosh, and Saralbhanga), the Brahmaputra flows westward through Assam until it reaches Dhubri district. Bhutan on the southern slopes of the eastern Himalayas includes four major river systems: Drangme Chhu, Punatsang Chhu, Wang Chhu, and Amo Chhu that joins the Brahmaputra River in India (Alam et al., 2017). Therefore, making Bhutan a basin country of the river. Inside India, the Brahmaputra stays for 918 km. From Dhubri, the Brahmaputra turns southwards and enters Bangladesh through the Kurigram district, where it is called Jamuna. The confluence of the Jamuna with the Padma near Goalundo town is considered to be the lower (southernmost) limit of the Brahmaputra sub-basin. Inside Bangladesh, the Brahmaputra stays for 337 km and then discharges into the Bay of Bengal (Bandyopadhyay et al., 2016; Ray et al., 2015; Rahaman & Varis, 2009; Sarma, 2005). The Brahmaputra is, therefore, a major transboundary river where China and Bhutan are upstream riparians, India is the middle riparian, and Bangladesh is the lowest riparian.

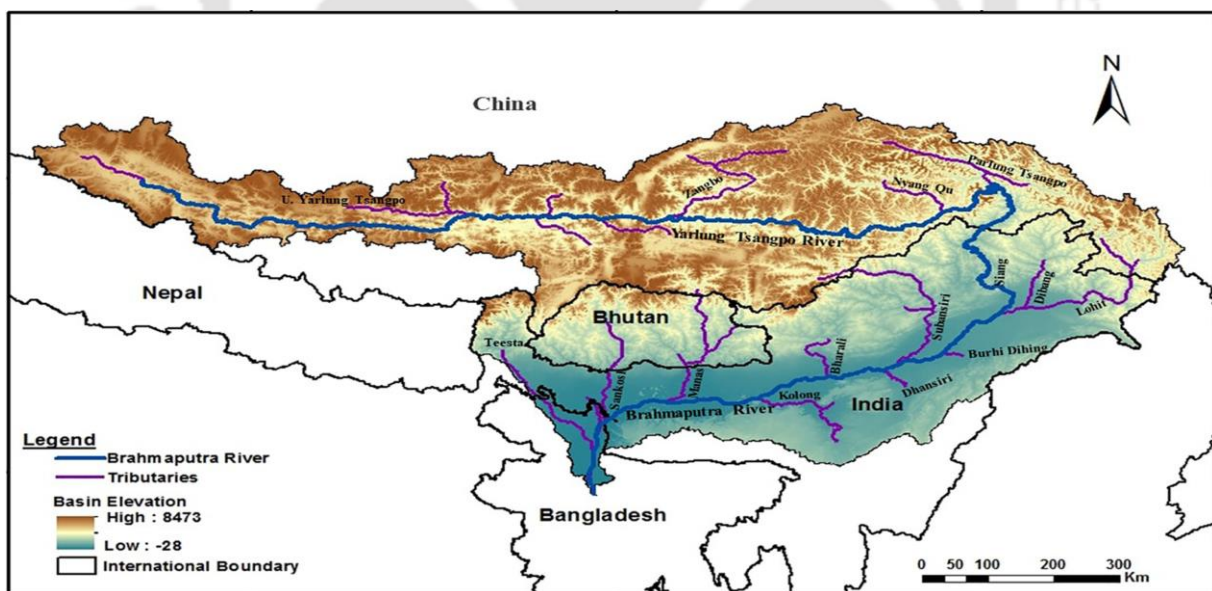


Figure 1.1. Brahmaputra River Basin Map
Source: Indian Institute of Technology Guwahati

1.3.1 Hydro-climatological Background

The Brahmaputra is the world's fourth-largest river in terms of mean annual discharge with very high unit water yields as measured in Pandu (Assam) and Bahadurabad (Bangladesh) (Pradhan et al., 2021). The basin is characterised by precipitation and climate variability. The annual flow in the upper Brahmaputra (Tibet) is fed by glacial/snow melts while the lower component in the south of the Himalayas is dominated by the South Asia monsoon (Pradhan et al., 2021; Ray et al., 2015). Being located in the rain shadow of the Himalayas, Tibet receives much less rainfall and is the driest part of the basin. As a result, the total annual streamflow of the Brahmaputra increases after entering India and is the largest at Bahadurabad in Bangladesh (Pangare et al., 2021). The average monthly discharge in Assam is the highest in July and lowest in February (Sarma, 2005). Rainfall variation is responsible for determining the basin climate, generating shorter warm summers in the high-altitude Tibetan portion and longer summers in the lower basin (Ray et al., 2015). The Brahmaputra drains diverse environments of the cold arid Tibetan plateau, steep rain-drenched Himalayan slopes in Arunachal Pradesh, alluvial valley in Assam, and fluvial-deltaic plain of Bangladesh (Sarma, 2005). Severe annual floods are a recurring phenomenon in the lower part of the basin caused by the southwest monsoon during June-September (Dhar & Nandargi, 2000). Owing to its heterogeneous characteristics, limited basin-wide hydro-climatological information is available for hydrological modelling for river water management (Dutta & Sarma, 2021). Water management must also incorporate the potential impacts of climate change. The upper Brahmaputra will be most affected by climate change with a 22% reduction of snowmelt contribution to annual water yield, followed by the middle Brahmaputra with an increase in rain runoff (Palash et al., 2023; Pradhan et al., 2021).

1.3.2 Morphological Background

The Brahmaputra is one of the most braided and second-highest sediment-laden rivers in the world (Pradhan et al., 2021). This is attributed to the active erosion of the Himalayan foothills as the river gradient decreases abruptly at the Great Bend and the carrying of alluvial deposits from the Assam Valley (Gogoi & Sharma, 2021; Sarma, 2005). The braided channel pattern is due to aggradation and degradation causing channel widening and avulsion (Sarma, 2005). The high seismic intensity of the Himalayan zone led to major earthquakes in 1897 and 1950 in Assam causing changes in channel configuration, ground subsidence, and landslides (Sarma, 2005). The morphological evolution and braid-channel migration develop fluvial landforms such as transient sandbars and stable river islands (Gogoi & Sharma, 2021). The dynamic

meandering tributaries are also responsible for bank erosion in Assam and Bangladesh. The increasing trend of the Brahmaputra's braiding intensity from 1987 to 2015 caused severe erosion, decreasing the area of Majuli Island in Assam (the world's largest riverine island) (Gogoi & Sharma, 2021).

1.3.3 Socio-economic Background

Apart from holding immense social and cultural significance, the Brahmaputra is the economic lifeline for the riverine communities supporting agriculture, livestock, fisheries, pottery, handloom, and apparel industries (Barua, 2018). Development in the basin is, however, impeded due to varying national interests, historical and contemporary rivalries, and territorial disputes (He, 2021; Barua & Vij, 2018). The BRB countries' demographic and socio-economic profiles and background information are shown in Appendix: Table A1 and Table A2 respectively. The tables show that all basin countries are performing at various stages of development. In terms of population, India overtook China as the world's most populous country. China's economic performance outpaced India's and its current nominal GDP is roughly six times that of India. Compared to Bhutan and China, poverty ratios in Bangladesh and India are relatively high. All countries have a fairly high percentage of the population having access to water and electricity. China is facing a severe water shortage because of growing demand due to skewed water distribution and quality contamination from increased urbanisation (Biba, 2016; Li & Wu, 2016). Except for Bhutan, all other countries exhibit heavy dependency on electricity generated from non-renewable sources. With declining coal supply, the dominant energy source in China and India, plans are underway for diversifying energy by exploiting the abundant hydropower reserves of the BRB (Li et al., 2018; Biba, 2016).

The Brahmaputra is devoid of any multilateral institution for its management and as a corollary, there is no basin-wide treaty involving all four riparian countries (Barua, 2018). The only form of subtle cooperation includes a few bilateral Memoranda of Understanding (MoUs) on unilateral monsoonal data sharing between China-India, China-Bangladesh, and India-Bangladesh (Barua, 2018; Zhang, 2015). The lack of any standard procedure made data sharing a power interplay tool, aggravating mistrust and suspicion of vulnerable lower riparians (Barua et al., 2018). The basin geopolitics and absence of power parity preclude options of negotiations for a multilateral treaty as it might result in asymmetric cooperation and trigger potential conflicts (Barua et al., 2018; Barua & Vij, 2018).

Overall, the BRB is an interesting case to study because of the following unique features. First, the co-existence of extensive poverty amidst ample water-related economic opportunities- indeed a developmental paradox (Barua et al., 2018). Second, the Brahmaputra defies the Malthusian assumption of physical scarcity- indeed a “well-watered” basin as per the Falkenmark definition of water availability (Bandyopadhyay et al., 2016). Third, the national priorities of the riparian countries concerning the river vary- indeed, a basin of diverse strategic interests (Barua & Vij, 2018a). Fourth, amidst growing population and urbanisation, the Brahmaputra is in a relatively pristine state of development- an indicator of sub-optimal utilisation (Pradhan et al., 2021; Ray et al., 2015). Fifth and most significantly, despite being the largest (by annual discharge) of the Ganges-Brahmaputra-Meghna (GBM) system, the Brahmaputra lacks any institutional cooperative mechanism (Barua, 2018). Sixth, the presence of two Asian giants as basin riparians- China and India. Last and strikingly, even without basin-wide cooperation amidst diverse interests, the Brahmaputra River- a reservoir of abundant resources to date experienced no flashpoint directly related to water. This can be a possible hypothesis for less motivation by the riparians to cooperate. Nevertheless, avoiding a cooperative strategy might lead to undesirable future basin scenarios. Climate change will severely affect people residing in the highly vulnerable BRB (Palash et al., 2023). Coupled with climate change, China and India’s unilateral water interventions are predicted to stress the future water-energy-food (WEF) nexus of the BRB (He, 2021; Yang et al., 2016). With little progress being made to date, there is a need for greater and improved communication and dialogue platforms to build trust and confidence among the riparians (Ho et al., 2019; Barua, 2018; Hanasz, 2017). For sustainable water management, riparians must recognise their long-term hydro-interdependency.

1.4 Research Gaps

This thesis identified four major research gaps in the BRB. The first research gap emanates from knowledge inadequacy concerning the BRB. In the South Asian context, existing studies mostly focus on the GBM river system. Very few studies were found extensively focusing on all the BRB riparians together. The second research gap is the need for empirical findings to understand the economic and political factors driving the BRB interaction. Third is the methodology gap, as no previous study deployed a systematic tool such as the game theoretical approach to analyse riparians’ strategic behaviour for BRB cooperation, considering existing power asymmetry. Fourth is the conceptual gap concerning the relevance of the benefit sharing

concept in the BRB for fostering BRB cooperation. Such knowledge has practical relevance as it will provide policy-oriented findings for examining the benefits provided by the river.

This thesis is focused on the relatively under-researched BRB. Believing in the notion of water as a catalyst of cooperation among strategic riparians, the emphasis is on promoting basin-level cooperation through the benefit sharing principle and hence, the thesis title.

1.5 Research Aim and Objectives

Using a game theoretical approach, this thesis examines the existing and evolving bilateral water interaction among the BRB riparians and the prospect of benefit sharing. While this thesis does not undermine the importance of environmental and political benefits of transboundary water cooperation, it argues that inducing bilateral cooperation by sharing economic benefits from the river can be a good starting point for building trust and, eventually, inspiring multilateral cooperation for the BRB riparians. An economic perspective is an effective method for fostering cooperation because it creates win-win situations for riparians (Dombrowsky, 2009; Qaddumi, 2008).

The objectives of this research and the related research questions framed to address these objectives are:

Objective 1: To identify the economic benefits of the Brahmaputra River Basin and their role in transboundary cooperation.

- What are the economic benefits the Brahmaputra River provides?
- How can the identified benefits help induce cooperation between the riparians?

Objective 2: To understand and evaluate the existing geopolitics and hydropolitics and their influence on transboundary interaction.

- Does regional geopolitics influence transboundary interaction in the BRB?
- Is hydropolitics and geopolitics in the BRB intertwined and is it evolving?

Objective 3: To assess and evaluate existing cooperation in the BRB, and predict future outcomes using a game theoretic approach.

- How do the riparians devise their strategy for water interaction given the hydropolitics and geopolitics in the BRB?
- Do these strategies provide the optimal payoffs to the BRB riparians?
- Is there a scope for better payoffs through basin/sub-basin cooperation?

1.6 Research Scope

The scope of this thesis will be limited to highlighting the Brahmaputra River benefits but not a complete assessment of benefit sharing through quantification of the benefits and costs. Although this thesis believes in an inclusive and participatory transboundary water governance mechanism, the analysis will be confined to examining benefit sharing prospects at the national level. Besides putting India at the center, this thesis will restrict the analysis to the transboundary interaction of China-India, Bhutan-India, and India-Bangladesh, based on immediate upstream-downstream configurations. Furthermore, although international watersheds subsume surface water and groundwater, this thesis will limit its scope to surface water management in the BRB and not include aquifer management in its analysis. Accordingly, water quality problems are not a subject of discussion. Finally, considering the aim of this thesis, the empirical models are developed based on pure game theory concepts without integrating hydrological modelling, dynamic optimisation, and simulations as commonly found in the literature.

1.7 Research Significance

This thesis enriches existing transboundary water-related research by making three notable and timely contributions. To begin with, it advances for the first time a game theoretical analysis of the transboundary Brahmaputra River interaction to identify the strategic interests and preferences of the basin riparians. Results obtained from game theoretical analysis are more realistic and logical, for the outcomes are a byproduct of strategic benefits and power dynamics, which is highly relevant in transboundary interactions. Apart from this value addition, this thesis empirically shows the evolving trajectory of riparian bilateral relations, bringing evidence from their respective diplomatic timeframes. As water relations are a subset of overall bilateral relations, a rigorous account of bilateral relationships is presented to comprehensively understand the type of strategic interaction between the riparians. The third novelty of this thesis lies in explaining the existing hydropolitics and basin geopolitics and predicting their impact on future Brahmaputra water interactions. Thereby, contributing towards a long-term vision for BRB cooperation as a climate adaptation and disaster risk mitigation strategy.

1.8 Thesis Layout

The thesis comprises six chapters. A brief overview of the chapters is detailed here.

- **Chapter 1** sets the context by introducing the larger transboundary water discourse as an evolving field of research. Citing experiences of transboundary river basins worldwide, it then narrows down to the South Asian context and discusses problems

integral to its management. This kindled the problem formulation and motivation of the study, pointing out research gaps. The existing literature identified benefit sharing as the conceptual framework and game theory as the analytical framework for this thesis. This chapter incorporates the aim, objectives, and research questions. It also outlines the thesis scope. The chapter ends with the significance of this thesis.

- **Chapter 2** is a detailed discussion of the methodology of this thesis. The sub-sections elaborate on the data and collection methods and explain the analytical framework. The last section reports the limitations of the thesis.
- **Chapter 3** is the outcome of the first research objective. The chapter begins with the importance of economic benefits in inducing transboundary water cooperation. While identifying the economic benefits from the BRB, hydropower, and navigation stood out to be the two most preferred economic benefits from the river. Using secondary and primary data, the chapter concludes that hydropower development is a common strategic interest for China, India, and Bhutan whereas navigation is for India and Bangladesh.
- **Chapter 4** addresses the second research objective by initially describing the geopolitical relationship between the riparians and then raising the emerging hydrogeopolitics. The chapter examines the influence of geopolitics and hydrogeopolitics in shaping the current transboundary interaction to a purposeful status quo. This chapter concluded that while the presence of the status quo has avoided overt conflicts, it hindered water cooperation at the basin level.
- **Chapter 5** is the outcome of the third research objective. This chapter presents a game theoretical analysis of riparian interactions using secondary and primary data. Starting from their respective years of diplomatic relations, the entire set of bilateral events is segregated into three timelines (t_1 , t_2 , and t_3) to maintain consistency and highlight the trend in bilateral relations. This qualitative data is then transformed into meaningful parameters to explain the payoffs of riparian strategies through two-player game models. It begins with discussing China-India as BRB riparians, followed by Bhutan-India and, finally, India-Bangladesh.
- **Chapter 6** concludes the research. The chapter ends with highlighting the policy implications of sub-basin cooperation between India, Bhutan, and Bangladesh. It also proposes future research avenues.

Chapter 2 METHODOLOGY

2.1 Outlining the Research Structure

The step-by-step process followed for conducting this research is shown in Figure 2.1. A detailed research design provided a manageable direction to effectively address the research problem and achieve the research objectives.

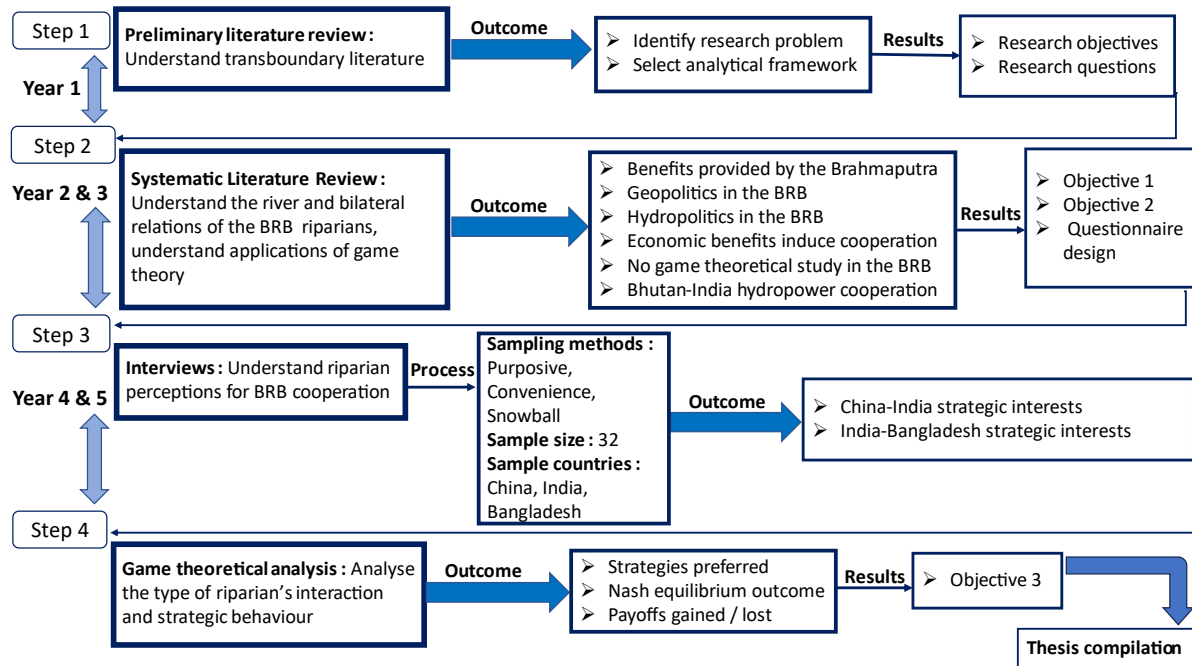


Figure 2.1. Schematic of the Research Design

Source: Author’s construction

In the first year, a preliminary literature review was carried out to identify the research problem, select the analytical framework, develop research objectives, and specify questions. A systematic literature review was carried out in the second and third years which helped in understanding the river basin and bilateral relations of the riparian countries. Apart from completely addressing the first two research objectives, sufficient knowledge was gathered at this stage to frame the interview questionnaires. Moreover, it provided an understanding of the application of the methodological tool for this thesis. The fourth and fifth years consisted of conducting interviews and game theoretical analysis to address the third research objective. Throughout this entire duration, research writing constituted an integral part that finally shaped this thesis in the fifth year.

2.2 Data

The thesis used both secondary and primary data. Concerning secondary data, alongside peer-reviewed literature, reliable grey literature was also incorporated (books, conference articles, organisational websites and reports, government reports, opinion articles, and media reports published in English) (Appendix: Table A3) to gather additional relevant and recent information. The collection of grey literature was done by identifying the list of organisations from all four countries, related to the required aspects of the study area. For more nuanced perceptions related to the Brahmaputra River interaction, primary data was collected.

2.2.1 Data Collection

This thesis required a qualitative research method to get a rigorous picture of the BRB. Qualitative research methods serve to explore the grey areas that remain outside the confines of quantitative predictive research in human behaviour (Denzin & Lincoln, 1994). It allows the researcher to explore a phenomenon, deploying whatever strategies, methods, or empirical materials are at hand. The primary rationale behind choosing the qualitative research method is the aim of this thesis, which requires a deeper understanding and in-depth analysis of the drivers of transboundary interaction and outcomes. A quantitative study alone would not have sufficed.

For an objective understanding of the BRB and developing the research problem, the first set of literature reviews involved a loose keyword search in Google Scholar. Some of such keywords used were “*Transboundary river*”, “*Transboundary water conflict/ cooperation*”, “*Benefit sharing*”, and “*Brahmaputra River Basin*”. This set of literature provided insight into concepts such as transboundary water interaction, power, political economy, and hydro-hegemony. It provided knowledge of the various benefits of water cooperation. This further helped in narrowing the scope of the research problem and formulating the objectives and research questions. Further, it also highlighted the analytical framework to be deployed. Transboundary waters being a common pool resource cause strategic interaction amongst competing users and uses. This makes it imperative to analyse the strategic behaviour of the actors involved which game theory can offer.

2.2.1.1 Systematic Literature Review

To address the research objectives, a systematic literature review was carried out. A systematic review is an examination of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research and to collect and analyse data from studies that are included in the review (Moher et al., 2009). Traditional reviews lack thoroughness, rigour, and unbiasedness for delving deeper into a problem (Snyder, 2019). Via

a systematic review, the author's claims of relevance in their research can be justified, allowing for the identification of gaps and exploring directions for future research (Shaffril et al., 2018). The review was guided by the PRISMA, one of the most widely used SLR methods, comprising four stages (Shaffril et al., 2018). The systematic search was performed in the year 2021. In the first stage, articles were mapped in Web of Science and Scopus bibliographic databases having institutional access. Data collection began using a string of broader search keywords such as "*Brahmaputra AND River AND Basin*" and then moving to more specific searches such as "*Brahmaputra AND River AND Basin AND Conflict/Cooperation*" to understand basin hydrogeopolitics. Country-specific search queries were used like "*China AND Brahmaputra*"; "*India AND Brahmaputra*"; "*Bangladesh AND Brahmaputra*"; and "*Bhutan AND Brahmaputra*" to identify riparian strategic interests which also informed their geopolitical narratives. Moreover, to understand the use of game theory as the main methodological tool, keywords used were "*Game theory AND Transboundary Rivers*"; "*Game theory AND Benefit Sharing*"; "*Game theory AND Brahmaputra AND River AND Basin*". The total number of articles identified after eliminating duplicate results was 941. In the second stage, search results were screened for the title, abstract, and/or keywords. After applying the exclusion criteria (Appendix: Table A4), 321 articles were identified. In the third stage, after an in-depth reading of the full article, 247 articles were found eligible. In the last stage, inclusive of reference snowballing⁵, both from back-referencing and citation tracking, 160 articles were finally chosen for narrative synthesis. Concerning the analytical framework, articles that used game theory for applying benefit sharing to induce transboundary water cooperation are only included (discussed in section 2.3.1). The systematic review process is explained in Figure 2.2. The review revealed that articles on the BRB inclusive of all four riparian countries are limited. Many have discussed the Brahmaputra as part of the GBM river system. Nevertheless, for a comprehensive understanding of South Asian hydrogeopolitics, articles on the GBM also form part of this thesis. China being the uppermost riparian in the BRB, it is imperative to understand China's transboundary water politics. With that aim, articles on other transboundary rivers of China like the Mekong and the Irtysh and Ili were also studied for comparative understanding. It was found that the majority of literature on the Brahmaputra is from the purview of China and India. The India-Bangladesh riparian relationship is mostly centered around the Ganges and Teesta. Bhutan-India articles do not directly focus on the Brahmaputra but elaborate on

⁵Snowballing refers to using the reference list of a paper or the citations to the paper to identify additional papers as cited in Anggraeni et al., (2019).

hydropower cooperation. No article was found on China-Bangladesh, China-Bhutan, and Bhutan-Bangladesh hydropolitical relationships. The review provided an overall understanding of the hydropolitical interests of BRB riparians. As the review identified geopolitical challenges, articles were read to examine basin geopolitics. The review also helped in understanding the appropriateness of types of games under different transboundary water settings and the formulation of payoffs. However, the review found no game theoretical study on the BRB till the last search made on June 2023. Amongst the South Asian transboundary river basins, most studies can be found on the Mekong River. This leaves us with no direct reference for replicating game theoretical applications in the BRB which is equally challenging and a novelty of this thesis.

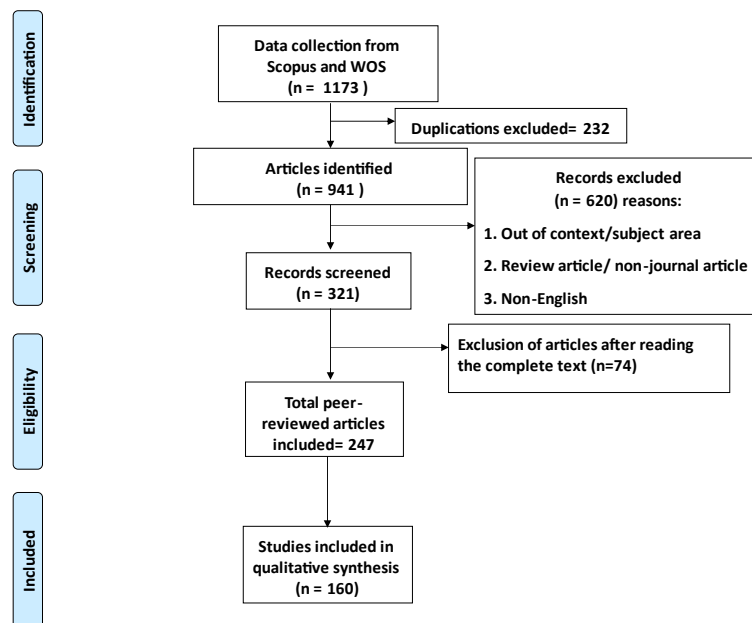


Figure 2.2. Step-wise Systematic Literature Review

Source: Author’s construction

To substantiate the gaps in existing literature, primary data is used as a representative view of the basin countries.

2.2.1.2 Interview

Primary data was collected through expert interviews. An interview is a conversation that produces situated understandings, facilitating inquiry into sensitive information (Denzin & Lincoln, 1994). A total of 32 one-on-one interviews were conducted.

a) Objective

To understand the riparian perceptions of BRB cooperation, this thesis necessitated conducting interviews. The opinions and perceptions expressed in these interviews helped identify the strategic interests and preferences of the riparians to find out what is hindering them from cooperation and how they can be induced to cooperate. This added value to secondary data.

b) Sampling methods and procedure

Key respondents were drawn from three BRB countries- India, China, and Bangladesh. The aim of this thesis necessitated adopting non-probability sampling methods like purposive, snowball, and convenience sampling (Taherdoost, 2016). Purposive sampling is based on the judgement of the researcher as to who will provide the best information to achieve research objectives. To abstain from any bias, expert sampling was preferred for eliciting responses from individuals regarded as experts in the research area. Based on purposive and expert sampling, diverse stakeholders were selected such as academicians (having expertise in transboundary rivers, particularly the Brahmaputra River, river engineering, international relations, politics, and diplomacy), ex-bureaucrat (having expertise in foreign affairs and diplomacy), government official (having expertise in river engineering, water resources management, and disaster management), and media (having expertise in foreign affairs, and environmental journalism). Convenience sampling is selecting participants because they are often readily and easily available. Based on convenience sampling, respondents found in the attendance lists of *Brahmaputra Dialogue* (BD) workshop reports and acquaintances of the supervisor and researcher were selected. The BD project was initiated by the South Asia Consortium for Interdisciplinary Water Studies (SaciWATERS) in 2013 for improved water governance in the Brahmaputra. Initially started as a bilateral dialogue between India and Bangladesh, the BD project eventually became a multilateral platform for the four riparian countries. Key participants⁶ of the dialogue included multiple stakeholders from academia, government departments, development organisations, civil society, and media. The dialogues provided a platform for riparian interaction to discuss the challenges and possibilities for cooperation, enabling joint socio-economic and policy research. For instance, a collaborative academic research project on the Brahmaputra between China, India, and Bangladesh was one such major outcome of the BD. In short, BD is a modest step toward trust-building between the Brahmaputra riparians. Snowball sampling is usually done by using networks when the

⁶https://drive.google.com/file/d/1FWyIMHm2Znzi9wvn_bVs9EIHZYMN0z8B/view

researcher has little information to study. A few respondents were selected based on snowballing from the respondents interviewed earlier, traced from LinkedIn and Google searches. The first set of interviews was conducted with the Chinese, followed by Bangladeshis, and finally, Indians. The underlying reason is to initially understand upstream and downstream perceptions and accordingly, frame questions for middle riparian India about its consequent role and reactions. To ensure a representative sample, Indian interviewees included two Tibetans based in Dharamshala, two government officials from Assam and one from Arunachal Pradesh. As this thesis is central to India's relationship with BRB riparians, the highest number of interviews were conducted with diverse Indian respondents (n= 20), followed by Bangladesh (n= 7), and China (n= 5).

c) Ethical consideration

A proper code of conduct was adhered to when collecting data from respondents to maintain scientific integrity. Request mails defining the research objective and the purpose of interviews were initially sent to obtain informed consent from the participants for voluntary participation. The participants were assured of confidentiality to protect their right to privacy. They were offered the choice of selecting a mode of interview. At the beginning of every interview session, proper permission was obtained regarding their preference for recording.

d) Mode of interview

Starting in January 2022, respondents were mailed requesting an appointment for the interview. Repeated request emails had to be sent in cases when a reply was not received even after months. In some cases where the email addresses were not available, the researcher sent a connect request on LinkedIn. Upon getting connected, messages requesting an appointment for interviews were sent. On some occasions, prospective respondents replied and agreed, but on other occasions, no reply was received even after repeated requests. The mode of the interview was mostly electronic (video-calling applications, like WebEx and Zoom) considering the travel restrictions due to the COVID-19 pandemic. The rest were mailed interviews, two physical interviews, and one telephonic interview. Each of the different modes had its pros and cons. Face-to-face interviews allowed flexibility in the flow of conversation as the researcher had the freedom to cross-question for deeper investigation. On the other hand, mailed interviews provided clear-cut answers as the interviewee could abstain from any confusion, deviations, and monotonous replies. Besides, it saved time for transcription. The online interview sessions lasted for 40-60 minutes. On a few occasions, recordings were not allowed

or could not be done due to technical glitches. Proper interview notes were taken in such cases to maintain accuracy. All interviews were conducted in English between January and November 2022. One respondent preferred to speak in Assamese and was transcribed in English. Moreover, it is interesting to note that despite the researcher's position as being one of the basin countries (India), no probable bias arose as such during the interview process. In fact, belongingness to the BRB and not a third party, made it much more convenient to converse with all respondents, especially with the Chinese because they knew that the interviewer understood the river basin and challenges around well. Therefore, they were not hesitant and conversed more freely than they would have in the presence of a third party.

e) Questionnaire format

Responses were obtained through a semi-structured questionnaire which allowed respondents to answer flexibly and comprehensively. Semi-structured interviews are open-ended and ensure flexibility of conversation based on the context to bring up additional information to meet the research aim (Denzin & Lincoln, 1994). The interviewer had the scope to ask follow-up questions to dig deeper with clarity. Besides, the questions were customised for every respondent according to their country of origin, background, profession, and area of interest to elicit diverse information on their perceptions. Further, responses from the previous interviewees were analysed to pinpoint gaps and focus on subsequent data collection. A sample questionnaire is shown in the Appendix: Table A5.

Part A consists of the formal introductory questions, formed to build a good rapport with the respondent. Part B consists of questions relating to the particular riparian's relationship with co-riparians. Part C narrows down to questions focusing on immediate upstream-downstream relationships. Part D tries to examine the scope of issue linkages for incentivising water cooperation. As this research is undertaken from an Indian perspective, the Indian questionnaire had additional parts focusing on India-China, India-Bangladesh, and India-Bhutan relations. Besides, the centre-state water relations in India were also examined.

f) Interview data analysis

In the preparation phase of data analysis, respondents were first chronologically denoted (ensuring confidentiality) based on country-wise interviews conducted (Appendix: Table A6). For instance, C01 for the first Chinese, I01 for Indian, and B01 for Bangladeshi. Moreover, respondents who were BD participants have been additionally marked as 'BD': 2 from China, 4 from India and Bangladesh, respectively. Furthermore, based on the types of respondents,

academia denoted as AC, ex-bureaucrats as EB, government officials as GO, and media professionals as MP (Table 2.1).

Table 2.1: Types of Interview Respondents

Types of respondents	Basin countries		
	China	India	Bangladesh
Academia (AC)	5	12	4
Ex-bureaucrats (EB)	-	1	1
Government official (GO)	-	5	2
Media professionals (MP)	-	2	-
Sub-total	5	20	7
Total respondents	32		

Source: Author's construction

All recorded interviews were transcribed for thorough analysis. Initially, Otter.ai, an artificial intelligence-based software was used for the transcription of speech-to-text. However, due to lapses of complete accuracy in software transcription, conversation analysis of audio recordings was done manually to preserve the intended meanings. Repetitions and fillers were retained in the readable transcripts to emphasise recurring terms. Simultaneously, data analysis began to check whether interview questions were drawing adequate responses. Using an interpretive approach, data analysis of the semi-structured interviews involved an iterative process (Denzin & Lincoln, 1994) of repeatedly reading the recorded transcripts to get a sense of the country-wise perceptions regarding Brahmaputra cooperation. A country-wise comparison of the perceptions was performed to highlight the similarities and differences in respondents' opinions (Table 2.2). Indian and Bangladeshi respondents share a lot of common perceptions. Perception differences exist between Chinese respondents as those residing in China consider China as transparent, responsible, and cooperative upper riparian contrary to the views expressed by overseas Chinese who mentioned China as non-cooperative.

Table 2.2: Perception Comparison

Perceptions	Country		
	China	India	Bangladesh
Benefit sharing	-	✓	✓
Bilateral relations	✓	✓	✓
Data sharing	-	✓	✓
Information asymmetry	-	✓	✓
Lack of communication	✓	✓	✓
Lack of trust	✓	✓	✓
Misunderstanding	✓	✓	✓

No third-party intervention	✓	✓	-
Power asymmetry	✓	✓	✓
Preference for basin-wide cooperation	-	✓	✓
Scope for sub-basin cooperation	-	✓	✓
Speculation	✓	✓	✓

Source: Author's construction

Data showed that being an upper riparian China is considered to be indifferent to cooperation, India prefers China to cooperate, and Bangladesh is in favour of basin cooperation. Then we interpret it in terms of the research questions to derive meaningful answers, and finally to reflect on the possibility of sub-basin cooperation. The perceptions are regarded as representative opinions of countries as the experts have close experience working in the research area.

2.3 Analytical Framework- Game Theory

Originating from mathematics and nurtured by economics, game theory is the science of rational decision-making in strategic interactions among agents. Strategic interaction implies situations where the utility or payoff of each agent depends not only on their acts but also on the acts of other agents (Dixit, Skeath, & Reiley, 2010; Osborne, 2004). It analyses the logic behind the purposeful behaviour of rational actors who ought to make choices, guided by their preferences (Dinar, 2004). Rationality in game theory implies choosing the best for oneself to maximise utility with or without consideration of the opponents. The essential elements required to analyse any social situation using game theory are a set of players or decision-makers, their available options or strategies, and resulting outcomes or payoffs for each combination of such strategies. The classification of games is based on the outcomes (zero-sum and non-zero-sum), interests (cooperative and non-cooperative), and moves (sequential and simultaneous) of players involved. In case the payoffs are diametrically opposite so that one player's gain is another's loss, it is called a zero-sum game. Otherwise, they are called non-zero-sum games (positive-sum or negative-sum games). If there is a coincidence of interests among players, it is called a cooperative game where joint-action agreements are enforceable. Non-cooperative games are those where joint-action agreements are not enforceable because there is no coincidence of interests among players as they see only their strategic objectives. The basic concepts of non-cooperative game theory describe individual optimal decision-making and the Nash equilibrium (Nash, 1951). A situation, where consideration is made about the opponent's optimal move while optimising their strategy and when all players do their best against the others, is described as the stable solution or the *Nash equilibrium solution*. It is called a stable solution because each actor forms correct beliefs about the strategies of others

and there is no incentive to deviate as defection would yield worse outcomes. On the other hand, players when choosing their best strategy are unaffected or not influenced by the choices of the opponent is regarded as the *dominant strategy solution*. Although independent concepts, the dominant strategy solution could also be the Nash equilibrium solution in case players' strategies match. A player's choice of an action for themselves that guarantees the highest payoffs, regardless of what other players do is called a strictly dominant strategy, and weakly dominant if the player earns at least an equal payoff. Furthermore, based on players' moves, games are classified into sequential and simultaneous games. In sequential move games, players take turns making moves in sequence guided by their experience and future predictions, allowing players to change their actions over time. Such games are depicted as extensive games (also known as game trees) and solved through backward induction of the players to find the sub-game perfect equilibrium (also a Nash equilibrium). In simultaneous move games, all players act at the same time in the sense that each is ignorant of the other's actions while choosing own actions once and for all. Such games are depicted as strategic games (payoff matrix), solved through iterative elimination of dominated strategies to find the Nash equilibrium. However, real-life situations are a combination of both these two types of moves. Depending on the mutual and conflicting preferences of the players, the structure of payoffs in a given round of play can be the benefit of cooperation (CC) relative to defection (DD). For mutual benefits to exist, players must prefer cooperation to defection, that is, $CC > DD$. Game theory establishes the possibility of cooperation even in the absence of enforcing authority. The role of payoffs in affecting cooperation is significant. Changes in the payoffs can alter the preferences of the players and transform situations from one class of game into another. Cooperation may be unlikely under single-play conditions with inertia due to underlying adjustment costs, domestic politics, or information imperfections but through repeated interactions⁷ of the players, cooperation will emerge with the achievement of a lot of mutual gains, which is known as evolutionary cooperation (Friedman, 1998). The prospects for cooperation are also influenced by the number of players in three ways. An increase in the number of players makes cooperation complex by increasing transaction and information costs of cooperation⁸, the likelihood of autonomous defection, and the infeasibility of sanctioning defectors, thereby leading to free-riding and eventual collapse of cooperation. In sum, game theory is essentially the study of competition and cooperation (Madani, 2010). It can be used

⁷Repeated interaction is a situation where a one-time game is played repeatedly in successive periods.

⁸A transaction cost is a cost in making any economic trade when participating in a market. An information cost is an expenditure of time and money that are required to obtain information.

for the explanation of real and experimental events, prediction of already developing situations, and providing recommendations for future interactions.

2.3.1 Game Theory and Water Resources

Game theory finds application in international relations and by extension, to other strategic issues like transboundary waters. Transboundary water resources can be rightly considered a global common good as the spatial scope of its upstream-downstream externalities is transnational (Holzinger, 2003). In game theoretic terms, the management of such a common resource possessing rival and non-excludable benefits can be considered a strategic interaction. Transboundary water interaction is the analysis of interdependent interactions among nations whereby the goals of any nation not only depend upon its actions but are also driven by the actions of other nations (Correa, 2001). The heterogeneity of riparian actors concerning size, power, and preferences determines their set of utility functions for the common good and produces different strategic interactions under different social contexts. As such, game theory helps in the explanation and prediction of such dynamic relations by summarizing large amounts of information in the formal description of the modelled game. Such reasons validate the applicability of game theory for analysing transboundary water management. Due to the incentive for free-riding or defecting on the optimal solution, transboundary water problems are mostly of a prisoner's dilemma structure, although other structures like chicken and stag hunts are also possible (Khachatryan & Schoengold, 2019). In a prisoner's dilemma, two criminal partners are separately interrogated by police due to a lack of strong evidence, guaranteeing freedom to the testifying accused and a long sentence to the silent accused. It would be best for both to keep silent or cooperate with their accomplice and incur short sentences. However, unable to communicate and trust the accomplice, each is tempted to confess or defect and avoid the sentence. Individual rationality leads them to incriminate each other and serve long sentences. In stag hunt, an assurance game, two hunters can together hunt a stag which gives the highest payoff to be shared equally between them or a hare individually. If any hunter devotes energy to catching a hare, the stag escapes and the hare belongs to the defecting hunter alone. Each gets tempted to defect and catch a hare for that is easy to hunt though each prefers a share of the stag to a hare. In chicken game, two drivers head toward each other on a narrow bridge. If they continue to prioritise their ego and not swerve away, it will lead to a collision. If one yields to the other, it loses and is labelled 'chicken' while the other driver wins bravely. The pride of dying is greater for both than swerving. If both players happen to swerve, a tie occurs leaving both with no gains (Osborne, 2004). In short, prisoner's

dilemma models a situation in which there are gains from cooperation but the players' strong incentive to defect due to lack of communication and trust leads them to a sub-optimal outcome whereas defection in chicken, an anti-coordination game, where both players aggressively compete against each other leads to the worst outcome. Unlike the prisoner's dilemma game where the players have a strictly dominant strategy, in stag hunt, the players have a weakly dominant strategy where there can be both cooperative or non-cooperative Nash equilibrium. It is simply due to a lack of trust that non-cooperation may be the result of a stag hunt and so, it is also called a "trust dilemma" (Madani, 2010). Further, in Rambo, a suasion game, two flatmates have a dispute over cleaning the flat. Defection is the dominant strategy of the Rambo for not cleaning under any circumstance, leaving others dissatisfied. The aggrieved player tries to incentivise the Rambo through compensation or issue linkages. This game analyses situations with a pronounced asymmetrical distribution of player power, with one having a strictly dominant strategy (Diez et al., 2011).

Dating from the 1950s, game theoretical application to transboundary waters increased since the 1990s with rising awareness for cooperative management of this scarce resource (Dinar, 2004). The pioneering work of game theory for transboundary water management was published in 1969. Using the concept of a cooperative two-person non-zero-sum game and integrating it with a linear programming problem, Rogers (1969) found that strategies other than joint development pursued by two riparian nations of the lower Ganges and Brahmaputra, India and East Pakistan (now Bangladesh) yielded fewer net benefits, mostly to downstream Bangladesh. Another study on the Nile River basin applied cooperative game theory solution concepts to calculate gains from the cooperation of the ten Nile riparians (Wu & Whittington, 2006). The uniqueness of the Nile River lies in the dominance of downstream countries, Egypt and Sudan. Due to its political and military power, Egypt uses the river water in its entirety whereas the source country Ethiopia uses almost none. Despite such socio-political tensions, the grand coalition strategy was found to generate substantial mutual gains from the benefit sharing of the Nile waters. Non-cooperative game theoretical concepts were used to illustrate the superiority of interconnected games over isolated games through issue linkage for Greek and Bulgarian negotiations in the Nestos/Mesta River (Eleftheriadou & Mylopoulos, 2008). Issue linkage implies interconnecting water issues with non-water issues (socioeconomic or political) to develop sustainable cooperative solutions acceptable to the parties involved. In an isolated scenario, the absence of motives and mutual trust hindered water cooperation. But under issue linkage, downstream Greece provided technical assistance to upstream Bulgaria

for constructing wastewater treatment plants (WWTPs), thereby, motivating Bulgaria to cancel water diversion plans. Again, Bulgaria helped construct border checkpoints for Greece and used this issue during negotiations when Greece demanded more water allocation. Issue linkages between water and energy sectors also induced cooperation in the Volta River basin between upstream Burkina Faso and downstream Ghana, modelled using a non-cooperative static Stackelberg game (Bhaduri & Liebe, 2013). Stackelberg's game analyses players' sequential moves whereby the leader or upstream country gets the first-mover advantage and the downstream country follows. The peculiarity of the Volta basin is the downstream generation of hydropower depending on upstream flow utilisation. Risks of conflicts arose when greater upstream diversions for irrigated agriculture reduced downstream power due to lesser inflow in the Volta reservoir. Issue linkage developed a cooperative outcome as upstream riparian promised a guaranteed downstream flow against the exchange of discounted energy produced downstream. In the Mekong River Basin, studies using cooperative game theory concepts reallocated the incremental gains from benefit sharing through hydropower cooperation, generating win-win outcomes for all lower Mekong riparians (Liao & Hannam, 2013; Bhagabati et al., 2014; Li et al., 2019). In the Kura-Araks basin, interconnected game theory through repeated negotiations over water quantity and quality issues between upstream Georgia, and downstream Azerbaijan, created mutually beneficial and welfare-enhancing cooperative outcomes (Khachatryan & Schoengold, 2019). In a hypothetical basin, evolutionary game theory was applied to show the transition from the non-cooperative prisoner's dilemma outcome to a cooperative outcome through repeated interactions of initial development, conflict, initial cooperation, and in-depth cooperation (Yu et al., 2019). The success of evolutionary cooperation depends to a great extent on the role of incentives, particularly for the upstream country as the greater the potential water benefits, the faster the convergence to basin cooperation (Mirzaei-Nodoushan et al., 2021).

Existing literature confirmed that basin-wide cooperation benefits are always greater than unilateral or sub-coalition benefits. In all these studies, the role of economic incentives like hydropower plays a dominant role in inducing cooperation. This corroborates the fact that economic benefits can solely incentivise riparians to cooperate in transboundary rivers (Alam et al., 2009). Regarding the type of games, cooperative game theory is more commonly applied in basins having institutional cooperation such as the Nile and the Mekong. Cooperative game theory solution concepts directly focus on the equitable allocation of benefits of cooperation rather than observing the strategic stages leading to players' coalition. However, in a practical

context, the power and information asymmetry of riparians assign unequal probabilities of forming coalitions. Moreover, implementing cooperative game theory solution concepts is difficult in data-deficit river basins. Benefit sharing through interconnected games provides more realistic solutions for maintaining the necessary power balance and creating common motives for cooperation as it allows riparians to reap various socio-economic and political benefits, apart from only economic benefits. As an alternative solution, downstream compensation to incentivise upstream cooperation usually results in welfare-reducing victim-pay outcomes. Finally, evolutionary games in transboundary water interactions hold greater relevance for encapsulating various stages of negotiations.

To conclude, the adoption of a systematic literature review method in the thesis was essential to address the research problem, given the scope of the research. It effectively pinpointed the prevailing perception gaps regarding BRB cooperation, indicating the need for enhanced narratives and first-hand voices of experts involved in the field. The qualitative methods of collecting secondary and primary data provided information on the overall political economy of the basin and can be considered one of the major strengths of the thesis. To derive riparians' strategic interests and predict future basin scenarios, the thesis deployed a game theoretical approach. For a data deficit river basin, the application of dynamic optimisation modelling would have been silent on the riparian preferences and strategies as advanced by game theory. Such information is especially useful for initiating BRB cooperation.

2.4 Research Limitations

The thesis being of a dynamic nature, practical difficulties were encountered in reviewing secondary data, implying pertinent studies might be missed out unintentionally. Concerning primary data collection, travel restrictions due to the COVID-19 pandemic came as a mixed blessing. Although its absence might have permitted conducting more interviews through physical visits, at the same time, it made possible online interviews which saved more time, money, and effort. The only requirement was the installation of a high-speed stable internet connection which even made it possible to conduct two interviews in a day with respondents from different time zones. Therefore, carrying out this thesis on a proportionately larger number of online interviews cannot be termed a limitation altogether.

It was especially difficult to contact the Chinese respondents because even after numerous request emails, responses could not be received. The Chinese interviews, therefore, lack diversity as it was only possible to interview academicians. However, those interviewed are

actively involved in government policy-making, particularly the Brahmaputra negotiations, thus, assuring highly enriched responses. Moreover, comprehensive reports on the Brahmaputra by Samaranayake et al., (2016) and Yasuda et al., (2017) based on inputs by diverse Chinese stakeholders complements this thesis. Interviews could not be conducted with the Bhutanese stakeholders because they do not prefer online interviews due to internet connectivity issues. However, the availability of sufficient and high-quality Bhutanese government's secondary data sources and the *Brahmaputra Dialogue* workshop reports which include interview discussions of various Bhutanese stakeholders belonging to academia, civil society, and government departments served as a valuable data source for understanding Bhutan's strategic interests and preferences for the Brahmaputra River.

Out of 72 interview requests sent, 32 responded from across the three countries. Out of those who responded, the number of males exceeded female respondents (7:1). Despite efforts to maintain gender equity among interviewees, this thesis could not meet this criterion. From a gendered lens, valuable insights were drawn that in South Asia, transboundary water, and international relations are male-dominated fields. Though sufficient responses have been collected to meet the objectives of the thesis, from a quantitative perspective the number of interviews might seem less. However, we refrained from interviewing individuals other than experts in the fields as that would add no value to this thesis. Apart from these data collection limitations, data analysis is limited to the formulation of empirical game theory models with qualitative data assigned as payoffs. Due to limited basin-wide data availability and the incorporation of hydropolitical and geopolitical dimensions, it was not possible to quantify the payoffs for analysis.

Chapter 3 ECONOMIC BENEFITS FROM THE BRAHMAPUTRA RIVER BASIN

This chapter addresses the first research objective of exploring benefit-sharing prospects in the BRB. The chapter uses secondary and primary data to answer the two research questions under this objective. All interviewees were asked how their respective country sees the Brahmaputra River, the benefits provided by the river, and whether the benefits have been optimally utilised. Based on the responses, this chapter first identifies the economic benefits of the Brahmaputra and examines whether these benefits induce cooperation in the light of the strategic interests of the riparians.

Economic benefits or ‘benefits from the river’ are the outputs derived from water resources like electricity, food crops, fisheries, navigation, and recreation (Alam et al., 2009; Sadoff & Grey, 2002). Economic benefits underpin transboundary cooperation in theory and practice (Feng et al., 2019; Arjoon et al., 2016; Alam et al., 2009; Dombrowsky, 2009; Dinar, 2004). The potential of economic benefits in inducing riparians motivated by economic growth and WEF nexus security to cooperate are significant, further resulting in catalysts like poverty alleviation, regional integration, eased political tensions, improved communications, and peace for fostering cooperation (Sadoff & Grey, 2002). Developing countries in Asia, particularly the Chinese and Indian governments, prioritise exploring the economic opportunities from water over ecological benefits, primarily for national economic gains (Xie et al., 2023; He, 2015; Rasul, 2015). Nevertheless, the maximisation of economic gains is subject to environmental boundaries.

Out of various kinds of economic benefits, cooperation based on non-consumptive uses of water, such as hydropower and navigation produces greater benefits, as it does not affect water availability for other uses (Wu & Whittington, 2006; Sadoff & Grey, 2002). Besides enhancing water and energy security, multipurpose dams with storage reservoirs further cater to flood-drought management, navigation, and irrigation (Bin, 2021; Rasul et al., 2021; Rahaman & Varis, 2009). Existing discussions around the Brahmaputra have so far been mostly centered on hydropower development plans in China and India (Deka, 2021; Sharma, 2018; Xie et al., 2017; Jiang et al., 2017), and inland water navigation in India and Bangladesh (Deka, 2021; Pradhan et al., 2021; Barua et al., 2018). Data collected from expert interviews also identified that most BRB countries have preferences for hydropower, while there is also an interest in utilising the navigational potential of the Brahmaputra. The respondents unanimously agreed that the river benefits have not been optimally utilised due to geographical challenges, political

and social issues, inadequate policy frameworks, and non-collaboration at different levels (C_{AC}, I_{AC}, I_{GO}, I_{EB}, B_{AC}, B_{GO}).

As this thesis attempts to identify the entry points of BRB cooperation, it argues that sharing economic benefits like hydropower and navigation can act as enablers. Apart from contributing to economic development, clean energy and green navigation are directly linked to environmental benefits, and spillover political and catalytic benefits through regional integration. The subsections below discuss country-wise hydropower and navigation potential in the BRB.

3.1 Hydropower Development

The hydropower potential of the Brahmaputra is among the greatest in the world (206GW), with China having 110GW, India 66GW, Bhutan 30GW, and Bangladesh 0GW (Ray et al., 2015; Rahaman & Varis, 2009). However, the potential being harnessed is 6GW (Pradhan et al., 2021; Ray et al., 2015). The untapped potential is of great interest to both China and India for meeting growing energy demands (Barua & Vij, 2018; Liu, 2015). Bhutan and India are already partnering over hydropower generated in Bhutan (Tortajada & Saklani, 2018). The next sub-divisions in this subsection discuss the hydropower ambitions of China, India, and Bhutan.

3.1.1 Hydropower Development in China

The NDRC Report⁹ “China’s Energy Conditions and Policies”, 2007 stated that China strives to build a stable, economical, and clean energy supply system by prioritising renewable energy, relying on domestic resources, and increasing international cooperation. The Report acknowledged that as a responsible developing country, China prioritises environmental protection and prevention of global climate change in its ambitions for cascade hydropower development. It further specified China’s opposition to politicising energy issues but fostering energy security through mutually beneficial international cooperation. China’s hydropower resources are extensive but unevenly distributed far from the centers of consumption, with the largest hydropower base in Southwest China, accounting for about two-thirds of the total technically feasible hydropotential. Tapping hydropower reserves of Southwest China is beset with several challenges. Mountainous physiography entailing technical difficulties and high costs, backward socio-economy and low population density, sensitive transboundary nature of

⁹<https://en.ndrc.gov.cn/policies/202105/P020210527780237298276.pdf>

rivers relating to hydropolitics are reasons behind low utilisation and huge abandoned hydropotential in this region (Sun et al., 2019; Li et al., 2018).

Out of all the Southwestern river basins of China, the Yarlung Tsangpo has the highest renewable surface water resources and hydropower reserves (110GW), yet to be realised due to harsh mining conditions (Li et al., 2018; Ray et al., 2015; Cathcart, 1998). China, thereby, intends to exploit the untapped Brahmaputra but did not explicitly reveal the name in either any of its Five Year Plan (FYP) or in the 13 national hydropower bases identified by China (Sun et al., 2019). The Chinese respondents also informed that China's strategic interests in the Brahmaputra are meeting water scarcity of the arid northern region (Tibet being scantily populated) and energy security through hydropower development (C_{AC}). With that motive, the first hydropower dam in the Brahmaputra was completed under the 12th FYP in 2015 (Zhang & Li, 2018). The International Campaign for Tibet (ICT) identified a list of new hydropower projects over the Yarlung Tsangpo proposed by the 13th FYP (2016-2020) of China¹⁰. Along with Dagu, and Jiexu, several hydropower projects are under construction or planned and the Jiaxa is awaiting commission thus, the river is no longer free-flowing in China (Pradhan et al., 2021). It was learned that prohibiting local inhabitants from visiting the site, China is constantly engaged in undercover hydropower dam constructions in Tibet (I_{AC}). Upon enquiring about the economic opportunities for the locals, it was mentioned that neither the Tibetans secure employment in these projects nor the hydroelectricity produced in those dams is supplied locally in Tibet, but transferred to cities of mainland China. In fact, Tibetans dislike such infrastructure constructions for destroying their pasture lands and simple nomadic livelihoods. The Tsangpo or "the purifier" is revered in Tibetan culture for providing ecological benefits and supporting agriculture (C_{AC}, I_{AC}). As Buddhism forbids fishing, Tibetans do not indulge in fishing in the Brahmaputra. Furthermore, as stated by one Chinese respondent, Brahmaputra diversion under the much-speculated western route of the South-North Water Diversion Project (SNWDP) is currently not prioritised by China (C_{AC}).

3.1.2 Hydropower Development in India

Basin-wise hydropower development in India is the least for the Brahmaputra River (6.08%) (Table 3.1). Table 3.1 shows that capacity developed is also less in other transboundary rivers such as the Indus (43.28%) and the Ganges (26.26%), in contrast to the domestic rivers. The plausible hypothesis behind this might be the difficulties associated with managing and

¹⁰<https://savetibet.org/wp-content/uploads/2019/06/damming-tibets-rivers.pdf>

building consensus on rivers that run across international borders. Even amongst the three transboundary rivers, the capacity yet to be developed is the highest in the Brahmaputra (88.03%). This might be due to a lack of collaboration in the BRB.

Table 3.1: Basin-wise Hydroelectricity Development in India as of 31.03.2019

River Basin	Capacity Developed		Capacity under Construction		Capacity yet to be Developed	
	(MW)	(%)	(MW)	(%)	(MW)	(%)
Indus	14294.3	43.28	3871.5	11.72	14862.2	45.00
Ganga	5317.2	26.26	8.12	1645.0	13289.6	65.62
Central Indian river system	3147.5	81.37	400.0	10.34	320.5	8.29
West flowing river system	5631.7	62.60	100.0	1.11	3265.3	36.29
East flowing river system	8249.0	59.88	960	6.97	4566.1	33.15
Brahmaputra	3974.0	6.08	3853.0	5.89	57573.0	88.03
Total	40613.6	27.95	10829.5	7.45	93876.9	64.60

Source: Central Electricity Authority, India

https://cea.nic.in/wp-content/uploads/2020/03/hydro_review-2018.pdf

India holds the second-largest hydropower potential in the BRB (66GW) (Rahaman & Varis, 2009). The Brahmaputra basin in Northeast India stores a huge hydropower potential of about 58,356MW, around 44.42% of the total potential of the country; with Arunachal Pradesh alone having 67.5%. As a corollary, the untapped potential is greater in Arunachal Pradesh (93.78%) than in Assam (46.15%). The total percentage yet to be exploited is about 92.9% till the year 2021¹¹. Increasing initiatives are thus, underway to tap the rich hydropower potential of this region, signifying India's ambition to become energy-secured (Bandyopadhyay et al., 2016). India plans to develop several run-of-river (ROR) projects in Arunachal Pradesh to meet the country's power shortage. Some of the ROR projects already in operation in India are Kopili (275MW), Khongdong (50MW), and Karbi Langpi (100MW) in Assam and Ranganadi (405MW), Kameng (600MW), and Pare (110MW) in Arunachal Pradesh¹². Besides, the Lower Subansiri project is under construction in Arunachal Pradesh. Given the high seismic intensity and rich biodiversity and cultural heritage, the hastiness of projects granted by the Arunachal Pradesh state government to private companies is feared to generate greater costs (Borghain,

¹¹<https://neepco.co.in/projects/power-potential>

¹²http://cea.nic.in/reports/annual/hydroreview/hydro_review-2018.pdf

2019). Unlike Arunachal Pradesh, hydropower development is not a priority for the downstream state of Assam. Being a floodplain, Assam annually faces the double whammy of devastating Brahmaputra floods and riverbank erosions, affecting more than 30 lakh hectares or around 40% of the state's total land¹³. Sustaining the agrarian economy of Assam requires irrigation development and flood and erosion control through concerted policy decisions between not only state and central governments, but also transboundary cooperation on long-term measures in the form of upstream multipurpose storage reservoirs (Goyari, 2005). Moreover, dam-induced floods from Arunachal Pradesh in the districts of Upper Assam are a major cause of concern, leading to people's resistance to dam construction (Thakur, 2020; Borgohain, 2019). There is a lack of consensus between the Arunachal Pradesh and Assam state governments concerning the Brahmaputra River management (Samaranayake et al., 2018). The two states need to forego their zero-sum mindset and make collaborative efforts to be a part of the transboundary decision-making process for an inclusive hydro-diplomacy (IGo).

3.1.3 Hydropower Development in Bhutan

Bhutan has one of the largest repositories of hydropower with a theoretical potential of 30GW, out of which 23.8GW is techno-economically feasible for development (NTGMP, 2018). Large hydroelectric plants operating in Bhutan generate power both for domestic consumption and exports to India (Table 3.2).

Table 3.2: Existing Large Hydroelectric Plants in Bhutan

Generating Stations	Location	Year of commissioning	Installed Capacity (No.*MW)	Generating Capacity (MW)
Chukha	Chhukha	1986-88	4x84.0	336.0
Kurichu	Monger	2001	4x15.0	60.0
Basochhu-I	Wangdue	2002	2x12.0	24.0
Basochhu-II	Wangdue	2004	2x20.0	40.0
Tala	Chhukha	2006-07	6x170.0	1020.0
Dagachhu	Dagana	2015	2x63.0	126.0
Mangdechhu	Trongsa	2019	4x170	720.0
Total			2326.0	2332.0

Source: Statistical Yearbook of Bhutan, 2020

Bhutan is the only country in South Asia possessing surplus quantity and optimality in hydropower projects, thus, making it cost-efficient, less risky, and more lucrative for exports (Ogino et al., 2019a). Power export to India provides a large and stable source of revenue for

¹³<https://waterresources.assam.gov.in/>

Bhutan (Table 3.3), the primary source of Bhutan’s socioeconomic development, over and above its tourism industry (Tortajada & Saklani, 2018).

Table 3.3: Hydropower Export Revenue of Bhutan

Power Plant	Installed Capacity (MW)	Export Revenue (In Million Nu.) / Year					Total Export Revenue
		2015	2016	2017	2018	2019	
Chhukha	336	4,011.96	4,563.64	4,681.31	3,687.77	4,231.66	21,176.34
Tala	1020	6,577.10	6,464.21	6,239.32	5,395.79	5,690.82	30,367.24
Kurichu	60	191.25	2,185.79	173.21	138.22	167.45	2,855.92
Dagachu	126	3,003.59	3,205.42	1,302.93	1,210.75	1,360.55	10,083.24
Mangdechhu	720	-	-	-	-	5,345.23	5,345.23
Total		13,783.90	16,419.06	12,396.77	10,432.53	16,795.71	69,827.97

Note: Mangdechhu powerplant was commissioned in June 2019.

Source: Department of Hydropower & Power Systems, MoEA, Bhutan.

Hydropower generation being cyclic due to water flow variation, Bhutan also imports power from India during the lean season to avoid power deficits (Ogino et al., 2019b). Therefore, Bhutan and India share the benefits of intra-industry trade (international trade model) whereby countries trade the same product. Although Bhutan imports power from India, the quantum of power exported by Bhutan to India has been consistently surpassing its power imports, with the highest quantum of exports observed in 2020 (Table 3.4).

Table 3.4: Bhutan-India Hydroelectricity Trade

Year	Export (MU)	Import (MU)	Export Value (Million Nu.)	Import Value (Million Nu.)	GDP growth (annual %)
2013	5,648.22	112.55	11,227.26	222.92	2.12
2014	5146.59	159.13	10,633.63	319.02	5.77
2015	5,721.11	124.51	2,124.48	249.65	6.64
2016	6,133.22	86.63	13,032.05	172.95	8.12
2017	5,372.48	93.01	11,983.49	74.94	4.65
2018	4,535.00	134.00	10,578.00	295.00	3.05
2019	6,146.60	96.37	16,237.20	206.17	5.46
2020	9,206.58	81.75	27,523.03	180.68	-10
2021	8,075.50	-	24,435.44	-	4.1
2022	7,270.36	-	22,475.36	-	NA

Source: Author’s compilation from Bhutan Trade Statistics

<https://www.mof.gov.bt/publications/reports/bhutan-trade-statistics/>

Table 3.4 shows that despite slight fluctuations in the quantity of exports and imports over the years, Bhutan’s value of export revenue far exceeds its import costs. This indicates Bhutan shares a favourable balance of hydroelectricity trade with India. As the Managing Director of

Druk Green Power Corporation (DGPC) reported, the COVID-19 pandemic in 2020 reduced Bhutan's domestic consumption of electricity by 8% but electricity export to India has not been affected¹⁴. In the post-COVID years, Bhutan has no record of importing electricity from India, implying its energy self-sufficiency. Bhutan is not only self-sufficient in power but also the only power-surplus BBIN (Bangladesh, Bhutan, India, Nepal) country at present, exporting 75% of its generation to India which is approximately over 1000MW during the wet season (Haran, 2021). The mutual need for hydropower thus, developed a symbiotic, positive Bhutan-India bilateral relationship, with India playing the role of a benevolent hegemon to its upper riparian (Barua et al., 2018).

Bhutan's 12th FYP (2018–2023) envisions reducing poverty and inequality by ensuring renewable energy supply via enhancing cooperation with other countries and strengthening engagement in international and regional frameworks¹⁵. With that aim, the Department of Hydropower and Power Systems, (DHPS) Bhutan with the Central Electricity Authority (CEA) of India together developed the National Transmission Grid Master Plan (NTGMP), 2018. The Report provides a realistic hydropower development five-year timeframe from 2020 to 2040 to ensure flexibility in planning for the prioritised implementation of proposed projects. Apart from cost optimisation of the transmission system, environmental protection was prioritised by Bhutan for minimising adverse impacts of transmission lines passing through national parks and biological corridors.

The NTGMP Report clarified that Bhutan's increasing imports of project equipment and construction materials from India resulted in a negative balance of trade due to the long gestation period of hydropower projects. However, good economic dividends from exports are expected to boost GDP growth because of minimal project risks. Delaying these hydro projects would cost Bhutan a cumulative loss of 1,349 billion Bhutanese Ngultrum (BTN) export earnings by 2050, considering five years of slippage in capacity addition.

The Report identified viable hydropower projects to be commissioned in Bhutan and cross-border transmission links for future power trading between the two nations (Table 3.5). Under the beyond 2040 timeframe, all techno-economically viable projects of Bhutan are considered. This indicates increased power generation in the future. Power exports to India will consistently increase and in fact, double by 2030. By 2030, there will be a huge surplus in Bhutan to be

¹⁴<https://www.sasec.asia/index.php?page=news&nid=1178&url=bhu-hydro-export-aug2020>

¹⁵<https://www.sasec.asia/index.php?page=bhutan>

exported to India after meeting its internal requirement of 2500MW. This highlights the prospects of future mutually beneficial hydropower cooperation between Bhutan and India.

Table 3.5: Planned Hydropower Development of Bhutan

Timeframe	Hydropower projects	Generation capacity (MW)		Total cumulative generation (MW)	Total exports (MW)
2020	1. Punatsangchhu-II 2. Mangdechhu 3. Nikachhu	1,020 1720 118	=1,858	3,464	2,875.20
2025	1. Punatsangchhu-I 2. Kholongchhu	1,200 600	=1,800	5,264	4,512
2030	1. Dorjilung 2. Sankosh 3. Nyera Amari I & II (integrated)	1,125 2,585 404	=4,114	9,378	8,383
2035	1. Kuri-Gongri 2. Bunakha RS 3. Chamkharchhu-I 4. Wangchhu	2,640 180 770 570	=4,160	13,538	12,329
2040	1. Panbang 2. Khomachhu 3. Chamkharchhu-II 4. Chamkharchhu-IV 5. Gongri	1,100 363 590 364 652	=3,069	16,607	15,235
Beyond 2040	73 potential projects		=10,295	23,833	22,319

Source: Author's compilation from NTGMP Report, 2018

Bangladesh, a riverine country, has profuse water resources but its plain landmass and low elevation restrain hydropower generation (Das et al., 2020). The supply of natural gas, the predominant source of Bangladesh's power sector is predicted to deplete rapidly with growing energy demands (Das et al., 2020; Rahaman & Hossain, 2020). The future energy security of Bangladesh can, therefore, be met by importing renewable hydropower from China, Bhutan, and Northeast India while improving the environmental concern. Energy cooperation through optimally utilising the river's hydropower potential can pave the way to Brahmaputra water cooperation. There are positive indications of this from Bhutan, India, and Bangladesh (discussed in Chapter 6).

3.2 Navigation Development

The Brahmaputra River stores immense opportunities for inland water navigation between India and Bangladesh but has not been harnessed well (Pandey et al., 2020; Barua et al., 2018,

2019; Barua & Vij, 2018). Inland waterways are defined as public goods providing non-rival and non-excludable benefits, leading to allocative inefficiency (Schiessel Harvey, 2019). For facilitating the transition toward a sustainable and green economy, inland water navigation is critical (Tabor, 2022). The concept of a “green economy” is perceived as a low-carbon, resource-efficient, and socially inclusive pathway to sustainability¹⁶. Waterway connectivity is cost-effective and environment-friendly compared to roadways and railways (Trivedi et al., 2021; Nagabhatla & Jain, 2013). During the 1990s, increasing recognition of the social, economic, and environmental benefits of restoring inland waterways started growing worldwide (Schiessel Harvey, 2019). Once well-connected through waterways, the demarcation of political boundaries between India and Bangladesh deprioritised riverine connectivity due to greater emphasis on developing other modes of transportation but of late, these nations are restoring the cut-off old routes (Vidyadharan, 2021; Shringla, 2018; Yhome, 2017). The next sub-divisions in this subsection discuss the navigation status in India and Bangladesh.

3.2.1 Navigation Development in India

The Inland Waterway Authority of India (IWAI), the nodal agency for the development of navigational infrastructure in national waterways on 1st September 1988 declared the Brahmaputra as National Waterway- 2 (NW-2), out of a total of five¹⁷. The total stretch is 891 km long from Sadiya in Assam to Dhubri near the Bangladesh border (Figure 3.1). The geographic extent of the waterway is entirely in Assam. Assam has the third-highest length of waterways (4267 km) in India, with a navigable length of 1938 km and 45.42% of navigable length to total length¹⁸. This reflects that Assam has a sound potential for inland water trade (IWT). Proposed as a pillar of the Act East Policy (AEP), waterway connectivity projects will act as economic growth corridors for isolated Northeast India (Das, 2022; Akhtar, 2017). Terminals at 12 locations are being maintained on NW-2 for handling cargo vessels and passenger ferries. However, severe flooding and bank erosion in the Brahmaputra lead to frequent changes of course and insufficient navigational depths, hindering smooth traffic in NW-2 (Rangaraj & Raghuram, 2007).

¹⁶<https://sdgs.un.org/>

¹⁷<https://iwai.nic.in/>

¹⁸<http://shipmin.gov.in/sites/default/files/7841625184IWT.pdf>



Figure 3.1. National Waterway-2 Map
Source: IWAI

The total cargo traffic on NW-2 was 26.01 lakh tonnes during 2017-18 as against 25.91 lakh tonnes during 2016-17, showing an increase of only 0.38% (Table 3.6). Compared to NW-1, cargo movement on NW-2 has remained mostly stagnant during the given period. This leaves scope for the development of inland water trade and connectivity in NW-2.

Table 3.6: Cargo Movement on National Waterways in India

Detail	Cargo Moved (lakh tonnes)				Tonne km (in lakh)			
	2014-15	2015-16	2016-17	2017-18	2014-15	2015-16	2016-17	2017-18
NW-1	50.50 (60.2)	62.37 (63.1)	45.05 (55.4)	54.79 (64.4)	22636 (97.4)	26995 (97.8)	24598 (97.6)	27773 (97.9)
NW-2	24.92 (29.7)	25.84 (26.2)	25.91 (31.9)	26.01 (30.6)	508 (2.2)	505 (1.8)	503 (2.0)	504.36 (1.8)
NW-3	8.44 (10.1)	10.61 (10.7)	10.33 (12.7)	4.28 (5.0)	92 (0.4)	105 (0.4)	109 (0.4)	81.14 (0.3)
Total	83.86 (100.0)	98.82 (100.0)	81.29 (100.0)	85.08 (100.0)	23236 (100.0)	27605 (100.0)	25210 (100.0)	28358.50 (100.0)

Source: Ministry of Shipping, IWAI

Note: Figure within brackets indicates percentage to the total.

3.2.2 Navigation Development in Bangladesh

The delta nation Bangladesh possesses a 24,000 km inland waterways network, comprising over 5,968 km of navigable waterways for mechanised vessels during the monsoon season, and about 3,865 km during the dry season¹⁹. The IWT sector cost-effectively transports over 50

¹⁹“About Us.” Bangladesh Inland Water Transport Authority (BIWTA), 2021.

<http://www.biwta.gov.bd/site/page/aea3e3d9-0e99-4bcd-9330-a0a9961c793c/আমদের-সম্পদকে>

percent of total freight traffic and around one-quarter of all passenger traffic and is most popular in the southwest part of Bangladesh which is where the major portion of the Brahmaputra basin lies (Chowdhury, 2010). IWT is a substantial contributor to the national economy facilitating the mobility of people and mostly, agricultural commodities (CUTS, 2017a). The contribution of the IWT sub-sector to Bangladesh's GDP is increasing annually (Table 3.7). But its sectoral share and growth rate are declining continuously.

Table 3.7: Contribution of IWT Sub-sector to Bangladesh GDP

Year	GDP (Constant Prices) (Million Taka)	Sectoral Share (Constant Prices)	Sectoral Growth Rate (Constant Prices)
2016-17	67,273	0.74	4.10
2017-18	69,627	0.71	3.50
2018-19	72,157	0.68	3.63
2019-20	73,218	0.66	1.47

Source: Bangladesh Bureau of Statistics

The inland waterways network in Bangladesh is, therefore, not utilized to its full potential. Navigational routes also get disrupted due to silting and declining lean season water depths without frequent dredging (Chowdhury, 2010). The 7th FYP of Bangladesh (2016-2020) targeted the development of new waterways and maintaining the navigability of existing channels to aid its economic growth.

The navigation opportunities for landlocked Bhutan are the least explored and could immensely benefit from the NW-2 for access to the Bay of Bengal (Rasul et al., 2021; Haran, 2021). There lies a host of benefits and also, challenges in this regard (discussed in Chapter 6). Although existing literature has no mention of China's interest in utilising the navigability of the Brahmaputra, opportunities can be explored for expanding regional connectivity through the Brahmaputra waterways.

3.3 Preference for Cooperation

Each riparian nation holds different perspectives on Brahmaputra water management. China aims for water and energy security from the Brahmaputra (Barua, 2018; Zhang & Li, 2018; Liu, 2015). India prioritises hydropower development, flood/erosion/sediment control, navigation, and economic development of isolated Northeast India (Barua, 2018; Barua & Vij, 2018). Bangladesh is concerned with managing physical challenges such as riverbank erosion, sedimentation, floods, droughts, and groundwater availability, besides developing inland navigation (Barua, 2018; Samaranayake et al., 2016; Chowdhury, 2010). Bhutan considers the Brahmaputra as a power revenue-generating source (Barua, 2018; Tortajada & Saklani, 2018). Utilising the untapped economic benefits of the Brahmaputra is, therefore, an emerging

hydropolitics of the riparian national governments, determined for WEF nexus security and sustainable economic development (Pandey et al., 2020; Barua & Vij, 2018; Biba, 2016). However, common strategic interests that could facilitate transboundary cooperation are hydropower generation, inland navigation, and flood and erosion management (Barua et al., 2019). Despite these common hydropolitical interests, the underlying geopolitical equations in the basin encouraged the riparians to embrace unilateral actions instead of collaborations resulting in missed opportunities for regional development (Barua, 2018; Yasuda et al., 2017, 2018; Samaranayake et al., 2016). The absence of institutional arrangement in the BRB is also a reason behind its underutilisation.

An Indian respondent stated, *“If water sharing agreement is a problem then why not benefit sharing through collaborative dam constructions in China with the involvement of Indian engineers, apprising them of the dam designs’ safety?”* (I_{AC}). Upon asking the Chinese respondents about the prospects of China-India hydropower collaboration, they appraised that China being technically and financially better off, does not require India’s help for collaborative hydropower development projects (C_{AC}). Also, given the technical difficulties of transferring hydropower generated in China to India due to long-distance transmission losses, China finds no economic incentive for BRB cooperation (C_{AC}, I_{AC}). *“There can be no hydropower sharing between India and China but plans for reservoir construction in China that will help maintain water flow for navigation between India and Bangladesh or for downstream flood control is feasible”* (C_{AC}). As the uppermost BRB riparian, China can play a responsible role by assuring the benefits of collaborative water management to its downstream riparians. By contrast, all Indian and Bangladeshi respondents expressed a strong preference for BRB cooperation. Bangladesh perceives that China-India geopolitical conflicts are the most dangerous and damaging obstacle to regional cooperation, and Bangladesh will be the most vulnerable, being the lowest riparian (B_{AC}, B_{EB}). Upon asking the Bangladeshi respondents about their role in inducing upstream countries to cooperate, they mentioned that Bangladesh has very limited bargaining power because of power asymmetry in the basin (B_{AC}, B_{EB}). B_{EB} commented, *“We can just talk to the Chinese and express our concerns on data sharing, what else can we do? I don't know what it will take to convince China but in its power game, we are suffering”*.

According to the Indian and Bangladeshi respondents, given China’s dominant attitude toward non-cooperation, cooperative solutions through joint action on hydropower and navigation can be figured out between India, Bhutan, and Bangladesh, and also between India and Bangladesh (I_{AC}, I_{GO}, I_{MP}, B_{AC}, B_{EB}, B_{GO}). Joint actions through benefit sharing arrangements will create

the highest intensity of cooperation in the BRB by redistributing all four types of benefits-ecological, economic, political, and catalytic and associated costs among the riparians. Sharing benefits from the river like hydropower and navigation will ensure economic benefits like energy security, cost-effective trade and transit, contributing to the socio-economic development and economic growth of these countries. In addition, linkage effects will ensure the benefits of carbon neutrality and the creation of a green economy. Apart from sustaining warm political relations, the countries will be able to initiate regional integration through water cooperation. Cooperation will further reduce the environmental costs of unilateral water interventions. As transboundary cooperation is incremental, bilateral cooperation achieved through the sharing of economic benefits as the starting point, can lead to sub-basin cooperation, and ultimately encourage basin-wide cooperation.

3.4 Summing Up

In this chapter, the scope of implementing benefit sharing was discussed by identifying the most preferred economic benefits from the river and the common strategic interests of the riparians. As the river development is impacted by basin geopolitics, the next chapter discusses the geopolitical relations of the riparians to examine if there is a correlation between hydrogeopolitics and geopolitics in influencing Brahmaputra River interaction.

Chapter 4 **HYDROPOLITICS AND GEOPOLITICS IN THE BRAHMAPUTRA RIVER BASIN²⁰**

This chapter addresses the second research objective of assessing the interlink between hydropolitics and geopolitics in the BRB and its influence on transboundary interaction. To answer the two research questions under this objective, this chapter is entirely based on secondary data.

As found in the previous chapter, the Brahmaputra is a rich repository of economic benefits such as hydropower, irrigation, and inland water navigation, apart from holding immense social and cultural significance for the river-dependent communities. Although there exist common strategic interests, the riparians have failed to identify common grounds to cooperate for the development of the basin (Barua et al., 2018). In this chapter, we expound on hydropolitics between the riparians of the Brahmaputra and how regional geopolitics contributes to the present *cul-de-sac*. The sub-sections below first put forward a geopolitical and hydro-political account of the BRB and then conclude with the type of transboundary interaction.

4.1 Evolving Geopolitical Landscape in the Brahmaputra Basin

Geopolitics can be defined as the causal relationship between political power and geographic space on the relative power position among countries; leading to advantages and vulnerabilities to national security from territorial and maritime space (Scott, 2008). In other words, geopolitics explains countries' demonstration of power over the control of strategically significant geographical entities for meeting political interests. Transboundary water is one such territorially embedded factor used as a power consolidation mechanism by nation-states and in the process, transforms it into a weapon of domination and legitimacy (Daoudy, 2020). In the BRB, relations between riparian countries are ridden with varying degrees of geopolitical contestation and diverse national interests.

Hindi-Chini Bhai-Bhai predicament?

China-India relationship has been volatile due to territorial disagreements prevailing since British rule in the sub-continent. The formation of the Republic of India in 1947 and the People's Republic of China in 1949 bequeathed the colonial maps of a disputed border (Bhasin,

²⁰This chapter, entitled "Hydropolitics intertwined with geopolitics in the Brahmaputra River Basin" has been published in *WIREs Water Journal* in 2022.

2021; Xuecheng, 2011; Guruswamy & Singh, 2009). The territorial dispute eventually led to an open border conflict in 1962 and a Line of Actual Control (LAC), instead of a settled boundary. While several boundary agreements to maintain peace and stability were inked in the 1990s and economic ties picked up in the 2000s, the relationship has continued to be bedevilled by conflicting territorial claims and counterclaims and competing infrastructure development along the LAC (Garver, 2011; Guruswamy & Singh, 2009).

The unresolved border issue continues to be the main element impinging bilateral relations between China and India. Further, India's consequent hosting of the Dalai Lama and Tibetan exiles came at the cost of China's displeasure. From a national security perspective, the geopolitical location of Tibet holds immense strategic importance, generating rivalry and fear between these Asian giants (Topgyal, 2011). China was threatened by India's refusal to recognise Chinese sovereignty over Tibet before 1950. Similarly, India feared that the resolution of the Tibet issue might lead the Dalai Lama and Tibetan government-in-exile reluctantly to yield to Chinese pressure in support of Beijing's boundary claims (Topgyal, 2011). Related to the Tibet issue is the dispute in the eastern sector of the border along the McMahon Line (Rao, 2021). The McMahon Line, defining the Indo-Tibetan border was the outcome of the 1914 Simla Convention between British India and independent Tibet and hence, China disowned the agreement as it was not a signatory (Xuecheng, 2011; Soni & Marwah, 2011). Following China's occupation of Tibet in 1951, Beijing began paying greater attention to its claims over the Indian state of Arunachal Pradesh calling it "South Tibet" (Raghavan, 2019).

Since then, it has been noted that the Dalai Lama's visit to the state of Arunachal Pradesh produced tension in the China-India relationship (Correspondent, 2018). Moreover, with both China and India prioritising bilateralism and disapproving of any third-party intervention in matters of territorial sovereignty (Barua et al., 2018; Ho, 2016), this has also meant that contestation on other bilateral issues such as transboundary rivers has not received due attention (Chellaney, 2008).

Increased geostrategic competition is another aspect of tense China-India bilateral relations. China is vying for an increasing foothold in South Asian countries, which were traditionally under India's overwhelming predominance, thus, generating strategic insecurity for India (Freeman, 2018). China's expanding trade and infrastructural investments in Bangladesh, for instance, put India in discomfort, given that it might undermine India's influence in the country (Correspondent, 2020b). India believes such actions might enable China to win concessions

from Bhutan and Bangladesh related to China's Belt and Road Initiative (BRI), which India has refused to join on the grounds of national sovereignty, territorial integrity, and 'debt-trap' diplomacy (Ahmed & Sheikh, 2021; Jacob, 2017a).

Nevertheless, though China made economic inroads, India's dominant role in shaping the economic and political configurations in Bhutan and Bangladesh gives India additional leverage, hailed as 'blood ties' (Hossain & Islam, 2021; Paul, 2019).

Jealous big-brother attitude

The strong foundation of Bhutan-India diplomatic relations evolved from the 1949 Peace and Friendship Treaty, granting India an advisor status in Bhutan's external relations and not a domestic intervenor. Without a history of geopolitical rivalry, mutual trust resulted in significant economic benefits for both countries through hydropower cooperation (Saklani et al., 2020; Tortajada & Saklani, 2018). It also provided political and security benefits to India as it prevented any coalition between Bhutan and China (Yasuda et al., 2017). The landlocked Himalayan kingdom of Bhutan is a buffer for India after China annexed Tibet. The Bhutan-India symbiotic relationship is also seen as India being a benevolent hegemon with a 'jealous big-brother attitude' and hampering Bhutan's engagement with China (Mishra, 2019). It must also be mentioned that critics in Bhutan are against their country's heavy dependency on India and seek economic diversification (Sarki, 2019).

India being geographically positioned between Bhutan and Bangladesh, the initiation of the Bhutan-Bangladesh hydropower trade requires India's support. To enable such trade, India gave its consent to Bangladesh to invest in the Bhutanese hydropower project in 2016 (Paul, 2019; Yasuda et al., 2017). Bhutan was the first country to recognise Bangladesh after the latter's independence in 1971. Diplomatic relations between the two countries were established in 1973²¹. Without any geopolitical complexities, Bhutan and Bangladesh share cordial bilateral ties through trade (routed via India).

Estranged ties between China and Bhutan

Although neighbours since 1951, China and Bhutan have had no diplomatic relations; Bhutan does not even have a Chinese consulate (Sarki, 2019). China's desire to occupy Bhutan since the 1930s and the daunting act of Tibet's annexation is Bhutan's calculus for embracing India's patronage in its foreign policy (Kaul, 2022; Pant & Shivamurthy, 2021; Mishra, 2019). China

²¹<https://www.mfa.gov.bt/rbedhaka/bhutan-bangladesh-relations/>

and Bhutan share outstanding border disputes in Central, Western, and Eastern Bhutan, aside this China's expansionist tactics of military outposts and village settlement constructions in Northern Bhutan (Pant & Shivamurthy, 2021; Bisht, 2014). Nevertheless, China resumed border negotiations with Bhutan after the Doklam incident with a MoU for expediting boundary negotiations and demarcation in 2021 (Kannan, 2021). The Bhutanese Foreign Minister explicitly assured that India's interests in the Doklam tri-junction would not be compromised by China-Bhutan ties (Haidar, 2022). India perceives less possibility of Bhutan dissenting with India for diplomatically engaging with China, as India has always provided Bhutan with military security and economic aid (Pant & Shivamurthy, 2021). However, for Bhutan, being geographically wedged between two Asian giants and diplomatically closer to India, manoeuvring strategic negotiations with both can be testing; Bhutan cannot afford to hurt India's sentiments while preferring to embrace China (Kaul, 2022).

'Mango diplomacy between neighbours'

Besides political upheavals in bilateral relations and typical border-related problems, India and Bangladesh never fought any border war against each other (Hossain & Islam, 2021; Sur, 2014). The changing contours of Bangladesh's domestic politics under its two major political parties- the Awami League (AL) and the Bangladesh Nationalist Party (BNP) determined the type of foreign policy implemented with India, friendly or adversarial (Kumar, 2014). The two nations' shared history is often glorified through the Ganges water-sharing treaty.

Bangladesh acknowledges India's wholehearted assistance to its independence (Chowdhury, 2013). As historical allies since the 1971 Liberation War, India-Bangladesh disagreements persist over the riverine border created by the Brahmaputra, resulting in cross-border smuggling, insurgencies, and illegal immigration to India (Samaranayake et al., 2018). The alleged encroachment of the '*chars*' (islands created during dry season) and '*Sattras*' lands (Vaishnavite monasteries) in Assam by Bangladeshi immigrants tainted the social milieu of Assam. The ratification of the Land Boundary Agreement (LBA) in 2015 created a new chapter in India-Bangladesh relations, but issues like the National Register of Citizens (NRC) and Citizenship Amendment Act (CAA) created impediments to deepening bilateral relations (Hossain & Islam, 2021).

Despite these issues, India-Bangladesh exhibit warm relations, with annual attempts to make it sweeter through Bangladesh's practice of "mango diplomacy", the emblematic Bangladeshi produce (Correspondent, 2022). Mango diplomacy is an age-old South Asian tradition of using

mangoes as a diplomatic gift by political leaders (of India, Pakistan, and Bangladesh), aiming to maintain friendship and improve bilateral ties, along with a wider mix of objectives (Brummell, 2022).

Necessary but evolving bonds

China-Bangladesh relations had a hostile beginning as China opposed the independence of Bangladesh in 1971 and commenced diplomatic relations only later in 1975 (Yasuda et al., 2017). Despite such opposition, Bangladesh has now developed robust strategic and defence cooperation with China, besides giving full support to the BRI project (Hossain & Islam, 2021). On its part, China committed to approximately \$1 billion investment for the mega Teesta River management project (Bhattacharjee, 2020). This will secure Bangladesh's lean season flow, reducing dependence on India and perhaps making the stalled Teesta Agreement redundant. The 8th China-Bangladesh Friendship Bridge is ready for inauguration by the Bangladeshi government after the completion of seven such bridges with Chinese grants (Wu & Jun, 2022). Though not financially, Chinese companies were involved in a technical capacity in the recently inaugurated Padma bridge, Bangladesh's biggest infrastructure project as confirmed by Bangladesh (Chaudhury, 2022). China's growing bonhomie with Bangladesh depicts strategic connotation as China considers the geostrategic location of Bangladesh as the preferred route to reach Northeast India and lay territorial claims over Arunachal Pradesh, besides meeting energy demand from Bangladesh's rich reserves of natural gas (Ghoshal, 2010). Additionally, China is interested in port development in Bangladesh to expand trade routes via access to the Indian Ocean Region (Hossain & Islam, 2021).

4.2 Hydropolitical Nuances in the Brahmaputra River Basin

Hydropolitics is defined as the authoritative allocation, contested use, and management of the security underpinnings of transboundary water resources whereby power and politics determine over time who gets what, how much, and why, highlighting the continuum of conflict and cooperation of riparian nations (Meissner, 2014). In the BRB, the interplay of power and information asymmetry in the broader geopolitical context has led to water securitisation (Xie & Warner, 2021; Barua et al., 2018), thus, making water an issue of national sovereignty (Hanasz, 2017). The existing MoUs on hydrological data sharing in the BRB address specific aspects (particularly flood management) of the broader issue of integrated water management (Barua et al., 2018; Liu, 2015). These MoUs do not include any mechanism of dispute settlement related to data sharing, thus, limiting the legal reach of the MoUs (Liu, 2015). MoUs

are the Chinese way of wielding soft power and conduct reactive diplomacy in response to downstream requests, often through a one-river, one-country approach (Zhang & Li, 2018; Wouters & Chen, 2013).

Unilateral hydropower development plans have been fast-tracked in the BRB since the turn of the millennium, leading to competitive prior appropriation rights of China and India in their part of the basin (Ho, 2017). China completed the Zangmu dam in 2014 (Zhang, 2015) and is currently constructing five multipurpose dams in the upper part of the Yarlung Zangbo for hydropower and irrigation purposes (Zhang et al., 2019).

Although they are ROR hydropower dams, the fear of potential negative impacts on downstream livelihoods is inconclusive due to a lack of sufficient scientific knowledge (Zhang et al., 2019). Similarly, in the Indian part of the basin, plans are underway for many hydroelectric projects (Thakur, 2020; Borgohain, 2019). These projects are resented by riverine communities and environmental activists as they may damage the river ecosystem, increase the rural poor's vulnerability, and intensify the Himalayan zone's seismicity (Baruah, 2012). China's ambitious mega-dam at the Tsangpo Grand Canyon also received approval in 2021 after years of denial on grounds of technical implausibility (Krishnan, 2021). India retaliated by announcing a dam in Assam for flood control (Saikia, 2020). The outcome of such a 'dam-for-dam' strategy looms large amongst riparian communities. Both countries' commitments to the Paris Climate Agreement (COP 21) and the Glasgow Climate Conference (COP 26), pledging to reduce carbon emissions by 2030 and achieve carbon neutrality by 2060 and 2070, respectively, reflect their climate action priorities of transforming to renewable energy. Hence, there is a race for harnessing the hydropower potential of the river and gaining water rights.

Bhutan's ambitious climate policy for retaining carbon-negative status requires a climate-resilient development pathway through hydropower generation- the country's economic backbone (Choden & Choden, 2020). This will create a rush toward harnessing the hydropower potential of the BRB. For Bangladesh, transitioning to a developing country status, Brahmaputra's importance lies in enhancing food security through irrigated agriculture and boosting the country's water-intensive manufacturing export sector (IUCN & BFD, 2016).

Fragmented cooperation in the basin has failed to eliminate insecurity and build trust between the riparians (He, 2021; Deka, 2021). Consequently, speculations are widespread in the BRB. For instance, certain public discourse in India blames Chinese activities behind flash floods, murky flows, and seasonal drying up of the Brahmaputra and speculates upstream diversion;

whereas China links any Indian water intervention to diplomatic sabotage in the territory it claims (Deka, 2021; Chen et al., 2014).

Further, India's water infrastructure plans make Bangladesh anxious about the altered flow regime impacting their lives and livelihoods. India failed to deliver on the Teesta water-sharing agreement because of domestic politics between federal and state governments. Such experiences²² make Bangladesh apprehensive about signing another bilateral accord with India on the Brahmaputra, deliberately pursuing 'non-decision making' (Vij et al., 2020). Reportedly, there is growing resentment toward the social and environmental impacts of hydropower projects in Bhutan (Saklani & Tortajada, 2019). Hence, securing India's future energy supply from Bhutanese hydropower is a question of time, prodding India to unilaterally utilise the BRB waters to be self-sufficient. Moreover, regular catastrophic dam-induced floods caused by Bhutan in the districts of lower Assam have raised public resentment (Sarmah, 2022).

4.3 Status Quo in the Brahmaputra River Basin

The BRB suffers from stereotypical upstream-downstream syndrome intertwined with the influence of geopolitics in framing water interactions. The overlapping attributes of geopolitics and hydropolitics act as a feedback loop in determining the type of BRB interaction (Figure 4.1). China-India BRB interaction particularly validates these overlaps as a feedback loop. The dynamic geopolitics, coupled with the riparians' competing and growing water-energy-food demands, poses hydropolitical challenges capable of pushing water interaction toward the spectrum of conflict. The nuances of hydropolitics mean that the river is used to determine the relative power position of China and India, creating both opportunities and vulnerabilities for the riparian countries. Opportunities exist in terms of shared climate action goals and vulnerabilities arise from competing hydropower projects.

As a corollary, mutual security concerns and the border stalemate between China and India overshadow BRB management. Subtle cooperation is acknowledged that MoU-backed seasonal data sharing is in place but undoubtedly is at the bottom rung of any comprehensive cooperation. A recent instance of hydropolitics intertwined with geopolitics was when China leveraged its geographical position against India by withholding hydrological data after the

²²The Farakka and Teesta barrage, and the proposed Tipaimukh dam.

Doklam border crisis (initiated between China and Bhutan) but continued sharing it with Bangladesh, which China later clarified was due to monitoring stations' maintenance.

The challenging hydropolitics intertwined with geopolitics in the BRB has resulted in a purposeful status quo. China and India maintain the status quo to gain water rights to pursue unilateral decision-making for achieving their respective development agendas. Bangladesh, based on its experience with India on the Ganges and Teesta treaties, prefers an impasse to further strengthen its technical and negotiation skills. Bhutan, an upstream riparian, is not affected by the existing status quo and has not shown much interest in negotiations for basin-level cooperation. Maintaining the status quo is a cautious move by the riparians to avoid overt conflicts; however, such an impasse at the regional and national level has made the Brahmaputra a contested river, and the local communities continue to suffer.

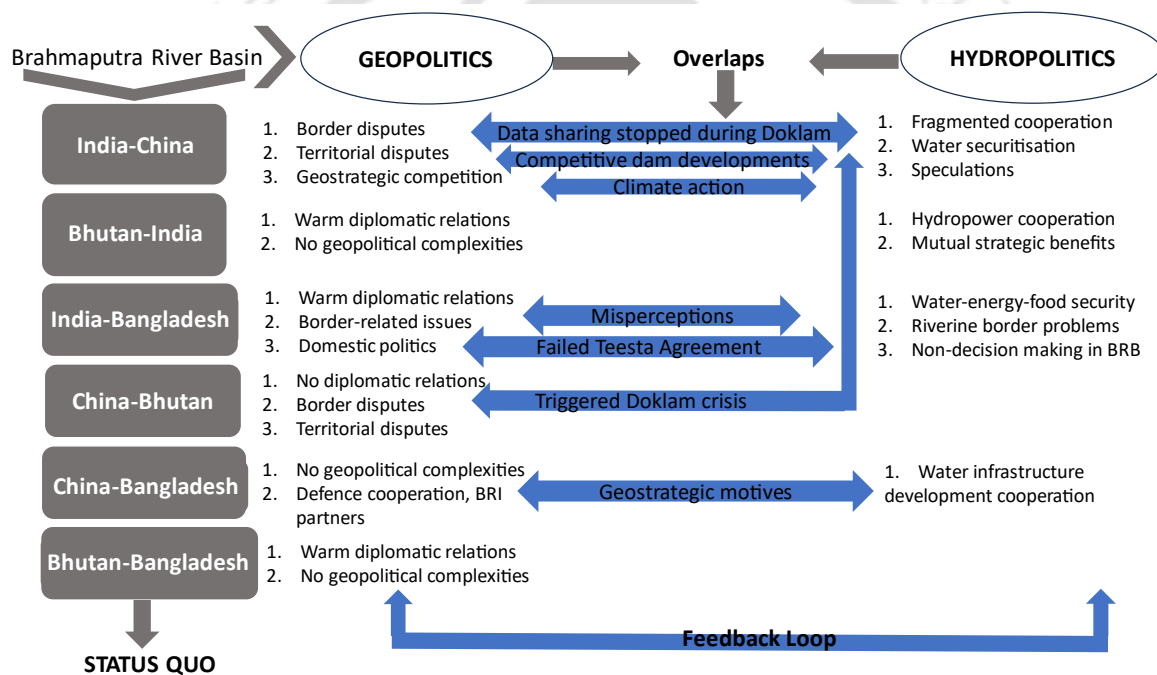


Figure 4.1. Schematic of the Brahmaputra Interaction

Source: Author's construction

4.4 Summing Up

This chapter concluded that the presence of the status quo has hindered water cooperation at the basin level. To see if benefit sharing can help break the status quo and create win-win outcomes, it would be prudent to understand the factors framing riparian strategies. This will be analysed in the next chapter.

Chapter 5 GAME THEORETICAL ANALYSIS OF BRAHMAPUTRA RIVER INTERACTION

This chapter addresses the third research objective of assessing and evaluating existing cooperation in the BRB and predicting future outcomes using a game theoretic approach. The three research questions under this objective are being answered using both secondary data and primary data which is collected through expert interviews. These qualitative data provided an essence of bilateral relations and aided in developing the game models. The game theoretical analysis looks at the bilateral relations based on upstream-downstream configurations. The subsections in this chapter are, therefore, presented as China-India, Bhutan-India, and India-Bangladesh transboundary interactions.

Setting the Game Elements

In the game models, the upper riparian is assumed to be Player 1, and the lower riparian is Player 2. Here, 'players' conceptualise the four riparian national governments as unitary actors who are at the helm of transboundary decision-making. However, diplomacy being a two-level game of domestic-international interactions influenced by national interests, domestic politics, bargaining power, interest groups, public opinion, and elections (Putnam, 1988), these drivers constitute the set of utility functions of the four rational players, aiming to choose the "best" available options to maximise their utility from the transboundary river.

Although there can be multiple strategies, to simplify the analysis, both players are assumed to have two symmetric strategies: cooperation (C) and non-cooperation (D). As all countries benefit from the BRB, let U_C , U_I , U_{Bh} , and U_{Bg} denote unilateral benefits of river utilisation for China, India, Bhutan, and Bangladesh, respectively. Cooperation between the riparians through benefit sharing can result in a bundle of potential benefits 'P', inclusive of ecological (P_{eg}), economic (P_{ec}), political (P_{pl}), and catalytic (P_{ct}) (Appendix: Table A7). The cost component is denoted by 'Q', which is of various intensities based on the riparian's power and geographical position in the basin. 'Q' represents the net cost from unilateralism and usually, is higher for the lower riparian due to greater vulnerability threats.

5.1 China-India Interaction in the BRB

China and India are two important BRB riparians, both being emerging developing economies, sharing an area of 50.5% and 33.6% respectively of the BRB (Barua, 2018). Ecologically

concerned, both countries grappling with energy challenges, aim to secure the water-energy-food nexus by exploiting this untapped river (Lyu et al., 2023; Barua & Vij, 2018). In terms of the immense hydropower potential of this river, China ranks the highest (53.4%) and India the second highest (32%) in the basin but the least exploited (Li et al., 2018; Ray et al., 2015). Thus, for both countries, the Brahmaputra River is a repository to pursue their Nationally Determined Contributions (NDCs) by diversifying the energy mix and reducing carbon emissions.

Historically, China-India relations exhibit both conflictive and cooperative elements, with a significantly aggressive geopolitical rivalry of late (Raju, 2020). The border war in particular and the series of continued Chinese transgressions on the LAC, a nondemarcated border with China, violating Confidence-Building Measures (CBMs) shaped India's perception of a defector and belligerent China (Boon, 2016). It, therefore, transformed bilateral ties into a condition of mutual suspicion and distrust (Ahlawat & Hughes, 2018). The strained trajectory of bilateral relations and the fact that both China and India manage their shared rivers as a subset of their bilateral relationships has made transboundary cooperation complex (Wouters & Chen, 2013). The Brahmaputra's location near the disputed China-India borderline makes it a politically sensitive and trust-deficit river basin (Barua, 2018). Although not hydrologically, India's water interventions can impact China geopolitically as China considers such actions as diplomatic sabotage in the territory it claims (Samaranayake et al., 2016).

5.1.1 Riparian Strategies and Interactions

The significant factors that shaped the China-India bilateral relationship from 1950 to date and the Brahmaputra interaction (Figure 5.1) are discussed below. The entire discussion is segregated such that the first period, 1950-2000 gives the history of geopolitical complexities when the Brahmaputra River issues had not arisen. The second period, 2000-2017, saw the beginning of cooperation in the Brahmaputra. The third period 2017 to date, highlights the shift in bilateral behaviour with the repercussions of border disputes on water relations, indicating that hydropolitics is intertwined with geopolitics.

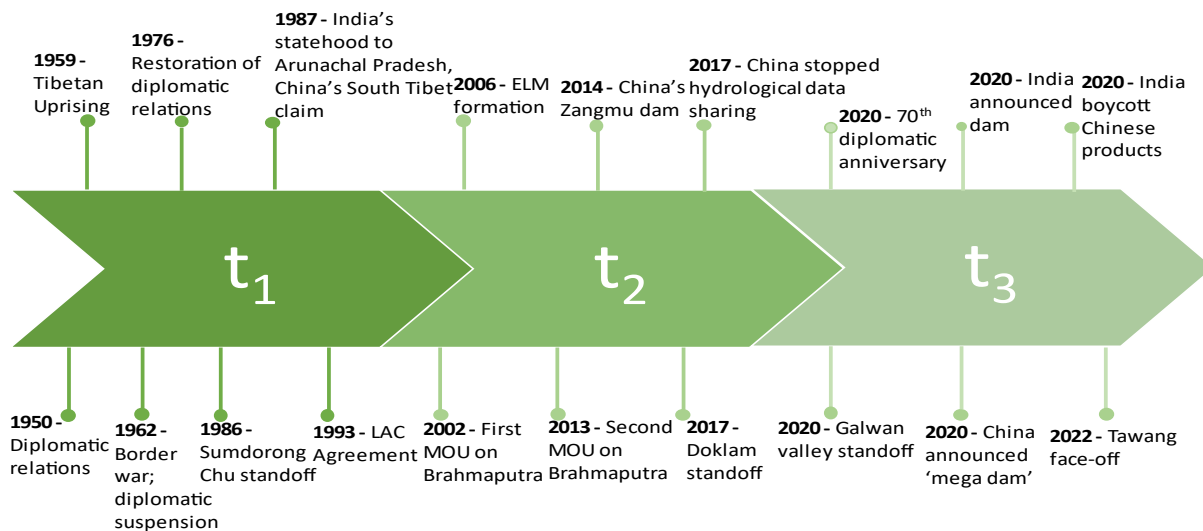


Figure 5.1. China-India Bilateral Timeline

Source: Author's construction

5.1.1.1 Period of friendship and war due to geopolitical complexities (t_1) (1950-2000)

The period from the 1950s to the 2000s can be considered a period of friendship and war as it witnessed both diplomatic ties, marked by the 1954 Panchsheel Treaty or the Treaty of Five Principles of Peaceful Coexistence, and diplomatic setbacks, set in motion by China's unilaterally declaring border war (Ahlawat & Hughes, 2018; Zhang & Li, 2013; Soni & Marwah, 2011). As stated by the Chinese respondents "*Amongst all other BRB riparians, China-India relationship is especially complex due to unresolved border issues in Arunachal Pradesh, degrading mutual trust*" (C_{AC}). China's unilateral declaration of the border war in 1962 resulted in India's defeat (Zhang & Li, 2013). As an outcome, both countries have contested claims along the western, middle, and eastern sectors of the LAC (Bhasin, 2021; Xuecheng, 2011). The Indian claims include the entire Aksai Chin region as the union territory of Ladakh and the Chinese claims include Arunachal Pradesh, south of the McMahon Line as "South Tibet" (Raju, 2020; Topgyal, 2011). Beijing started asserting its claims of "South Tibet" more prominently in the late 1980s, which prompted India to grant statehood to Arunachal Pradesh in 1987 (Baruah et al., 2022; Raghavan, 2019). In 1993, India and China signed an Agreement on the Maintenance of Peace and Tranquillity along the LAC and in 1996 implemented CBMs for border security and respect the LAC (Xuecheng, 2011). During this period Brahmaputra negotiations did not come to the forefront as redeveloping post-war relations through economic and political diplomacy was prioritised (Raghavan, 2019).

5.1.1.2 Period of improved relations through data sharing (t_2) (2000-2017) but a status quo

A noteworthy event of the millennium is the recognition of Brahmaputra River diplomacy. In 2000, India insisted China on hydrological data after a catastrophic upstream flash flood devastated Arunachal Pradesh and Assam (Yasuda et al., 2017). China acceded to India's request and the first MoU on the Brahmaputra River aimed at facilitating advance flood warning by China to India was signed in 2002, initially for five years and further renewed in 2008, 2013, and 2018 (Zhang & Li, 2018). In 2013, the Ministry of Water Resources of both countries signed another MoU on the provision of flood-season hydrological data and emergency management. Additionally, in 2014 China extended the period of hydrological data sharing (water level, discharge, and rainfall) to May 15 from the previous June 1 to October 15, as an assurance against its safe ROR dams²³. Apart from the provision of flood-season hydrological data, in 2006, an Expert Level Mechanism (ELM) was established for discussion of trans-border river issues which concluded 12 meetings alternately in India and China till 2019, the 13th meeting in 2022 through video conferencing due to COVID pandemic and the 14th meeting in 2023 in New Delhi²⁴. Despite growing border stability insured by the CBMs and consequent economic advancements, the Chinese strategic infrastructure development in Tibet along the LAC during the 2000s posed a security threat to India (Baruah et al., 2022; Joshi & Mukherjee, 2019; Garver, 2011; Guruswamy & Singh, 2009).

Indian respondents repeatedly brought up the issue of information asymmetry and lack of transparency in China's dam building in Tibet as a cause of major concern for India. India does not have information on the Brahmaputra water flow from China nor access to lean-season data thereby generating speculations and suspicions regarding the possible impacts of China's actions (IAC, IGO). But a Chinese respondent defended stating, "*We are blamed, especially by the Indian media that China does not share information. But we publish a lot of information; there are many records and yearbooks but of course, written in Chinese. I don't see that as our problem to be blamed for not being transparent*" (CAC). The same respondent also asserted that building dams are China's user rights and no one can stop or question China. Nevertheless, Indian respondents acknowledged that given China's geographical advantage, its upstream user rights cannot be denied or contested. "*China will construct dams and nobody can stop the Chinese for they are militarily, economically, and politically powerful, even in a position to*

²³<https://sandrp.in/tag/expert-level-mechanismelm/>

²⁴<https://jalshakti-dowr.gov.in/india-china-cooperation/>

compete with the US” (IAC). China completed the Zangmu dam in 2014 (Zhang, 2015) and is currently constructing five multipurpose dams in the upper part of the Yarlung Zangbo for hydropower and irrigation purposes (Zhang et al., 2019). However, in the absence of dialogues and transparency in information sharing, such water infrastructure development by China is perceived as a threat by lower riparians (Zhang et al., 2019) leading to suspicion and mistrust. Indian and Chinese respondents emphasised the role of the media in shaping ‘true’ narratives for influencing effective discussions (C_{AC}, I_{MP}).

Further, Chinese respondents also brought up the issue of India's consequent hosting of the Dalai Lama and Tibetan exiles at the cost of China's displeasure, besides, India's refusal to join China's BRI project. As an implication, China finds no economic leverage in the BRB but greater geopolitical and geoeconomic interest in the Mekong region as it holds immense strategic importance for its BRI project. This is the reason behind China's proactive role in the Mekong River Basin than the BRB (C_{AC}). Further, they added that as India's South Asian neighbours except Bhutan have already joined BRI, India's participation hardly matters now for China (C_{AC}). *“As long as the Chinese Communist Party maintains its monopoly on power, whether Xi Jinping or his successor the fact is that it won't change China's attitude”* (IAC). Thus, overcoming the border impasse between China and India seems difficult in the immediate future. In fact, an Indian respondent stated, *“Given the border issues, water cooperation is considered low politics and both riparians officially will not see this as a problem till the time their economic interests are hurt”* (IAC).

The transboundary interaction between China and India is influenced by trust deficit and hesitance to extend cooperation beyond the existing MoU on monsoonal data sharing. This has led to a stalemate resulting in the status quo. The lack of mutual trust has stemmed from a variety of factors including historical tensions related to unresolved border issues including Tibet, and the power imbalance visible through China's unilateral actions that disregard the concerns of downstream India.

5.1.1.3 Period of intense competition (t_3) (2017-to date) leading to strained water relation

Bilateral momentum was further disturbed by the Depsang standoff in 2013 and the Doklam standoff in 2017, involving Bhutan. The Doklam crisis can be considered a turning point in bilateral relations, indicating a change in approach by the Chinese to border issues with India, spiralling into offensive retaliatory actions (Raju, 2020; Jacob, 2017b). This was the first time since 2002, that border disputes had repercussions on water relations. China stopped data

sharing with India in 2017, giving the justification for hydrological stations' maintenance as well as cancelling the annual meeting of the ELM (Feng et al., 2019). One of the Chinese respondents stated, "*The MoU on hydrological data sharing was considered an indicator of improved relations but during the period of deteriorated bilateral relations in 2017 it was violated, indicating MoUs cannot define strong bilateral ties*" (CAC). Another Chinese respondent acknowledged that China's hydrological data sharing in the BRB cannot be considered a public good provision when compared to the Mekong because China leverages the Brahmaputra in terms of territorial dispute that was evident from the Doklam crisis. "*China stopped data sharing in 2017 but also resumed later for the sake of India by fixing the hydrological stations despite having the option not to share*" (CAC). In response to this, the Indian respondents opined that China's withholding of hydrological data severely eroded bilateral trust because such cooperation is perceived to be the building block towards long-term cooperation, thus making water an issue of national sovereignty (Hanasz, 2017).

The concurrent crises of the Galwan and COVID-19 pandemic in 2020 changed India's balancing behaviour against China by overtly deepening Quad (a strategic security dialogue between Australia, India, Japan, and the United States) cooperation to build regional stability (Tarapore, 2023). The violent border skirmish in the Galwan Valley, triggered by competing border infrastructure constructions, took lives on both sides of the border after 58 years (Pandalai, 2020). After this crisis, India's attitude toward China shifted from its previous hedging strategy of maintaining a sort of working relationship and adopted a hawkish stance (Jacob, 2022; Boon, 2016). The Galwan Valley crisis in the year 2020, also the 70th diplomatic anniversary, shaped strong anti-China sentiments in India leading to the boycott and ban of Chinese products and apps (Correspondent, 2020a). Besides, post-Galwan incident, the Indian government sanctioned several border infrastructure projects for easy deployment of military troops anticipating future crises (Singh, 2022). Indian respondents, therefore, expressed pessimism and further deterioration of bilateral relations. The latest military face-off was reported in the Tawang sector in Arunachal Pradesh on 9 December 2022 (Bhalla & Negi, 2022). Given China's growing assertive stance, India too geared up its internal and external balance strategies to cope with China (Raghavan, 2019). In retaliation to China's model villages program, the Indian government under its Vibrant Villages Programme (VVP) is developing border villages and mini hydropower projects along the LAC in Arunachal Pradesh to boost the local economy and prevent youth out-migration to assert dominance over China (Sharma, 2023). On its part, the Chinese Ministry of Civil Affairs for the third time renamed 11 places in Arunachal Pradesh to lay claim to the Indian territory which they call "South

Tibet” (Haidar & Peri, 2023). India counteracted China’s strategic encirclement in India’s periphery or “String of Pearls” strategy by tilting towards the USA and embracing the Quad (Freeman, 2018). As stated by a Chinese respondent “*Looking to the future, it is very hard to see the relationship between India and China improving given India-US relations which have been framed largely alongside Quad*” (C_{AC}).

The tug-of-war between India and China to secure greater influence in South Asia poses other challenges as India opted to counteract instead of acceding to China’s dominance (Ahmed & Sheikh, 2021). Even for climate action, when China’s NDC at the COP26 disappointed the global audience for merely reiterating the COP21 commitments, that is, achieving carbon neutrality in 2060 (Jiang, 2021), India, the fourth-largest emitter of carbon dioxide made a surprise move by pledging carbon neutrality by 2070 in COP26, hailed as a bold step (Correspondent, 2021b). “*China for the first time explicitly mentioned developing hydropower resources of the Brahmaputra in the 14th five-year plan (2021-25). I think with huge concerns for climate change, there will be more hydropower projects in the coming five to ten years, creating tensions amongst downstream countries and reactions from India*” (C_{AC}). China when announced a 60GW hydropower dam in the Great Bend of the Brahmaputra (Baruah, 2021), India reacted by declaring a 10GW hydropower dam for flood control in Assam; along with assertively responding against any water diversion attempt as an encroachment of lower riparian rights²⁵. There is a strong realisation that given the sub-optimal utilisation of river benefits in India, particularly related to hydropower development, there is a need for greater exploitation to the full potential of BRB (I_{GO}, I_{EB}). Given this, water does not seem to be a catalyst for cooperation rather it has become an irritant between China and India. An Indian respondent pointed out, “*India should also enter into the “dam race” to harness its water wealth and avail power marketing opportunities and fulfill the power demands of India, Myanmar, and Bangladesh*” (I_{GO}). Such a competitive attitude by both players might change the basin dynamics.

5.1.2 Analysis of China-India Interaction Using Game Theory

Here, China is Player 1 and India is Player 2.

5.1.2.1 1950-2000 (t_1)

During the period 1950-2000, there was no interaction between China and India related to the Brahmaputra River. As such both players were reaping unilateral payoffs, U_C by Player 1 and U_I by Player 2. Transboundary interaction between the players was not realised until the

²⁵<https://pib.gov.in/PressReleasePage.aspx?PRID=1690471>

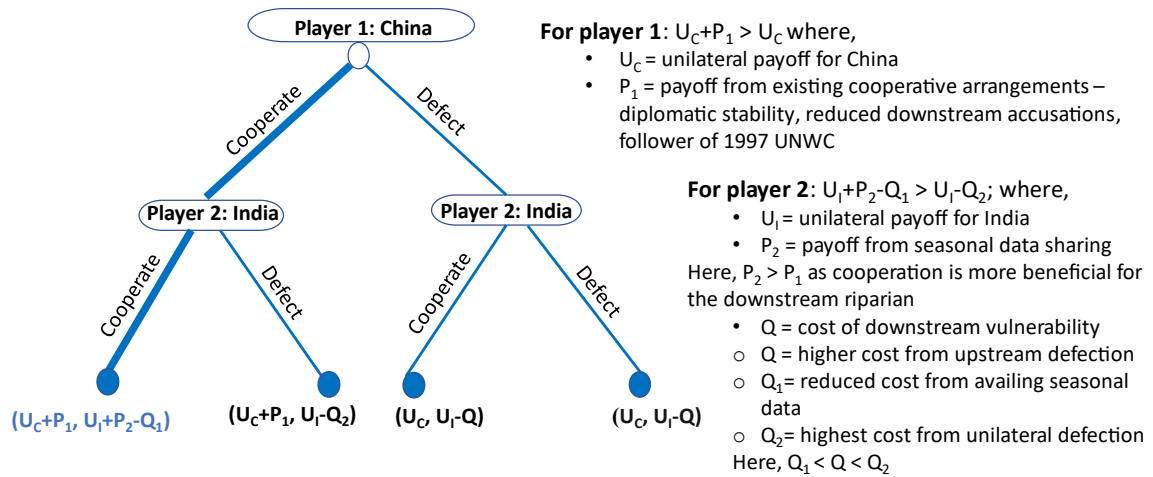
occurrence of upstream flash floods in 2000 that severely impacted Arunachal Pradesh and Assam. Thus, the game technically begins from the next period with the initiation of Brahmaputra interaction.

5.1.2.2 2000-2017 (t_2)

This period witnessed China's reactive water diplomacy upon India's request, resulting in hydrological data sharing MoUs and ELM. This is, therefore, modelled as an extensive game (also known as a game tree) to depict the sequential strategies of the players (Figure 5.2). Extensive games infuse dynamism in strategic interactions as players take turns to decide their purposeful moves and thus, fit best to understand China-India transboundary interaction. In a game tree, branches represent player strategies, with the resulting payoffs shown at the end. The first value in the payoff vector belongs to Player 1 and the second value belongs to Player 2. Conventionally, Player 1 is shown at the root node or empty history of the game tree. It implies that Player 1 moves at the start of the game having two strategies: 'cooperate' and 'defect'. In this case, China being the upper riparian has the first-mover advantage. Player 2 moves next having four plans of action: 'cooperate' and 'defect' to Player 1's cooperation and 'cooperate' and 'defect' to Player 1's defection. Here, Player 1's utility function consists of its preferences for exploring the hydropolitical dynamics in the BRB by constructing the first hydropower dam whereas Player 2's utility maximisation relates to securing hydrological information for flood forecasting.

The existing cooperation is not the best cooperative arrangement because the signing of MoUs for seasonal data sharing is only risk-averting and a shared goal of technical cooperation to solve a specific water-related problem, in this case, flood forecasting in India, which does not necessarily ensure the alignment of joint actions and policies (He, 2021). However, data and information sharing are considered to be the first step towards trust and confidence building, mitigating conflicts, and affirming long-term cooperation (Xie & Jia, 2017). Hence for plotting the game tree, we consider it as a cooperative arrangement between Player 1 and Player 2.

As mentioned previously, after the upstream flash flood in 2000, India (Player 2) requested China (Player 1) for hydrological data. Being the upstream player, Player 1 had the option to deny sharing data and choose 'defect' or accede to Player 2's request, that is, 'cooperate'. Four different scenarios can be developed accordingly.



Sub-game perfect equilibrium (a Nash equilibrium) outcome – Pareto optimal outcome = $(U_C + P_1, U_I + P_2 - Q_1)$

Figure 5.2: China-India Extensive Game

Source: Author’s construction

Player 1: Cooperate, Player 2: Cooperate

In response to Player 2’s request, Player 1 decided to ‘cooperate’, resulting in the 2002 MoU for flood-season data sharing by China to India, followed by the establishment of the ELM for bilateral discussions in 2006. As a rational player, Player 1 is better off cooperating as it helped maintain diplomatic stability and facilitate bilateral trust-building which was eroded in the aftermath of the Sino-Indian war. Player 1 avails payoff $(U_C + P_1)$ where ‘ P_1 ’ includes diplomatic stability, a channel for dialogue through ELM, trust-building, reduced downstream accusations, and credibility. China has thus succeeded in maneuvering soft power (in hegemonic political contexts, soft power concerns primarily the immaterial, consensual, and non-violent approaches to getting others what you want (Zeitoun et al., 2011)) in building the international reputation of a supportive and guiding hegemon by following the 1997 UNWC.

For Player 2, cooperation is the best strategy as upstream data and information can provide better flood forecasting, improved environmental, economic, and social outcomes, and maintain diplomatic stability with Player 1. As such Player 2 avails payoff $(U_I + P_2 - Q_1)$ whereby ‘ P_2 ’ is the benefit from data sharing and ELM discussions and ‘ Q_1 ’ is the reduced downstream vulnerability than ‘ Q ’ ($Q_1 < Q$). The cooperative payoff for Player 2 is greater than for Player 1 ($P_2 > P_1$) because cooperation is more beneficial for the downstream player preventing upstream threats.

Player 1: Cooperate, Player 2: Defect

Downstream defection, while upstream's willingness to cooperate is usually not the rational move and so Player 1 cooperates and Player 2 defects, is a rare case scenario. Nevertheless, the option cannot be ruled out. By backward induction, Player 2 might reason that as China shares the data free of cost with Bangladesh, but India has to pay for the same data, India can choose to defect by refusing to accept the MoU. China charges RMB 850,000 (about USD 134,000) annually from India for exchanging flow data during the monsoon (Zhang & Li, 2018). Further, Player 2 had the option to 'defect' because of distrust and strategic suspicion against Player 1's actions. Given the border war and Player 1's repeated border transgressions, Player 1 might again resort to hegemonic bullying by violating the MoU. However, rejecting Player 1's offer of seasonal data sharing and the opportunity to interact through ELM would leave Player 2 with absolutely no data and no platform for interaction meaning only a lesser payoff ($U_I - Q_2$) where $Q_1 < Q < Q_2$. 'Q₂' is the highest cost for Player 2 as defecting to Player 1's cooperative move may make further negotiations with Player 1 difficult, besides losing international support to convince Player 1 for future cooperation. Therefore, the resulting outcome will be ($U_C + P_1, U_I - Q_2$).

Player 1: Defect, Player 2: Cooperate

Data are usually collected within the territorial limits of a country. This makes it an instrument of power interplay in terms of sharing information, fully or partially, or keeping it under wraps entirely (Barua et al., 2018). As an upstream country and given the historical border disputes, Player 1 could have chosen 'defect' and denied Player 2's request. There are also several non-technical barriers (such as perceptions of limited gain or national security concerns) to hydrological data which could have played a role in the defect position for Player 1. For Player 1, defection would have given payoff 'U_C' but missed out on the additional payoff 'P₁' as discussed above. Being the downstream player, Player 2 still prefers to 'cooperate'. Upstream defection, however, leaves limited downstream options so, any unilateral cooperative effort by Player 2 would be of no avail. Unilateral defection by Player 1 would impose the cost 'Q' on Player 2 because, without upstream hydrological data, Player 2 cannot perform flood forecasting. Player 2 would thus, miss out on the 'P₁' component and be in a worse-off position. During the Doklam crisis, Player 1 defected from sharing data, and Player 2 was left with limited information. As an implication, the unannounced water release by China in 2017

wreaked havoc in India's Assam and Arunachal Pradesh (Deka, 2021). The resulting outcome of this scenario is (U_C, U_I-Q) .

Player 1: Defect, Player 2: Defect

The resulting outcome of this scenario is the same as the above because cooperation or defection by the downstream player when upstream player defects make no difference. Although Player 2 is also an Asian giant like Player 1, geographical location in the BRB is a disadvantage for Player 2. Thereby, the payoff remains the same for Player 2 when Player 1 defects, and the resulting outcome is (U_C, U_I-Q) .

However, even amidst geopolitical complexity and suspicious intentions of both nations about each other, vying to be Asia's undisputed superpower, till now both players have prevented matters from flaring up and ensured that some amount of cooperation always prevails. The BRB, thus, has not yet reached this extreme scenario whereby the two riparians have opted for defection.

From these four scenarios, (Cooperate, Cooperate) is the best response strategy for both players. Through backward induction, the players arrived at the sub-game perfect Nash equilibrium $(U_C+P_1, U_I+P_2-Q_1)$, which is also one of the Nash equilibria of this interaction as shown in Figure 5.2. The payoff $(U_C+P_1, U_I+P_2-Q_1)$ is Pareto optimal endowing both players with the highest possible benefits of that particular interaction in 2002.

However, over time as new events unfold (Player 1 completed the first dam in 2014 and Player 2 did not know it until found in satellite images), it is felt that the players are myopic in decision-making as they fail to identify opportunities to extend cooperation beyond seasonal data-sharing.

The present payoff from data sharing is essential for effective transboundary water management but has yet to lead to joint strategies for water management, such as coordinated water allocation plans, joint monitoring programs, or joint management of disasters. Such collaborative actions on river utilisation will help Player 2 eliminate the cost 'Q' as decisions would be taken jointly. With limited interaction, however, each player pursues its water development agenda without regard for the other. Player 2 is not informed about Player 1's actions concerning dam developments. Similarly, Player 1 is not informed about Player 2's water development plans and speculates diplomatic sabotage in Arunachal Pradesh. Noticeably, when Player 1 stopped data sharing with Player 2 in 2017, Player 2 had no genuine

information about the reason behind it as Player 1 continued sharing it with Bangladesh. Such strategic moves of the players are shown in the payoff matrix (Figure 5.3), retaining the same payoffs as in Figure 5.2. Both players find no incentive to deviate from the arrangements made in the early 2000s due to a lack of trust and fear of a worse-off position, resulting in a status quo. Thus, the Nash equilibrium outcome remains the same $(U_C+P_1, U_I+P_2-Q_1)$. Although the status quo is generating some amount of peace and stability in water relations but does not assure the greater bundle of potential benefits ‘P’ where $P = P_{eg} + P_{ec} + P_{pl} + P_{ct}$.

		India	
		C	D
China	C	(U_C+P, U_I+P)	(U_C+P_1, U_I-Q_2)
	D	(U_C, U_I-Q)	$(U_C+P_1, U_I+P_2-Q_1)$

 Nash Equilibrium Pareto Optimum

Where, $P = P_{eg} + P_{ec} + P_{pl} + P_{ct}$

Nash equilibrium outcome = $(U_C+P_1, U_I+P_2-Q_1)$ - Sub-optimal outcome (status quo)

Figure 5.3: China-India Strategic Game

Source: Author’s construction

According to game theory, such a situation where an individual decision-maker’s strategy to maximise individual gain ends up in a sub-optimal outcome for the whole system is called a prisoner’s dilemma (Madani, 2010). This occurs due to a lack of trust and effective communication between the players whereby fear of greater loss and betrayal causes both to maintain the status quo. Both players prioritise their national sovereignty over extending water cooperation to achieve the ultimate payoff (U_C+P, U_I+P) . Therefore, it seems as if the players are interacting in a prisoner’s dilemma structure and what appears to be the Pareto optimal outcome superficially, is actually not upon evaluating their dynamic interaction. Besides, as raised by an Indian respondent, the credibility of current data sharing by China is objectionable because all three hydrological monitoring stations Yanchun, Nugesha, and Nuxia lie in the rain shadow region of Tibet whereas precipitation increases only after crossing the Himalayan

Crestline where another tributary called the Parlung Tsangpo joins the mainstream in Medog country of Tibet just before entering Arunachal (I_{AC}). The players would have opted for breaking the dilemma (status quo) if they had learned to trust each other. However, trust-building seems very difficult according to respondents. *“Trust-building can be meaningful only if both parties are willing to reconcile and find a way to resolve their disputes. If one party believes that disputes are a source of leverage against the other country, then there can be no sincere trust-building”* (I_{AC}).

5.1.2.3 2017-to date (t_3)

Here, apart from geopolitical contestations, Player 1's utility function consists of maximising water and energy security from the Brahmaputra. Similarly, Player 2's utility maximisation relates to asserting user rights over the river through increased hydropower projects. Given the shift in Player 2's attitude towards Player 1 since the 2020 Galwan crisis and aggressive China-India bilateral behaviour, Player 2 might decide to break the current status quo and engage in competitive unilateral water interventions like Player 1. However, when both players resort to unilateralism, the resulting outcome (U'_C, U'_I-Q_3) where $U'_C < U_C$ and $U'_I < U_I$ (in reference to Figure 5.2) will be the worst because it will lead to the 'tragedy of commons'. There will be a contested control in the form of a dam race in the seismic Himalayan zone and destroy the relatively pristine Brahmaputra ecosystem, causing irreversible consequences. It will be especially bad for Player 2, imposing cost 'Q₃' because of its downstream vulnerability. *“Given the uncertainties of climate change, I really wonder what will happen if you construct a lot of hydropower dams upstream, even if ROR projects because we are not aware of how the course of the river will change as there are no basin-wide impact assessments”* (I_{AC}). The bilateral interaction will then transform from the current prisoner's dilemma into a chicken structure with increased rivalry and competition between the players. Myopic agents without foresight fail to identify that continued free-riding leads to resource degradation and change the game structure from a prisoner's dilemma what appears to be a non-conflictual situation to a game of chicken with equally higher costs for all (Ristić & Madani, 2019). In game theory, a strategic interaction is called chicken where aggressive competition for securing one's pride and identity results in the worst outcomes.

Based on national interests and pride, none of them prefers to swerve (“chicken” out) and opt for 'joint action' during this period. Both players can afford to wait to protect their sovereign rights and autonomous control over the river as they are not committed to any institutional water arrangement. Game theory suggests that to prevent this worst outcome in a chicken

interaction, one of the players must swerve and send a strong signal to convince the other player to cooperate. The Nash equilibrium strategy in the chicken game can be either (Defect, Cooperate) where the first player defects and the second player cooperates, or (Cooperate, Defect) where the first player cooperates and the second player defects.

As evident from the above analysis, China behaves as the geopolitical Rambo (Diez et al., 2011) in the BRB, possessing a strictly dominant strategy not to cooperate under any circumstance due to a lack of economic incentives. In repeated interactions, reputation holds significance as the opponent can punish the non-cooperative player using a trigger strategy. The Chinese respondents, however, confirmed that reputation cost is insignificant for China. *“China prioritises economic rather than water cooperation to build its reputation, and Brahmaputra cooperation holds no economic incentives for China”* (C_{AC}). Thereby, India can be the swerving player, implying India will not try to challenge China’s unilateral actions. As emphasised by the interviewees, unilateral action against China is not a rational move for India, being the downstream player. *“Climate ignorance is what we cannot afford to do now and must understand sooner that ecological and environmental issues do not respect national boundaries”* (I_{MP}). By backward induction, India might reason that adopting an aggressive attitude against China might lead China to completely stop the ongoing data-sharing mechanism or unilaterally change the border status quo, which will harm India’s interests. Therefore, (U_C+P’₁, U_I+P₂-Q’₁) will be the Nash equilibrium outcome of this game whereby Player 1 chooses ‘defect’ and Player 2 chooses ‘cooperate’. The new cost ‘Q’₁ (in reference to Figure 5.2) is a higher cost to Player 2 than the previous cost ‘Q’₁ due to lost pride and international reputation from yielding to China. It is India’s strategic loss under myopia from reducing water interventions early on despite China’s free riding of the resource and hence, does not imply India’s irrational play but rather an optimal play of higher future utility (Ristić & Madani, 2019). Cost ‘Q’₁ is still lesser than cost ‘Q’₃ by defecting against China as that would have been the worst (Q₃ > Q’₁ > Q₁). The payoff ‘P’₂ includes the benefits of restoring the natural river ecosystem. The payoff for Player 1 is (U_C+P’₁) where P’₁ < P₂ because of increased upstream ecological degradation in Tibet and thus, is different from its earlier payoff ‘P’₁.

The involvement of trusted third parties, such as mediators or facilitators can help to bridge the gap between China and India and build trust over time. But as both nations favour bilateralism in transboundary water negotiation due to fear of sovereignty encroachment (Ho, 2014), the respondents were clear that both China and India would not prefer third-party involvement. In

fact, an Indian academician expressed displeasure about India's failure to acquire considerable third-party attention. *“India is reluctant to publicize its concerns about China's water activities on the Tibetan Plateau. And without India speaking up, the international community is not going to take note of the Sino-Indian water discord and China's activities that are in breach of international norms and rules, then it's obvious that little can be done to build pressure on China”* (I_{AC}). One reason why India is reluctant to negotiate with China on the Brahmaputra could be a lack of scientific information, and open communication (Deka, 2021).

From the game theoretical lens, this can be explained in the following manner. If there is a third-party intervention, both players may move towards wider cooperation to achieve payoff ‘P’ but will also have to agree to third-party involvement in bilateral matters. The cooperative payoff, achieved through third-party intervention say, ‘S’ will be lesser than the payoff ‘P’ because ‘S’ has been achieved at the diffusion of sovereign power due to third-party intervention and not through bilateral efforts. Both players may, therefore, prefer to continue with the present payoff (U_C+P_1 , $U_I+P_2-Q_1$) as the cost of bargaining with their sovereignty is higher than the cooperative payoff ‘S’.

As the BRB flows through conflicting border regions, it seems as pointed out by one of the Indian respondents, *“As long as the territorial issues are not resolved, genuine basin-wide cooperation involving China will not be possible”* (I_{AC}). Another respondent reiterated, *“While this requires political wisdom from both sides, given the situation, it may not happen soon and the status quo will continue in the near future”* (I_{AC}). Further, I_{AC} mentioned, *“Even if the territorial issues are resolved between China and India, there is no guarantee that China will participate in basin cooperation with India, over the Brahmaputra because of sovereignty concerns related to Tibet”*. Accordingly, both Chinese and Indian respondents negate the role of issue linkages or compensating tactics available for India to induce China to cooperate (C_{AC}, I_{AC}). One Chinese respondent asserted, *“For China to cooperate, India needs to offer something and that could be India withdrawing its support against Tibetan secessionist movements or the Dalai Lama, and that seems very unlikely”* (C_{AC}). This indicates a severe lack of trust between the countries.

5.2 Bhutan-India Interaction in the BRB

Conventionally, economic development is determined by resources and the role of technology. Trust is an important determinant often overlooked because it is difficult to capture it in economic models. Trust implies A’s willingness to place its interests under the control of B on

the belief that B will honor the obligation to avoid using its discretion in a harmful manner (Hoffman, 2002). Trust can be a proxy for social capital (Putnam, 2001). Furthermore, trust is a significant determining factor in trade relations. According to Dearmon & Grier, (2009), social trust can foster economic development by directly impacting growth; creating efficiency gains in human capital, and investment by reducing asymmetric information, transaction costs, and increasing information sharing; and influencing the rate of capital accumulation. Poor countries tend to remain poor due to their limited trusting capacity in trade openness for fear of being betrayed and exploited (Monares et al., 2020). Therefore, trust is a precondition for cooperation and economic development. Once cooperation is established, trust manifests itself through cooperation in different intensities.

In South Asia, the Bhutan-India relationship is a unique and time-tested relationship built over mutual trust. Historically, there has been no geopolitical rivalry or recent disputes between them (Baruah et al., 2022; Sarki, 2019). Apart from a shared cultural connection via Buddhism, the two nations are connected by water. Both countries share a riparian relationship in the BRB- the pedestal of their power cooperation (Barua, 2018). Cooperation through the sharing of river benefits evidenced that given goodwill and trust, natural resources like water can fuel the engine of economic growth (Biswas, 2011). Bhutan and India have developed a mutually beneficial relationship through joint hydropower development. By investing in Bhutan's hydropower projects at a greater grant-to-loan proportion, India bears financial and completion risks on one hand, and in return, imports cheaper surplus power to meet its deficit. Likewise, financially and technically constrained Bhutan meets domestic goals through India-sponsored hydropower projects which were otherwise not possible to develop unilaterally, further boosting economic growth through export revenue (Saklani et al., 2020; Saini & Jain, 2016; Dhakal & Jenkins, 2013). Further, economic cooperation through hydropower development is also politically rewarding for both countries.

5.2.1 Riparian Strategies and Interactions

The significant factors that shaped the Bhutan-India bilateral relationship from 1949 to date and the Brahmaputra interaction (Figure 5.4) are discussed below. The entire discussion is segregated such that the first period, 1949-1968, includes the beginning of bilateral relations and power cooperation, ending with establishing diplomatic relations. The second period, 1968-2008, focused on overall development cooperation until Bhutan's democratisation. The third period, from 2008 to date, discusses enhanced cooperation under the new Bhutanese government.

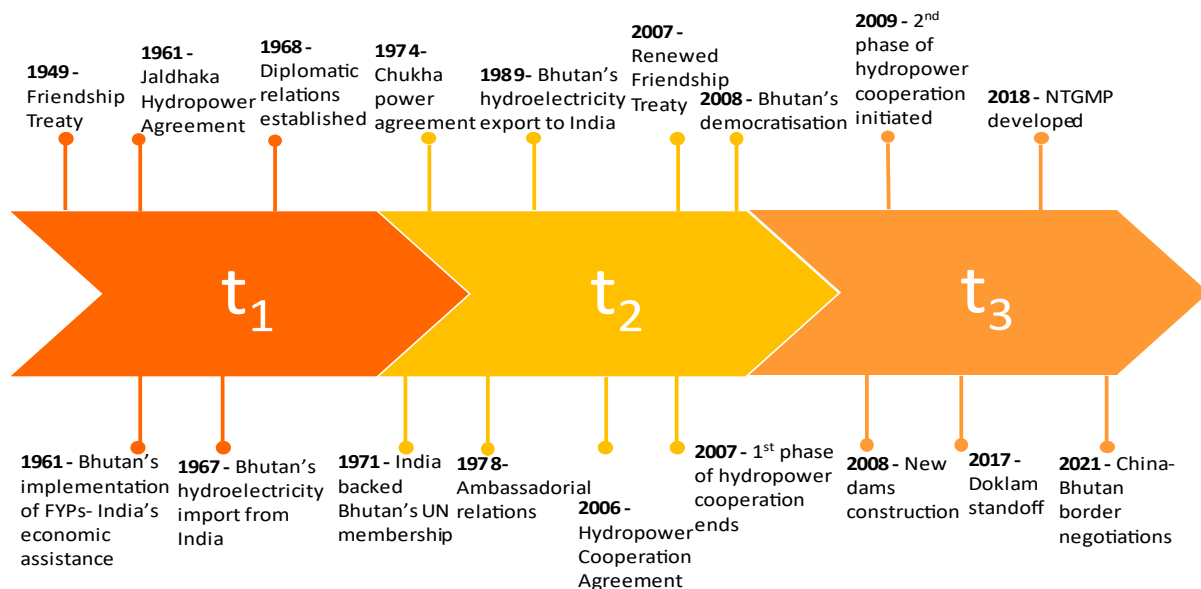


Figure 5.4. Bhutan-India Bilateral Timeline

Source: Author's construction

5.2.1.1 Period of foundational friendship (t_1) (1949-1968)

The basis of Bhutan-India relations is the Treaty of Perpetual Peace and Friendship signed in 1949 with independent India, replacing the 1910 Anglo-Bhutanese Punakha Treaty. Containing values of trust and equality, the 1949 Treaty marked the continuation of mutual camaraderie and no form of political pressure from India (Nga et al., 2019). Article 2 of the treaty states India's non-interference in the domestic affairs of Bhutan but Bhutan's acceptance of India's advice and guidance in foreign policy (Turner et al., 2011; Kumar, 2010). The treaty was an urgent necessity for the rise of China in 1949 astounded the serene Himalayan geopolitics and perturbed small state Bhutan (Nga et al., 2019). China's claims on the Bhutanese territory, atrocities, and eventual annexation of Bhutan's Buddhist neighbour, Tibet induced Bhutan to discard isolationism and embrace India for aid and security (Baruah et al., 2022; Kaul, 2022). After closing its northern border and ceasing trade relations with Tibet in 1960, Bhutan turned to India for greater economic dependence (Kumar, 2010). Since the early 1960s, India has economically assisted Bhutan's FYPs for socio-economic development²⁶. Hydropower cooperation, a strong pillar of Bhutan-India relations embarked with the first Jaldhaka Agreement in 1961 which mandated Bhutan to import hydroelectricity from India in 1967 (Tortajada & Saklani, 2018). It was only in 1968 that formal diplomatic relations were

²⁶https://www.mea.gov.in/Portal/ForeignRelation/Brief_Bilateral_Brief_bhutan_Feb_2020.pdf

established between the two countries. This in part attributed to limited bilateral engagements during the initial periods after India's independence and a secured belief in Bhutan as a staunch friend (Nga et al., 2019). Given Bhutan's dwindling confidence in India as a net security provider since the late 1950's Chinese repression of Tibet and particularly, after the 1962 Sino-Indian border war, formalising bilateral relations was felt necessary (Nga et al., 2019).

5.2.1.2 Period of renewed friendship under greater autonomy of Bhutan (*t*₂) (1968-2008)

Bilateral relations grew unabatedly from 1968 onwards with India's establishment of a Special Office in Thimphu and commissioning of ambassadorial relations in 1978²⁷. The focus of development cooperation during the 1960s and 1970s was on building social and physical infrastructure in Bhutan (Nga et al., 2019; Saklani & Tortajada, 2019). Contrary to the accusation of India's dominance by certain quarters, Bhutan during this period was visibly assertive in establishing an independent identity. India respected Bhutan's autonomy and refrained from interfering in its domestic matters like the introduction of national currency in 1969, forming its own foreign affairs department in 1970, diplomatic relations with Bangladesh in 1971, formal boundary talks with China in 1984, and diversifying economic aid sources from the West (Nga et al., 2019). India rather backed Bhutan's United Nations membership in 1971. In 1974, a second bilateral power agreement was signed whereby the Indian government offered full funding of the Chukha Hydroelectric Project (HEP) at concessional rates (Ranjan, 2021; Bisht, 2012). Thereafter its completion in 1988, Bhutan started power exports to India in 1989. Additionally, the Tala HEP construction began in 1998 with India's assistance, retaining the previous 60% grant and 40% loan structure. Bilateral relations during the 1990s were more of an expected reciprocity nature as both sides assured and provided support beyond power cooperation (Nga et al., 2019). The 2006 Agreement was signed to boost hydropower cooperation by inviting private sector participation (Ranjan, 2021). The first phase of power cooperation successfully ended in 2007 with the completion of Chukha, Kurichhu, and Tala HEPs (Bisht, 2012). The year 2007 also witnessed a new Friendship Treaty reaffirming peace and goodwill, retaining others but amending Article 2 of the 1949 Treaty. Provisions of Article 2 were portrayed as burdensome by unfriendly anti-India forces, accusing India of hegemonic ambitions (Turner et al., 2011; Kumar, 2010). Bhutan, therefore, desired renewal of the previous Treaty since 1979 for enhanced autonomy in conducting its external affairs, independent of India's guidance (Nga et al., 2019). Having attained 'territorial sovereignty and

²⁷<https://www.indembthimphu.gov.in/pages.php?id=549>

integrity' and a broader arena of bilateral cooperation as per the revised Treaty, Bhutan transitioned from monarchy to constitutional democracy in 2008. Democratisation was Bhutan's progressive decision, neither induced by conventional causes like economic crisis, regime disunity, or popular mobilisation nor by India's pressure (Turner et al., 2011).

5.2.1.3 Period of enhanced cooperation with ever-growing friendship (t_3) (2008-to present)

Overcoming all challenges, Bhutan-India goodwill and utmost trust grew over time. India's assistance to Bhutan ranged from education and scholarships to health, sports, space, culture, ICT, science, and technology (Nga et al., 2019). The second phase of hydropower cooperation was initiated with the 2009 joint protocol whereby India expressed commitment to develop 10,000MW hydropower in Bhutan and import surplus electricity by 2020, aiming for Bhutan's self-sufficiency and reduced trade deficits with India (Ranjan, 2021; Bisht, 2012). Under this pact, several India-assisted hydropower projects (Punatsangchu-I, Punatsangchu-II, and Mangdechhu) have been constructed from 2008 onwards (Ranjan, 2021). Apart from these ROR projects, Bhutan and India are also planning for reservoir projects such as Sankosh and Kuri-Gongri. Besides, a host of other projects are under construction. Indeed, Bhutan's priority in India's 'Neighbourhood First Policy' was evidenced when Narendra Modi chose Bhutan as his first foreign destination as the Prime Minister of India in 2014 and remarked, "*India-Bhutan hydropower cooperation is a classic example of win-win cooperation and a role model for the entire region*" (Panda, 2014). Further, for Bhutan, the India factor is a dilemma in negotiating relations with China as Bhutan urgently wants to resolve border disputes with China without disappointing its traditional friend, India (Kumar, 2010). Out of border disputes in three sectors, this dilemma is most critical for Bhutan in the Western sector (location of Doklam) because of its geostrategic importance for both India and China (Baruah et al., 2022; Kumar, 2010). Sino-Bhutanese counterclaims over Doklam and India's eventual intervention to safeguard Bhutan led to the long Sino-Indian military standoff in 2017 (Joseph, 2018). Although Bhutan resumed border negotiations with China in 2021, it assured respecting India's concerns and interests (Baruah et al., 2022). Under the China-Bhutan MoU on the Three-Step Roadmap for expediting boundary negotiations, both sides held talks in January and August 2023 for a possible solution (Krishnan & Haidar, 2023). Inherently deep-rooted trust, however, makes India confident regarding Bhutan's loyalty and sustained friendship (Baruah et al., 2022; Kumar, 2010). Even during the COVID-19 pandemic in 2020, India continued to prioritise Bhutan by gifting the first consignment of India-manufactured vaccines (Correspondent, 2021a). Post-pandemic,

Bhutan when opened its borders, however, reciprocated by implementing a daily Sustainable Development Fee (SDF) of 1,200INR for Indian tourists for the first time, though defending its decision on environmental protection grounds but leaving the Indian tourist sector disappointed (Seli, 2022).

In their commitment to future hydropower cooperation, both countries have worked out a joint hydropower development plan from the year 2020 to beyond 2040 (NTGMP, 2018) (discussed in Chapter 3, sub-division 3.1.3). Despite this celebrated hydropower cooperation, certain Bhutanese sections are critical of India's upper hand in hydropower deals posing greater economic, social, and environmental costs for Bhutan (Ranjan, 2021; Saklani & Tortajada, 2019; Bisht, 2014). Some of the rising concerns arise from Bhutan's mounting hydro-debts with India's recent fixing of 30% grant and 70% loan from the previous model of 60% grant and 40% loan, intrusion of Indian hydropower companies to Bhutan's allied sectors, disproportionately greater benefits for India, limited employment opportunities for Bhutanese labour, and hydrological risks posed by climate uncertainties (Tobden, 2022; Mishra, 2019; Ranjan, 2018). However, this debt does not pose a risk as the Indian Rupee is pegged at par with the Ngultrum and a ready electricity market in India makes possible upward revisions of export tariffs (Zangpo, 2022). Moreover, the project terms are unique with India solely bearing any delayed costs, committing to import all surplus power, and giving Bhutan the first right to hydroelectricity utilisation (Haran, 2021). The NTGMP has been prepared and finalised considering the above aspects and feedback of Bhutan.

5.2.2 Analysis of Bhutan-India Interaction Using Game Theory

Here, Bhutan is Player 1 and India is Player 2.

5.2.2.1 1949-1968 (t_1)

The entire period 1949-1968 is marked by significant simultaneous cooperative moves of the players. This is, therefore, modelled as a simultaneous game (also known as a strategic game) (Figure 5.5) where Player 1, depicted at the left, chooses the row, and Player 2, at the top, chooses the column while making decisions. The first value in the payoff vector belongs to Player 1 and the second to Player 2. Here, the player's utility function consists of maximising economic and political benefits.

		India	
		C	D
Bhutan	C	($U_{Bh}+P_0-Q'$, U_I+P)	($U_{Bh}-Q_0$, U_I-Q_1)
	D	($U_{Bh}-Q_2$, U_I-Q)	($U_{Bh}-Q_2$, U_I-Q_1)

Nash Equilibrium

- For player 1:** $U_{Bh}+P_0-Q' > U_{Bh}-Q_2$; where,
- U_{Bh} = unilateral payoff of power generation accruing to Bhutan
 - P_0 = greater payoff from mutual cooperation
 - $P_0 = P_{ec} + P_{pl}$
 - Q_2 = higher cost of unilateral defection
 - Q_0 = lesser cost from Player 2's defection
 - Q' = least cost from cooperation
Assuming $Q_2 > Q_0 > Q'$

- For player 2:** $U_I+P > U_I-Q_1$; where,
- U_I = unilateral payoff of power generation accruing to India
 - P = greater payoff from mutual cooperation
 - $P = P_{ec} + P_{pl}$
 - Q_1 = higher cost of unilateral defection
 - Q = lesser cost from Player 1's defection
Assuming $Q_1 > Q$

Here, $P_0 > P$ and $Q_2 > Q_1$

Figure 5.5. Bhutan-India Strategic Game

Source: Author's construction

Hypothetically, if both players had defected from recognising each other, the resulting outcome ($U_{Bh}-Q_2$, U_I-Q_1) would have been worse, more for Player 1, with cost ' Q_2 ' than Player 2, with cost ' Q_1 ' ($Q_2 > Q_1$), depriving both players of reciprocal benefits. It was a consensual decision of both players to sign the Friendship Treaty and indulge in hydropower cooperation. If Player 2 had decided not to cooperate ((C, D) position), it would have imposed cost ' Q_0 ' on Player 1 from reduced economic benefits due to the power deficit. Bhutan did not have any power until 1967 when it started importing hydropower from India (Haran, 2021). Player 2 would also have to bear a higher defection cost ' Q_1 ' ($Q_1 > Q_0$) from lost geopolitical and economic benefits from Player 1. India was attracted by the enormous hydropower potential of Bhutan since the 1950s which made the Friendship Treaty necessary to befriend the then-isolated Bhutan (Haran, 2021). As a developing economy, India could foresee meeting its future energy security from thinly populated Bhutan rather than developing unilaterally. Moreover, supporting the Bhutanese economy has geopolitical security implications as India can retain the support of its close ally Bhutan amidst evolving China-Bhutan relations (Yasuda et al., 2017). On the other hand, if Player 1 had defected to Player 2's proposal for cooperation, it would have been especially disastrous for the growth of its landlocked economy. Moreover, it would have increased its vulnerability to threats from China, thereby, imposing a higher cost ' Q_2 ' than cost ' Q_0 ' from Player 1's unilateral defection ((D, C) position). Bhutan's close links with its

southern neighbour India are a diplomatic endeavour to encounter any threats from its northern neighbour China (Kaul, 2022). Defection by Player 1 would have also imposed cost 'Q' on Player 2 from its inability to secure strategic benefits and import hydropower. Although cost 'Q' for Player 2 would have been less than cost 'Q₂' for Player 1 due to power asymmetry, the situation would have been unfavourable for both. It can be observed that unilateral defection was not a rational strategy for either player because apart from imposing a higher cost on the defecting player, the opponent player also had to bear a cost.

Instead, both decided to cooperate through hydropower trade and reap mutual economic and political benefits. Player 2 assisted in Player 1's development plans. With a free trade arrangement between the two countries, India is Bhutan's largest trade partner²⁸. This indicates that 'cooperation' was the dominant strategy for each player resulting in the Nash equilibrium outcome ($U_{Bh}+P_0-Q'$, U_I+P), with higher payoffs 'P₀' for Player 1 than payoff 'P' for Player 2 ($P_0 > P$). The cost of cooperation for Player 1 'Q'' ($Q' < Q_0 < Q_2$) incorporates Player 2's upper hand in its development programs. Bhutan needs to cautiously balance the self-interests of external stakeholders from benefitting from its resources and the long-term sustainable development goals (Correspondent, 2019).

5.2.2.2 1968-2008 (*t*₂)

During this period, development cooperation deepened with the establishment of diplomatic relations. Hydropower trade received a boost with the signing of many new agreements, allowing both players to import and export hydropower. New challenges galore in the new century but mutual understanding always prevailed. By now, having managed to strengthen its economic position and obtain UN recognition, Player 1 expressed the desire for greater autonomy. Player 2, who always supported Player 1, agreed to renew the 1949 Friendship Treaty in 2007. Next, Player 1 underwent a successful regime change without any interventions by Player 2. Exemplary bilateral relations continued unaffected by domestic transformation. With 'cooperation' retained as the dominant and Nash equilibrium strategy for each player, the resulting outcome ($U_{Bh}+P_2-Q''$, U_I+P_1) endowed higher payoffs to both players compared to the earlier period because of enhanced hydropower and development cooperation during this period, with the assumption that the cost of cooperation for Player 1 increases ($Q'' > Q'$). 'Q''' is the net environmental degradation factoring biodiversity losses and climate issues. Thus, the Nash equilibrium is also the dominant strategy equilibrium.

²⁸<https://www.mfa.gov.bt/rbedelhi/bhutan-india-relations/bhutan-india-trade-relations/>

For Player 1: $U_{Bh}+P_2-Q'' > U_{Bh} +P_0-Q'$; and for Player 2: $U_I+P_1 > U_I+P$

Also, $P_2 > P_1$

Game theory suggests a strong level of trust when each player finds ‘cooperation’ as the strictly dominant strategy. Therefore, the game theoretical analysis explains that Bhutan and India have been cooperating due to the strong level of trust and confidence between them. Bhutan’s higher economic development has been possible because both countries never betrayed each other. The relationship between the players can be summed up as a positive-sum game generating mutual benefits. Although ‘cooperation’ is more economically beneficial to Player 1 than Player 2, both players’ decision-making takes into account the fact that defection by any of them will cause a simultaneous loss for both of them. The success of Bhutan-India hydropower cooperation is due to mutual understanding, trust, and strong political commitments (Haran, 2021). This has further strengthened the bonds of friendship. It is a unique riparian relationship where despite being positionally disadvantaged in the basin, economic capacity and military might entitle India as the benevolent hegemon.

5.2.2.3 2008-to present (t_3)

It is clear from the above periods that trust and mutual benefits are the main determinants of Bhutan-India relations and by extension, sustained power cooperation. This made cooperation a historically dominant strategy for both players. Cooperation moved beyond the hydropower sector to other socioeconomic, cultural, educational, and technological aspects. Given the mutually beneficial hydropower trade, both players affirmed new commitments in 2009 and 2018 to deepen power trade. However, there are mixed opinions regarding Bhutan-India hydropower cooperation.

An Indian respondent commented, “*The relationship between India and Bhutan is just based on benefits which is the most dangerous thing*” (I_{AC}). In support, a Chinese respondent (C_{AC}) remarked, “*South Asian countries are always wary of India’s strategic politics that might negatively impact their economic development and so, India should not interfere in the domestic affairs of Bhutan*”. India must seize every opportunity not to disappoint Bhutan because the development of the Bhutanese economy holds spillover benefits for its Northeast states (Sarki, 2019). “*We should work with Bhutan to develop our relationship in a manner which promotes the national interests of both India and Bhutan*” (I_{EB}). To address new-age Bhutanese perceptions of India’s excessive influence on Bhutan’s hydropower-based economy, India agreed to trilateral power cooperation in 2016 (Baruah et al., 2022; Yasuda et al., 2017).

Besides, the location of Bhutan's hydropower dams in deep gorges with no or fewer human settlements lessens the possibility of the socio-environmental impact of hydropower (Yangka et al., 2019). Transaction costs including displacement, resettlement, and rehabilitation of population along the project sites in Bhutan are very small ranging from a few households to a thousand people, and therefore it is manageable (Tobden, 2022). Here, it also needs mention that water released from dams in Bhutan, notably the Kurichhu dam has been considerably flooding districts of lower Assam state in India (Borah et al., 2023; Sharma, 2018). Although India pays Bhutan its maintenance cost of hydrometeorological stations, the efficacy of early flood warnings is questionable (Borah et al., 2023). Predictions for acute climate change impacts on Bhutan's hydropower sector (Yangka et al., 2019) suggest both players must continue to work jointly for innovative solutions.

Furthermore, it would not be prudent to remark that Player 1's decisions are under the extreme influence of Player 2. As a sovereign player, Player 1 never hesitated to boldly express their concerns for protecting domestic interests without fearing a strong backlash from Player 2. This was evident from the fact that Player 1, known for valuing Gross National Happiness (GNH), refused to ratify Player 2's proposal of the BBIN-Motor Vehicles Agreement in 2017, anticipating environmental destruction and degraded security (Mitra, 2017). Nevertheless, neither Player 1 opposed the implementation of this pact by other countries involved nor Player 2 pressurised Player 1 to effect a change in its decision, once again affirming the high mutual respect and trust prevalent between the two players. Similarly, as explained above, the decision to implement SDF also bears testimony to Player 1's confidence regarding no resistance from Player 2.

To analyse whether the players must continue power cooperation or effect a change in their current strategy, we use the prediction feature of game theory. As rational players, their choice of future strategies will be governed by experience and current interaction. The payoffs are based on the NTGMP (2018) Report (given in Chapter 3, Table 3.5).

Options

Player 1: Cooperate, Player 2: Cooperate

If both players decide to continue their power trade till the beyond 2040 timeline, then Player 1 can generate 23,833MW of hydropower with the additional construction of India-assisted hydropower dams. This will create an export capacity of 22,319MW to Player 2. The higher the export quantity, the higher will be the revenue earned by Player 1 to boost its economic development. Similarly, higher imports of cheaper hydropower will ensure Player 2's energy

security and provide economic benefits. Further, mutual cooperation will usher in environmental benefits via the generation of renewable energy for achieving climate action goals. This will help Bhutan to retain its carbon negativity status. In a bid to minimise environmental and social impacts, Bhutan's future priority is a smaller number of mega hydro projects rather than several mini and micro projects (Tobden, 2022). Besides, guarantees both players continued geopolitical security from one another. Further, the Bhutan-India power trade can open the door for other players to collaborate, resulting in regional power cooperation (Tobden, 2022). The cooperative outcome will be $(U_{Bh}+P^*_{Bh}-Q''', U_{I+P^*_I-q})$ where payoff 'P*' will be greater than the previous payoffs of both due to cumulative mutual benefits, with the assumption that the cost of cooperation for Player 2 further increases ($Q''' > Q''$) due to rising environmental concerns of hydropower. Besides, Player 2 incurs a cost 'q' from the rising flash floods caused by Bhutan's dam releases.

For Player 1: $U_{Bh}+P^*_{Bh}-Q''' > U_{Bh}+P_2-Q''$; and for Player 2: $U_{I+P^*_I-q} > U_{I+P_1}$

Also, $P^*_{Bh} \geq P^*_I$

Player 1: Cooperate, Player 2: Defect

In an urge to claim user rights over the BRB, Player 2 might unilaterally indulge in developing untapped Brahmaputra hydropower potential. Player 2 might thereby, decide to stop investing in Bhutanese power projects and defect before the beyond 2040 timeline, say, by the year 2030. By 2030, Player 2 will be able to import 8,383MW of hydropower from Player 1. By defecting, Player 2 will not be in a better position because it will lose the import capacity of 22,319MW of cheaper power. The deficit of 13,936MW (22,319MW-8,383MW) will now have to be generated unilaterally. India's electricity demand is predicted to grow over the next two decades (Barbar et al., 2023). Unilateral power production in India will lead to greater social and environmental impacts which are assumed to be less when produced in Bhutan as mentioned above. Thus, India's oil import bills will increase and hinder its climate change mitigation efforts.

Player 2's defection will also cause Player 1 a lower hydropower generation of 9,378MW by 2030. Anticipating higher industrial estate growth in Bhutan, presuming 15% growth per year, peak load demand is predicted to increase (NTGMP, 2018). This will cause a power deficit of 14,455MW (23,833MW-9,378MW) beyond 2040 in Bhutan and impose costs from reduced economic and political benefits.

By rollback reasoning, Player 2 might reason that Player 1 will never betray Player 2 as it is deriving diplomatic and political security from Player 2. Player 2 thus, expects to continue

receiving geopolitical benefits from Player 1's cooperation. However, such benefits will not last long because Player 2's defection will eventually disappoint Player 1 and impose higher future costs from deteriorated bilateral relations with Player 1.

This scenario indicates that Player 2 has no incentive to deviate from its current strategy of cooperation as it will only make it worse off.

Player 1: Defect, Player 2: Cooperate

Although Bhutan's hydropower projects are ROR schemes without large storage dams, it might affect biodiversity conservation (Dorji et al., 2019). Increased domestic criticisms of hydropower trade might trigger Player 1 to defect by 2030. The power generation will remain the same, just like in the previous scenario, because defection by any of the players in 2030 will restrict higher power production until beyond the 2040 timeline. Such use of trigger strategy by Player 1 will induce Player 2 to apply trigger strategy in the next period. Betraying Player 2 will mean a greater economic loss for landlocked Player 1 because it will eliminate the future scope of alternative hydropower trade with any other country as the transmission lines must be routed through India (Baruah et al., 2022; Kumar, 2010) and Player 2 will be triggered to refuse. Apart from hampering economic development, reduced hydropower generation might risk Player 1's carbon negativity status. Player 1 might initially receive security benefits from Player 2 for a certain period but this will be hampered in the long run. Thus, defection will not be beneficial for Player 1 as it will have to incur higher future costs from reduced economic and political benefits.

This scenario indicates that Player 1 has no incentive to deviate from its current strategy of cooperation as it will only make it worse off.

Player 1: Defect, Player 2: Defect

In an extreme case, if both players decide to defect in 2030, apart from low hydropower availability for both countries, defection will mean a loss of spillover benefits. Player 1 might avail alternative sources of economic aid from the West or establish diplomatic relations with China. While China has no problem with close Bhutan-India relations, it is increasingly interested in resolving border disputes with Bhutan and embarking on diplomatic relations (C_{AC}, I_{AC}, I_{MP}, I_{EB}). None of these will be preferable to India's strategic interests. *"If China takes over certain disputed areas of Bhutan, it will bring security threats to India"* (I_{AC}). Nevertheless, *"Definitely, India cannot interfere in Bhutan-China relations and dominate Bhutan to not establish relations with China"* (I_{AC}). Both players will have to incur higher

economic and political costs and equally be in a worse situation. As rational players seeking optimal benefits, this scenario is less probable.

A comparison of all the scenarios reveals that (C, C) seems to be the highest payoff-generating strategy, incorporating Bhutan's sensitivity to environmental concerns. Rationality implies that 'cooperation' will be the strictly dominant strategy for the players in the future, like that in the present as the players have no incentive to deviate. Deviation by any one of the players will only leave both players in a worse-off position. The resulting Nash equilibrium outcome ($U_{Bh}+P^*_{Bh}-Q'''$, $U_I+P^*_{I-q}$) will be Pareto optimal where $P^* = P_{eg} + P_{ec} + P_{pl} + P_{ct}$. This is because cooperation is the best response strategy for each player along with acknowledging the economy-ecology trade-off, meaning higher economic growth net of ecological costs. In contrast to the limitations of small states in conducting their affairs (Kumar, 2010), Bhutan, under India's patronage has been successful in jealously guarding its sovereignty and enjoys independence in domestic and foreign policy, practising cautious diplomacy (Kaul, 2022).

5.3 India-Bangladesh Interaction in the BRB

India and Bangladesh share a unique relationship beyond a strategic partnership, based on a shared history and geographical proximity, enriched through cultural and economic ties and connected by transboundary rivers (Shringla, 2018; Islam, 2012). Their time-tested friendship emerged from the 1971 battlefield as allies nurtured by diplomacy. Practising the motto of '*Friendship to all and malice towards none*', Bangladesh is lauded for delicately balancing its foreign policy of non-alignment with all major powers of the region, including India (Plagemann, 2022). India-Bangladesh economic collaborations, however, have elevated bilateral ties, aiding Bangladesh to overcome poverty and show an impressive growth performance within a short time (Chakravarty, 2021). The two nations are bound by a common destiny for border security, cross-border terrorism and trafficking, economic development, connectivity, climate change, and the environment (Chowdhury, 2013). The recent trend in India-Bangladesh relations from insecurity to cooperation has brought peace dividends to Northeast India by phasing out insurgency and illegal immigration, opening economic opportunities for both countries (Rana, 2018).

Political and economic ties aside, India-Bangladesh hydro-diplomacy is an equally important bilateral element. For Bangladesh, a densely populated littoral country, India is the upper riparian on 54 shared rivers (Baten & Titumir, 2016). Being part of the GBM river system, the network of rivers supports a diversity of ecosystem services to both countries, including the Sundarbans mangrove forest, creating emerging opportunities for waterway connectivity and

biophysical and socio-economic challenges (flooding, erosion, salinisation, poverty, migration) whilst intensifying climate change vulnerability, posing shared governance risks (Bandyopadhyay et al., 2016; Bandyopadhyay & Ghosh, 2016). Bangladesh's affinity to multilateral engagements for transboundary solutions, whereas India's preference for bilateralism hinders cooperative management (Islam, 2021). The commonly reiterated fact is that despite sharing 54 rivers, the Ganges Treaty marks the only remarkable achievement in the history of Indo-Bangladesh water relations. The ongoing impasse on the proposed Teesta River agreement is a bone of contention in bilateral relations. Misperceptions loom large for Bangladesh, perceiving threats from India's unilateral decisions on shared rivers (Huda, 2017). One transboundary river that remains comparatively unattended in India-Bangladesh transboundary dialogues is the Brahmaputra. The BRB interlinking India and Bangladesh provides immense livelihood opportunities, including inland water navigation (Barua, 2018; Barua et al., 2018). However, inland navigation is still at its nascency and beset with several challenges due to the lack of an integrated water management approach in the Brahmaputra (Roy & Agrawal, 2022; Vidyadharan, 2021; Barua, 2018; CUTS, 2017a; CUTS, 2017b).

5.3.1 Riparian Strategies and Interactions

The significant factors that shaped the India-Bangladesh bilateral relationship from 1971 to date and the Brahmaputra interaction (Figure 5.6) are discussed below. The segregation of the periods has been done in the following manner. The events from 1971-1996 form the backdrop of political and water relations between India and Bangladesh. The second period 1996-2015 begins post-Ganges Treaty, heightening focus on another significant transboundary river, the Teesta. The third period 2015 to date discusses the new bilateral developments of the 'golden era'.

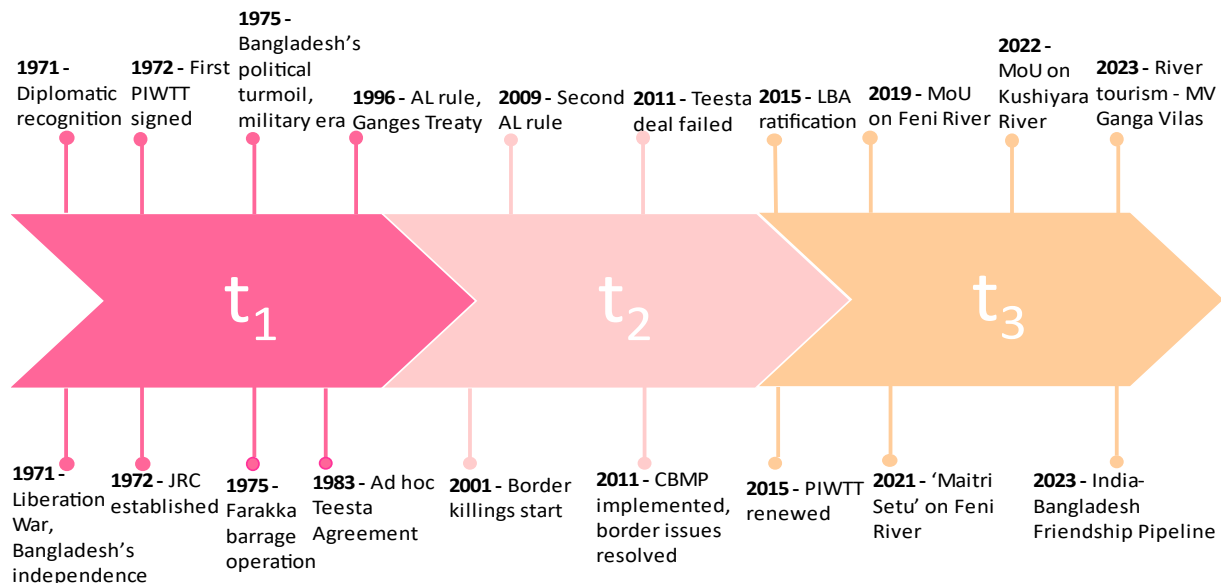


Figure 5.6. India-Bangladesh Bilateral Timeline

Source: Author's construction

5.3.1.1 Period of unstable bilateral relations due to political turmoil in Bangladesh (t_1) (1971-1996)

India contributed significantly to Bangladesh's (formerly East Pakistan) 1971 Liberation War against West Pakistan (Ali, 2018; Chowdhury, 2013). Beginning from the 1971 battlefield, Indo-Bangladesh cooperative ties received impetus under the patronage of Bangabandhu Sheikh Mujibur Rahman, the founder of Bangladesh. As acknowledged by respondent B_{EB}, "Without India's help, Bangladesh would not have emerged as an independent sovereign nation so quickly".

Bangladesh shares 4096 km of border on three sides with India (with the Northeast 1880 km) traversing through plains, riverine, and hilly borders, the fourth side being open to the Bay of Bengal (Das, 2008). With the carving of new territorial borders, Bangladesh became 90% 'India-locked' and likewise, Northeast India 'Bangladesh-locked' (Majumdar, 2014). Riverine connectivity between the two countries that had once existed through inland waterways, was completely suspended after the Indo-Pakistan War of 1965 (Basu Ray Chaudhury & Basu, 2015). According to Bangladeshi respondents, the economic implications of historical waterway connectivity disruption for Northeast India and Bangladesh necessitated revival measures after Bangladesh's independence (B_{AC}, B_{GO}, B_{EB}). Accordingly, the first protocol between Bangladesh and India was mutually signed in 1972 through which Bangladesh

allowed Indian inland ships to ply between West Bengal and Assam (CUTS, 2018). Moreover, the IWAI declared the Brahmaputra as NW-2 in 1988 for improving its navigability.

India-Bangladesh water disputes, however, originated even before Bangladesh became a sovereign nation and are a by-product of their respective domestic politics and consequent foreign policy pursued (Kashem & Islam, 2016; Islam, 2012). The prime source of water dispute, the Farakka Barrage was unilaterally constructed by upstream India in 1961, to divert transboundary Ganges River water for the preservation and maintenance of the Kolkata Port, also considered a political ploy against Pakistan (Bangladesh was then East Pakistan). India's proposal for cooperative development of the Ganges with Pakistan during the 1950s yielded no negotiations (Karim, 2008). With the emergence of Bangladesh in 1971, the two nations signed the 25-year Indo-Bangladesh Friendship Treaty in 1972 and established the Joint River Commission (JRC) in the same year to address transboundary water issues and flood-season data sharing by India (Majumdar, 2014; Islam, 2012). Bangladesh, under India-friendly AL rule, immediately raised the Ganges issue and while ministerial-level negotiations for short-term agreements were proceeding effectively, Bangladesh's political turmoil due to Sheikh Mujib's assassination in 1975 instigated India to commission the barrage operation. The coming to power of an anti-India military regime in Bangladesh strongly resented India's water withdrawals for reduced downstream flow and internationalised the Farakka issue (Hossain, 1981; Karim, 2008). The anti-India regime led Bangladesh to tilt toward the Islamic bloc and China, which had initially opposed Bangladesh's independence (Baruah et al., 2022; Majumdar, 2014; Chowdhury, 2013). Growing China-Bangladesh closeness much to India's disliking, particularly between the armed forces, thus impacted the India-Bangladesh relationship during this period (Kumar, 2014; Chowdhury, 2013). Nonetheless, even during the military era in Bangladesh and uneasy bilateral relations, the two nations signed an ad hoc water-sharing agreement in 1983 on the Teesta River, the fourth largest transboundary river in Bangladesh after the Ganges, Brahmaputra, and Meghna, also an important tributary of the Brahmaputra (Islam, 2021). The Agreement allocated 39% of the Teesta water flow to India and 36% to Bangladesh, with the remaining 25% left unallocated for future decision (Mirchandani, 2016). But with the return of the AL government in 1996 and improved bilateral relations, both countries signed the Ganges Water Treaty for water flow allocation at Farakka, recognising Bangladesh's lower riparian rights. Considered a landmark event in India-Bangladesh relations, the Ganges water-sharing treaty is the outcome of long negotiations, traversing various political regimes, showcasing the highest level of political commitment

(Karim, 2008). The Ganges Treaty bears testimony to the fact that despite decades of bickering, mobilisation of political will enabled India and Bangladesh to cooperate (Karim, 2008). The treaty resolved long-standing water allocation disputes at Farakka between the two countries but continues to be perceived as inequitable and unjust by certain Bangladeshi sections (de Micheaux et al., 2018). A Bangladeshi respondent (B_{AC}) when asked about the treaty and its features responded, “*If Bangladesh thinks India is not fair, could Bangladesh come up with a fair proposal to talk?*”.

5.3.1.2 Period of bilateral commitments (*t*₂) (1996-2015) amidst misperceptions

Post-settlement of the Ganges issue, the AL government refused renewal of the Friendship Treaty after its expiry in 1997, as the initially enthusiastic Bangladeshi sentiment for India turned to annoyance perceiving India’s unfair and excessive influence (Majumdar, 2014). During this period, border issues became more prominent although the phenomenon of migration from Bangladesh to India dates back to India’s partition (Chakravarty, 2021). The porous nature of the land and riverine border facilitated typical border-related problems like illegal migration and smuggling, leading to several border killings between the Indo-Bangladesh border security forces between 2001-2011, and mutual accusations of providing shelter to insurgents (Datta, 2002). In a commitment to security cooperation with India, the AL government after resuming power in 2009, took strict action against terrorism by identifying Indian insurgent bases in Bangladesh and jointly implemented the Coordinated Border Management Plan (CBMP) in 2011 to prevent border killings (Ali, 2018). An Indian respondent informed that under the CBMP, the Indian government implemented smart fencing through a virtual surveillance system, using cameras and sensors to guard the challenging 61km riverine border in the Dhubri district of Assam state, which has reduced cross-border crimes like illegal infiltration, cattle and contraband goods smuggling, human trafficking and terrorism (I_{AC}). Such moves by both countries infused a renewed vigour in bilateral relations. Besides, the joint communiqué signed in 2010 granted transit rights to India via Bangladesh’s waterways though was condemned by a section of Bangladeshi for not generating reciprocal benefits (Kumar, 2014).

This was also when Bangladesh raised the Teesta water-sharing issue, demanding equal water allocation because it had been facing acute lean-season water scarcity and the ad hoc agreement had expired in 1985. Both countries almost reached an Interim Agreement in 2011 but failed to conclude the treaty due to dissensions between India’s central and state governments (West Bengal) (Ali, 2018; Mirchandani, 2016). The Teesta is a case in point that domestic economic

interests are the prime driver of India-Bangladesh transboundary negotiations (Bandyopadhyay & Ghosh, 2016). In the Teesta River, India constructed the Teesta Barrage in 1975 for irrigation and hydropower generation, and Bangladesh constructed its own in 1990 for irrigation purposes, subject to upstream water release (Mirchandani, 2016). As an implication, bilateral relations were slightly strained because the AL government suffered a domestic backlash from the opposition for not being able to retrieve India's friendship equitably (Ahmed, 2012). Subsequently, India's repeatedly failed reassurances to solve the Teesta issue framed the Bangladeshi opinion that the rights that India claims for itself as a lower riparian do not apply to Bangladesh (Islam, 2021). Being a downstream riparian, speculative fears of India's planned river linking and hydropower dam projects, for instance, the Tipaimukh multipurpose hydroelectric project on the transboundary Barak-Meghna River are dominant in Bangladesh, particularly due to limited communication and data-sharing from India (Choudhury & Choudhury, 2020; Huda, 2017; Ahmed, 2012). Unilateral diversions or water withdrawals by India have severely disappointed Bangladesh because of several adverse impacts of floods and droughts on its economy and ecology, generating the popular view of India's hegemonic big-brother attitude (Vij et al., 2020; Baten & Titumir, 2016; Chowdhury, 2010).

5.3.1.3 Period of enhanced political friendship ushering significant bilateral progress (t_3) (2015-to present)

Negating Bangladeshi fears of an anti-Bangladesh policy of the newly elected Bharatiya Janata Party (BJP) government in India, the bilateral relationship between BJP and AL since 2014 reached new momentum with the resolution of several outstanding issues and ratification of the LBA in 2015 (Hossain & Islam, 2021; Huda, 2017; Kashem & Islam, 2016). In solidarity, two Bangladeshi respondents expressed faith that under the present BJP government, India has made rapid progress in regional cooperation through its 'Neighbourhood First Policy' (B_{AC}). Development cooperation has emerged as a key pillar of bilateral relationships whereby India has shown increasing support to Bangladesh in diverse sectors like power, infrastructure projects, ICT, education, and culture (Chakravarty, 2021; Shringla, 2018). The year 2017 took the bilateral relationship to a new height, generating 36 diverse development agreements, heralding a 'Golden Era' (Shringla, 2018). In 2019, a bilateral MoU was signed for allocating water from the transboundary Feni River to India for drinking water supply in the state of Tripura, although it makes Bangladesh wary of possible negative impacts on its Muhuri-Feni irrigation project (Thakur, 2020). Besides, the 'Maitri Setu' or India-Bangladesh Friendship

Bridge connecting the two countries over the Feni River was inaugurated in March 2021²⁹. Further, in September 2022, the two nations signed an MoU on water withdrawals of the Kushiyara River, a tributary of the Barak River, each by Assam and Bangladesh for their consumptive water requirements (Sajen, 2022). In a boost to energy cooperation, the first cross-border energy pipeline, named the India-Bangladesh Friendship Pipeline was inaugurated in March 2023³⁰. Despite mutual goodwill, however, the much-anticipated Teesta Treaty could not materialise.

To revive waterway connectivity, the two countries signed a Protocol on Inland Water Trade and Transit (PIWTT) in 2015 whereby they have also agreed to renew it automatically for five years (Vidyadharan, 2021; Yhome, 2017). As such, PIWTT allows both countries to explore investment on the routes designated under it. In 2016, India and Bangladesh signed another MoU to allow tourists from either country to use their coastal and protocol routes. Hailed as a “watershed moment” in IWT, the world’s longest river cruise, MV Ganga Vilas is an initiative undertaken by the Indian government in 2023, sailing through NW-1 and NW-2 from Kashi, Uttar Pradesh to Dibrugarh, Assam in India via Bangladesh (Correspondent, 2023a). Both Indian and Bangladeshi respondents emphasised the current friendliest political relations as an opportune moment for comprehensive bilateral cooperation and specifically mentioned sharing the economic and environmental benefits of inland water navigation (I_{AC}, I_{GO}, I_{MP}, B_{AC} B_{GO}, B_{EB}). *“With India undertaking the exercise of reviving national waterways, it makes it easier for us to maintain the river channels which was otherwise difficult for us due to the absence of an agreement with the upper riparian”* (B_{EB}).

5.3.2 Analysis of India-Bangladesh Interaction Using Game Theory

Here, India is Player 1 and Bangladesh is Player 2. Although each transboundary river is unique and not comparable, the analysis also subsumes interactions on the Ganges and Teesta, as meaningful insights could be drawn from their negotiation process and outcomes to predict the Brahmaputra negotiations.

5.3.2.1 1971-1996 (t_1)

As discussed above, the period 1971-1996 saw simultaneous moves by the players for negotiations on the Ganges River. The water interaction during this period, therefore, is explained with a strategic game (shown as a payoff matrix) to depict the simultaneous strategies

²⁹<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1703042>

³⁰<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1908377>

of the players (Figure 5.7). Player 1, shown at the left, selects the row strategies, and Player 2 at the top selects the column strategies. The first value in the payoff vector belongs to Player 1 and the second to Player 2. Here, the player's utility function consists of maximising ecological, economic, and political benefits from the Ganges River.

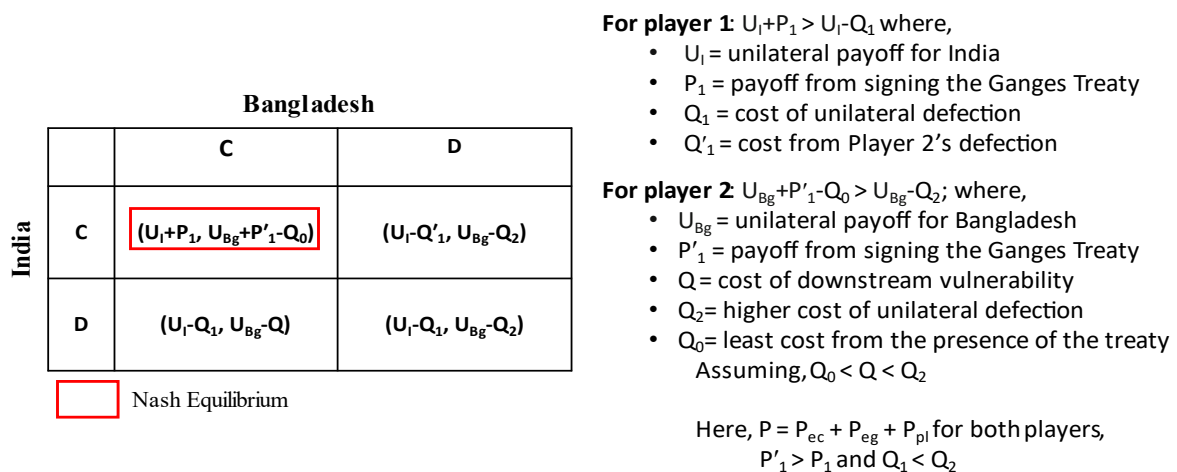


Figure 5.7. India-Bangladesh Strategic Game

Source: Author's construction

Player 1's initial development of the Farakka Barrage in 1961, alarmed Player 2 after its independence in 1971. Until the initiation of cooperative proposals, the players were at the (D, D) position, receiving the outcome $(U_I-Q_1, U_{Bg}-Q_2)$. In this position, Player 2 was worse off due to the greater cost of downstream vulnerability ' Q_2 ' from adverse implications of Farakka Barrage than cost ' Q_1 ' for Player 1 from increased downstream accusations. This was followed by several episodes of joint communication by the players for a decision on water allocation. Defection by Player 1 to Player 2's cooperative proposal for the Ganges Treaty would have left Player 2 with no payoffs but cost ' Q '. Although cost ' Q ' would have been lesser than cost ' Q_2 ' from unilateral defection by Player 2 ($Q < Q_2$), Player 1's non-cooperative move would have severely harmed Bangladesh. Even for Player 1, non-cooperation would not have been a rational strategy, incurring cost ' Q_1 ' as that would have grossly affected Player 1's global reputation of being a dominant hydro-hegemon, violating equitable and reasonable water utilisation principle and harming bilateral relations with its new South Asian neighbour. At the

(D, C) position, the outcome would have been $(U_I - Q_1, U_{Bg} - Q)$. Similarly, Player 2 had the option of choosing ‘non-cooperation’ and rejecting the proposed Ganges Treaty. However, Player 2 could perceive the greater cost of non-cooperation ‘ Q_2 ’ against upstream Player 1 as that would eliminate every possible space for future negotiations, leaving Player 1 in a comparatively better position due to its greater positional advantage but imposing slight cost ‘ Q'_1 ’ from losing Player 2’s support ($Q'_1 < Q_1$ for Player 1). At the (C, D) position, the outcome would have been $(U_I - Q'_1, U_{Bg} - Q_2)$. Bangladesh depends on the Ganges, their main river for agriculture, fisheries, industries, and navigation, besides, biodiversity maintenance of the Sundarbans and flushing salinity intrusion from the Bay of Bengal (Karim, 2008). Realising the Ganges Treaty was a priority for Player 2 to progress in other sectors by maintaining warm diplomatic relations with Player 1. To avoid the non-cooperative cost ‘ Q_1 ’ (unilateral defection cost ‘ Q_1 ’ for Player 1 is less than ‘ Q_2 ’ for Player 2 due to downstream vulnerability), Player 1 opted for cooperation and benefitted from payoff ‘ P_1 ’ which served its domestic interests of upstream water utilisation cooperatively. Player 2, too, benefitted from greater payoff ‘ P'_1 ’ due to the recognition of lower riparian rights ($P'_1 > P_1$). Despite power asymmetry, ‘cooperation’ was the best available option for both players. This Nash equilibrium strategy resulted in the outcome $(U_I + P_1, U_{Bg} + P'_1 - Q_0)$, where cooperative payoff ‘ P ’ includes additional economic, ecological, and political benefits. The cost ‘ Q_0 ’ here, still exists for Player 2 because a treaty does not signify the highest intensity of cooperation though ‘ Q_0 ’ is far lesser than ‘ Q_2 ’ ($Q_0 < Q_2$) from having no treaty at all. ‘ Q_0 ’ accounts for a mutual consensus concerning lean-season flow augmentation that could not be reached due to players’ differing perceptions. Allegations by Bangladesh of low flow allocation during the lean season made India propose storage reservoirs in Nepal and divert Brahmaputra waters to the Ganges basin through a canal, but this was opposed by Bangladesh (Rahaman & Varis, 2009).

5.3.2.2 1996-2015 (t_2)

In this period, the players failed to conclude the Teesta deal despite sincere bilateral efforts. Player 2 had a greater preference for the Teesta Treaty for a guaranteed downstream flow. Although Player 1 had no reservations about ‘cooperation’, domestic politics compelled Player 1 to defect in 2011. Here, Player 1’s utility function consists of maximising domestic political benefits, and Player 2’s to maximise economic benefits through irrigated agriculture. The Teesta case serves as an eye-opener for the importance of consensus-building at the domestic level, over and above the presence of political will at the state level. Domestic politics has a strong bearing on transboundary rivers, but its role is undermined because of the underlying

assumption that riparian states behave as unitary actors relatively unconstrained by domestic politics (Warner & Zawahri, 2012). The fact that the West Bengal government was on the same page with Bangladesh stimulated the Ganges negotiations (Karim, 2008) which was not the case with the Teesta. Moreover, the Indian states of Sikkim and West Bengal, through which the Teesta flows have varying interests in water utilisation (Mirchandani, 2016). This indicates India's hegemonic vulnerability from failing to persuade its state governments for broader national interests (Vij et al., 2020). If the Teesta Treaty had been signed, incremental water cooperation would have resulted in a better outcome (U_I+P_2 , $U_{Bg}+P'_2-Q_1$). Both players could have benefitted from a higher payoff ($P_2 > P_1$ for Player 1 and $P'_2 > P'_1$ for Player 2) by elevating water relations through the second treaty along with the Ganges Treaty. It might have also reduced the cost of vulnerability for Player 2 from the previous 'Q₀' to 'Q₁'. A guaranteed water flow would have addressed the economic activities of basin communities and water insecurity particularly, for Player 2 ($P'_2 > P_2$).

However, 'non-cooperation' was considered to be the rational strategy for Player 1, valuing domestic interests, and the default strategy for Player 2 due to its weaker riparian position resulting in the Pareto inferior outcome ($U_I+P_1-Q_1$, $U_{Bg}+P'_1-Q_0$), retaining the same outcome from the only existing Ganges Treaty. Thus, the power asymmetry is clearly visible. Interestingly, Player 1 also had to bear the previously absent cost of hegemonic vulnerability 'Q₁', arising from the failure to keep the commitment to negotiating the treaty. ($U_I+P_1-Q_1$, $U_{Bg}+P'_1-Q_0$) is, therefore, not the Nash equilibrium outcome as both players have an incentive to deviate. Bangladesh highly prefers the Teesta Treaty to materialise and India is also making all efforts throughout successive governments to sign the treaty.

5.3.2.3 2015-to present (*t*₃)

During this period, the players had separate negotiations for the transboundary Feni and Kushiyara rivers, shared between India and Bangladesh. It led to the signing of water-sharing MoUs, which also negates the hypothesis that the Teesta holds hostage to other transboundary river negotiations. India and Bangladesh also jointly developed the Indo-Bangladesh protocol routes over the Brahmaputra River to improve connectivity and boost inland navigation. Here, the player's utility function consists of maximising economic and political benefits through enhanced water cooperation and connectivity. Repeated interaction of the players thus, resulted in an increased outcome ($U_I+P'_1-Q'$, $U_{Bg}+P''_1-Q'_0$), where the incremental payoff 'P'₁' for Player 1 and 'P''₁' for Player 2 with Feni and Kushiyara MoUs on water withdrawals and progress on inland water trade is greater than their respective previous payoffs. Both players

benefitted from a reduction in costs, that is, $Q' < Q_1$ for Player 1 and $Q'_0 < Q_0$ for Player 2. Therefore, the congenial political environment of this period insists on a prediction analysis of evolutionary cooperation in the Brahmaputra River.

With that motive, we asked the respondents whether there is a possibility that India will approach Bangladesh for a treaty on the Brahmaputra River. One Indian respondent mentioned, *“Why should an upstream India approach Bangladesh and get into an unnecessary negotiation without an apparent incentive? It is essentially up to Bangladesh to ask for a more collaborative effort to secure its livelihood options, irrigation, fisheries and protecting delta ecosystem apart from inland waterways”* (IAC). On the other hand, Bangladeshi respondents explained that their reason for not approaching India is the lack of adequate knowledge, institutional capacity, data, and information. They prefer India to develop cooperative proposals (BAC, BGO). Besides, Bangladesh increasingly emphasise the stalled Teesta negotiations rather than shifting attention to the Brahmaputra (BAC, BGO). *“As a scientist, I think that Brahmaputra is not discussed during JRC meetings because it is not creating any serious lean season problem at the moment due to India’s less than potential use”* (BGO). Another respondent stated, *“I think the Brahmaputra is one of the last large rivers which is still natural. All other larger rivers like the Ganges or Teesta are so heavily intervened”* (BAC). Therefore, both countries' non-decision making in the Brahmaputra River can be considered a fair decision for now (IAC).

However, Bangladeshi respondents also admitted that *“In terms of the three biggest rivers Ganges, Brahmaputra, and the Meghna, the most important for Bangladesh is the Brahmaputra because the Ganges is overused or misused but the Brahmaputra is still not fully utilised”* (BAC, BGO). Another respondent added, *“The Brahmaputra is considered to be one of the most important rivers for Bangladesh since the life and livelihood of the huge Bangladeshi population (approximately 30% of the total) are dependent on it for agriculture, navigation, fisheries, freshwater supply, and sediment flow”* (BAC). Despite this recognition of interdependencies and willingness to cooperate, backward induction might construct Player 2’s reasoning that since its past cooperative efforts were not honoured by Player 1 concerning the Teesta Treaty, further cooperative moves too might not yield any fruitful results. India’s unilaterally constructing the Farakka barrage and last-minute backing off the Teesta River treaty are predominant sources of mistrust for Bangladesh (IAC, BAC). *“Some of the political parties in Bangladesh and India have attached nationalism to water sharing and use regressive nationalistic terms, for example, water is being siphoned off to India or the government is*

selling off the state's resources to India which impede any kind of cooperation that the government is undertaking with India” (B_{AC}). One Bangladeshi respondent expressed disappointment upon no agreed solution for flow augmentation to date, even when the 30-year Ganges Treaty is nearing expiry in 2026 (B_{EB}). Moreover, India uses material resources like position and strength and ideational resources like setting agendas to avoid discussions on the Brahmaputra River (Vij et al., 2020). Bangladeshi respondents highlighted Bangladesh’s limited bargaining power in inducing upstream countries to envision water cooperation, being the most downstream country (B_{AC}). Particularly, the absence of any joint MoU or agreement in the basin makes Bangladesh insecure as its interests depend only on upstream goodwill gestures (B_{AC}). “Downstream countries have not been successful in trying to get the upstream countries to cooperate because of power issues so, Bangladeshi stakeholders prefer a basin approach rather than a river approach to get around power disparities” (B_{AC}). The fifty years of warm diplomatic relations since 1971 failed to resolve water-sharing disputes due to institutional failure, lack of political consensus, diplomatic incompetency of Bangladesh, and India’s lack of interest and a non-compromising attitude (Islam, 2021). “A good relationship between political parties does not necessarily mean there has been substantial progress in cooperation as politicians do not have much interest in cooperation unless it serves their strategic interests” (B_{AC}). In fact, another Bangladeshi respondent asserted, “Downstream countries have equal dominance on the upstream country because we can also build barrage and block upstream migration of Hilsa fish or Gangetic dolphin to India and we are planning to build a Ganges barrage in our country to counter the ill-effects of Farakka Barrage” (B_{AC}). Nevertheless, Indian and Bangladeshi respondents consider the recent initiatives of enhancing inland navigation a promising sector for initiating cooperation in the Brahmaputra River. “It is possible to create a more enabling environment for cooperation through navigation because right now, non-cooperation is not the dominant strategy for India and Bangladesh” (I_{AC}, B_{AC}). “I don't think there is a high level of trust that we would like to see on both sides, there are too many political issues. But the discourse about sharing resources beyond water has improved than at the time of the Ganges or Teesta treaty” (B_{AC}). This is indicative of an optimistic future. As informed by the respondents, India and Bangladesh have a weakly dominant non-cooperative strategy. Each prefers the other player to initiate cooperation and intends to do exactly as the other player; that is, if one player cooperates, the opponent will cooperate too, and if one player does not cooperate, then the opponent will follow suit. Evidence of water cooperation or cooperative efforts undertaken by both are found in Indo-Bangladesh bilateral

history, which does not completely undermine the possibilities of future Brahmaputra River cooperation. As stated by a Bangladeshi respondent, “*In India, no matter how the sentiment is in Bangladesh, we know there will be someone who will always speak for Bangladesh. We have seen in Teesta that many people spoke on behalf of Bangladesh*” (B_{AC}). Hence, there is a possibility of Brahmaputra River cooperation in the future. If Brahmaputra River cooperation occurs, the new outcome will be $(U_I + P''_1 - q', U_{Bg} + P'''_1 - q'_0)$ where the incremental payoff ‘ P''_1 ’ for Player 1 and ‘ P'''_1 ’ for Player 2 inclusive of the Ganges Treaty, Feni and Kushiya Agreements, existing inland water trade, and Brahmaputra cooperation will be greater than their existing payoffs. The cost component still exists due to the absence of the Teesta Treaty. However, both players could have benefitted from a reduction in costs, that is, ‘ $q' < Q$ ’ for Player 1 and ‘ $q'_0 < Q'_0$ ’ for Player 2.

Despite this enabler, the players cannot entirely overcome the persisting non-decision making and move toward a treaty because of their strategic calculations. The concern for a treaty to Player 2 relates to India's leverage in realising multipurpose projects like the Tipaimukh dam (albeit now shelved), despite the Brahmaputra being a highly vital river for them. In Player 1's case, the hitherto less significant Brahmaputra River has only garnered recent attention in the context of the economic development of Northeastern states, besides claiming competitive user rights on the river. India is using its positional advantage to harness the untapped Brahmaputra potential and Bangladesh aggrieved by its experience of historically being a submissive riparian is using a lack of knowledge, data, and information tactics. Backed by unimpaired economic interests from the river, their strategy of non-decision making can be considered transitorily fair, causing the riparians' inertia to undertake constructive decisions. However, such a myopic decision on their part might cause them to bear greater future costs of non-cooperation.

Game theoretical analysis revealed that India-Bangladesh Brahmaputra interaction with no strictly dominant strategy depicts a stag hunt structure (Madani, 2010). Cooperation can result in the Pareto-optimal outcome but non-cooperation being a risk-free strategy, players might choose not to cooperate and retain the Pareto-inferior outcome. Cooperation in the stag hunt game is possible only through genuine trust-building between the players and the past few instances in India-Bangladesh relations, as discussed above severely impacted bilateral trust. However, as indicated by the series of recent bilateral events and also mentioned by the respondents, with increased political friendliness from 2015 onwards, trust-building is getting strengthened through developments in diverse sectors, particularly the inland navigation sector.

This justifies their stag hunt type of interaction, with the possibility of achieving greater outcomes only through cooperation and missed opportunities otherwise.

5.4 Summing Up

This chapter concluded that breaking the China-India status quo seems challenging given their aggressive geopolitical rivalry. Non-cooperation is the strictly dominant strategy for China due to the lack of economic incentives for Brahmaputra cooperation. Alternative solutions like issue linkage and third-party involvement also do not seem to play any role in inducing China to cooperate. The Bhutan-India case shows that trade between power asymmetric actors is effective not only because of reciprocal benefits but mutual trust. As a dependent variable, economic development is, therefore, a function of trust, which is possible to achieve only when both players cooperate. Cooperation initiated through the sharing of economic benefits (hydropower) led to spillover environmental, socioeconomic, and political benefits. Bhutan-India hydropower cooperation is, therefore, not hegemonic but sustainable. The India-Bangladesh is an interesting case of evolutionary cooperation. Despite domestic politics, the absence of a strictly dominant non-cooperative strategy and their growing recognition of interdependencies is an opportunity to break the non-decision making and expedite actions for India-Bangladesh Brahmaputra River cooperation. Although technical negotiations could not prepare the ground for a comprehensive Brahmaputra Treaty, expanding inland water trade, transit, and connectivity on the Brahmaputra can be a way forward to institutionalising cooperation.

Chapter 6 CONCLUSION AND WAY FORWARD

This chapter concludes by summarising the key research findings concerning the research aim and objectives and discussing the value and policy implications thereof. It also proposes avenues for future research.

6.1 Key Findings

This thesis aimed to examine the existing and evolving bilateral water interaction among the BRB riparians using a game theoretical approach. The analysis found that geopolitics is the main determinant of China-India Brahmaputra water interaction whereas domestic politics, political willingness, and economic interests are for India-Bangladesh. Such factors have hindered positive water interaction in the basin. The only exceptional riparian relation is of Bhutan-India. Bhutan-India depicts a classic case of benefit sharing and mutual trust, emanating from the hydropower sector that spilled over to diverse developmental sectors. As the only cooperating BRB riparians, Bhutan and India can be torchbearers for the non-cooperating riparians not only in the BRB but also, in any transboundary river basin.

In accordance with the three objectives of the thesis, three key chapters have been developed. The objective-wise chapter findings can be revisited in the following manner. Chapter 3 identified the economic benefits of the BRB and its current status of underutilisation. From the discussions in this chapter, it can be inferred that the BRB riparians have a high preference for utilising the economic benefits of the river particularly, hydropower and navigation. Chapter 3 holds significance wherein by highlighting the huge potential of the river, it generates curiosity to explore the grounds for development under cooperative management. The Chapter also reflects on the possibility of sub-basin cooperation. Chapter 4 made a comprehensive and systematic evaluation of the geopolitical relations of the BRB riparians and hydrogeopolitics and their influence on transboundary interaction. The highest intensity of geopolitical complexity is found in China-India bilateral relations. The chapter made a novel contribution by validating the intertwining attributes of dynamic geopolitics and emerging hydrogeopolitics that resulted in the basin status quo. Chapter 5 presented the most significant value of the thesis, that is, the application of game theory in assessing and predicting BRB cooperation. The chapter analysed the riparian strategies and payoffs in BRB interaction. The China-India interaction revealed non-cooperation as the dominant strategy and India-Bangladesh, as a weak dominant strategy. These strategies do not provide the optimal payoffs to the riparians and indicate a lack of trust. The role of issue linkages and third-party intervention in influencing China-India outcomes

was found to be insignificant. India-Bangladesh, however, showed signs of evolutionary cooperation. Furthermore, geopolitical challenges have a greater bearing on China-India transboundary interaction, unlike India-Bangladesh interactions which are mostly shaped by domestic politics. The absence of economic interests and political willingness between China and India may make Brahmaputra cooperation difficult. There is a prediction of further deterioration of bilateral relations and no sincere trust-building in the immediate future. The presence of the same between India and Bangladesh, however, creates favourable conditions for Brahmaputra cooperation. Bhutan and India share a strictly dominant strategy of cooperation and are predicted to continue the same to reap greater benefits.

Broadly, the game theoretical analysis in this thesis concluded that strategies adopted by the basin riparians in transboundary water interaction reflect their strategic benefits and power dynamics. Positional advantage in the basin is a necessary condition for determining the vulnerability level of riparians to unilateral interventions by co-riparians but the sufficient conditions are economic capacity, military might, and ideational power. Regardless of geographical position, economic incentives motivate riparian cooperation, in the absence of which unilateral actions are preferred. Despite gains from cooperation, the self-maximising attitude of riparians leads to non-cooperative behaviour with sub-optimal benefits for the entire system. As an analytical framework, the main value addition of game theory is allowing the study of strategic interaction between power and information asymmetric riparians of a transboundary river basin. Transboundary rivers being inevitably an instrument of power and politics, management becomes challenging. Management is further complex in the South Asian context due to overlapping geopolitical rivalries and political tensions with growing water demands. As an innovative concept, benefit sharing can help overcome such complexities and aid in inclusive water management. The prerequisites are recognition of hydro-interdependencies, the presence of mutual trust, and political willingness for incremental water cooperation.

6.2 Policy Implications

This thesis revealed two signs of positive developments in the BRB. Given the existing and evolving bilateral cooperation between Bhutan-India and India-Bangladesh respectively, the prospects of sub-basin cooperation can be evaluated. This also answers the last research question of the third thesis objective. Considering China and India's reservations to multilateral cooperation (Pandey et al., 2020; Xie et al., 2017; Wouters & Chen, 2013), the riparians need to explore opportunities for sub-basin cooperation. India, Bhutan, and Bangladesh

collaboration can address the costs of non-cooperation emanating from inland water navigation and the hydropower sector (Swain & Karim, 2022). Indian and Bangladeshi respondents expressed faith and confidence in Bhutan's preference for trilateral cooperation, given the already existing Bhutan-India power cooperation and Bhutan-Bangladesh trade relations.

6.2.1 India-Bhutan-Bangladesh Hydropower Cooperation

Regional energy cooperation through exploiting untapped hydropower resources in South Asia is essential for energy security and climate change mitigation (Timilsina, 2021; Rasul et al., 2021; Haran, 2021). The prevailing power asymmetry, lack of scientific knowledge, and an inadequate understanding of future ecological threats in the BRB (He, 2021; Pradhan et al., 2021), might make the countries hesitant about sub-basin cooperation. As suggested by the respondents, tackling this requires incorporating the voices of the grassroots people impacted by dam developments during environmental assessments. Some level of political willingness is already visible between the three countries. Given its minimal hydropower generation capacity, the 7th FYP (2016-2020) of the Bangladesh government emphasized regional cooperation to ensure reliable electricity to its population³¹. Hydropower imports will be the best strategy for Bangladesh to meet rising electricity demand and reduce dependence on natural gas (Rahaman & Hossain, 2020). Bhutan's 12th FYP (2018–2023) also intends to enhance cooperation with other countries and strengthen engagement in international and regional frameworks³². Trilateral hydropower cooperation is one way for Bhutan to diversify its economic dependence on India (Sarki, 2019). With India's approval, the Dorjilung dam in Bhutan is planned for Bhutan-India-Bangladesh cross-border electricity interconnections and currently undergoing a discussion phase (Huda, 2022b). In 2023, India and Bhutan expressed their commitment to trilateral hydropower cooperation with Bangladesh for the mutual benefit of all (Correspondent, 2023b). Thus, hydropower cooperation will be the rational strategy for all three countries, ensuring environmental, economic, political, and catalytic benefits of regional integration through the creation of a regional electricity market.

6.2.2 India-Bangladesh-Bhutan Navigation

Landlocked Bhutan can trade with Bangladesh via Brahmaputra waterways, further benefiting Northeast India (Rasul et al., 2021; Suberi, 2020). Bhutan signed an MoU in 2017 with Bangladesh to enable waterways trade and transit using Chittagong and Mongla seaports. With the signing of this MoU, waterways have become the preferred routes for Bhutanese traders to

³¹<https://www.sasec.asia/index.php?page=bangladesh>

³²<https://www.sasec.asia/index.php?page=bhutan>

export high-demand boulders to Bangladesh via Assam, India since 2019 (Suberi, 2020). India, followed by Bangladesh is Bhutan's largest export partner³³. Bangladesh will also be able to strengthen its competitive advantage by exporting more readymade garments and other products through inland trade. Developments to boost AEP through waterway connectivity are underway in India. Nevertheless, several implementation and logistics challenges exist due to inadequate infrastructure, lobbies, and other bureaucratic hurdles CUTS, (2018). Besides, insufficient navigation depths due to heavy sedimentation in the Brahmaputra demands periodic dredging to ensure sustainable waterways (CUTS, 2017b; 2018b). However, unilateral dredging interventions might be economically unviable and environmentally destructive to the riverine ecosystem (Akhtar, 2017). Heavy traffic and underwater noise from navigation can reduce fish productivity and migration of the *Hilsa*, the national fish of Bangladesh, and the river dolphins found in the Brahmaputra. Hence, to overcome such implementation challenges, respondents emphasised the need for joint riparian actions to be able to reap the environmental and economic benefits of efficient and cost-effective trade, improved connectivity, and tourism. It will be especially beneficial for Bhutan which had dropped out of the BBIN-MVA due to its environmental reservations and apprehensions of open border. Moreover, waterway connectivity will boost India's Sagarmala Programme, an initiative to reduce the logistical costs of trade³⁴. Inland water navigation can, therefore, contribute to the green growth of economies.

Initiating cooperation through either hydropower or navigation will enhance trust and might lead to comprehensive sub-basin cooperation in both sectors. Game theory prescribes that over long-term interaction between the players, cooperation evolves as the basin-wide dominant strategy. Effective sub-basin cooperation might eventually induce China to join the coalition, even if with an observer status as in the Mekong River Commission. However, Indian and Bangladeshi respondents were sceptical about China joining on board, given its dominant attitude (I_{AC}, I_{MP}, B_{AC}, B_{EB}, B_{GO}). Even Chinese respondents confirmed China's continued non-cooperation with any downstream coalition but China would not refuse any technical support upon being requested by lower riparians (C_{AC}). As the basin's middle riparian, India is in an ideal position to demonstrate riparian leadership by commencing sub-basin cooperation with Bhutan and Bangladesh (I_{AC}, I_{GO}). This would boost India's global status as a responsible basin riparian. This is particularly pertinent for India to retain the trust and confidence of its close

³³<https://www.mof.gov.bt/publications/reports/bhutan-trade-statistics/>

³⁴<https://pib.gov.in/newsite/PrintRelease.aspx?relid=200158>

South Asian allies, given the simmering Sino-Indian geopolitical tensions. Under its 'Neighbourhood-First Policy', India's water and energy diplomacy holds significance for a better and secure future in South Asia.

6.3 Scope for Future Research

Based on the findings of this thesis, conducting benefit sharing assessment in the BRB can be recommended. A game theoretical analysis for cost-benefit allocation of the tangible payoffs can be explored to calculate outcomes for each country. Quantification of the payoffs might help in better convincing the players and may help to move towards cooperative arrangements. Besides, coalition games can be developed for analysing a more complicated 3-player game to examine sub-basin cooperation. This might be one of the ways forward for creating a Brahmaputra River Basin Organisation and can open avenues for future research. Furthermore, as this thesis during its data collection process found very few women engaged in transboundary water studies in South Asia, future research can revolve around the inclusion of women in transboundary decision-making and its implications. Moreover, the dynamic subject matter of the thesis itself leaves much scope for exploring upcoming scenarios in the BRB with evolving bilateral and water relations. Through the application of game theory, it would be interesting to see how players continue to behave with the incorporation of more options and moves. Finally, this research possesses methodological generalisability as it can be applied at different scales within other hydro-geopolitical contexts of transboundary river basins.

In conclusion, benefit sharing can establish sub-basin cooperation in the BRB. There is a need for dialogue platforms to enable transparent communication and trust-building among the BRB riparians. Resolving all transboundary challenges might be difficult but it is essential to leverage the commonalities for opening entry points of cooperation. Informal diplomacy including, academia, civil society, riverine communities, and media can play a significant role in eliminating riparians' misunderstandings and building strong people-to-people connections to inspire formal cooperation. This will lead to an all-inclusive and participatory transboundary river governance.

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Appendices

Table A1: Demographic and Socio-economic Profile of BRB Countries

Parameter	Bangladesh	Bhutan	China	India
Population (2022)	17.11 crores	7.82 lakhs	141.21 crores	141.71 crores
GDP (current US\$) (2022)	460.20 billion	2.54 billion	17.96 trillion	3.38 trillion
Poverty (% of population) (2017 PPP)	13.5 (2016)	0.9 (2017)	0.1 (2019)	10 (2019)
Access to improved water resources (Rural %) (2020)	98.0	97.0	90.0	89.0
Access to improved water resources (Urban %) (2020)	97.0	98.0	97.0	94.0
Access to electricity (Total %) (2020)	96.2	100.0	100.0	99.0
Access to electricity (Urban %) (2020)	97.8	100.0	100.0	100.0
Access to electricity (Rural %) (2020)	95.2	100.0	100.0	98.5
HDI Rank (2022)	129	127	79	132

Source: World Bank

Table A2: Background Information on BRB Countries

Parameter	Bangladesh	Bhutan	China	India
Agriculture (% of GDP) (2020)	12.6	15.8	7.7	18.3
Annual freshwater withdrawals, agriculture (% of total) (2020)	88	94	62	90
Annual freshwater withdrawals, industry (% of total) (2020)	2	1	18	2
Annual freshwater withdrawals, domestic use (% of total) (2020)	10	5	20	7
Annual total freshwater withdrawals (% of internal resources) (2020)	34	0	20	45
Electricity production from oil, gas & coal sources (% of total) (2015)	98.8	-	73.0	81.9

Electric power consumption, (kWh per capita) (2014)	317	-	3905	797
Energy imports, net (% of energy use) (2014)	17	-	15.02	34.31
Renewable electricity output (% of total) (2015)	1.23	99.99	23.93	15.34
Renewable energy consumption (% of total) (2019)	24.75	82.27	14.45	32.93
CO ₂ emissions (metric tons per capita) (2019)	0.5	1.4	7.6	1.8

Source: World Bank

Table A3: Types of Grey Literature

Government websites	Organisational websites	Reports	Media reports
Central Electricity Authority (CEA), India	World Bank	Statistical Yearbook of Bhutan	The Hindu, India
Department of Power, Government of Arunachal Pradesh, India	CUTS International	Bhutan Trade Statistics	The Times of India, India
Bangladesh Bureau of Statistics	NITI Aayog, India Energy Dashboard	National Transmission Grid Master Plan (NTGMP)	Hindustan Times, India
Ministry of Shipping, IWAI, India	International Campaign for Tibet	Assam Statistical Handbook	The Assam Tribune, India
Department of Hydropower & Power Systems (DHPS), Bhutan	South Asia Subregional Economic Cooperation (SASEC)	Bangladesh National Conservation Strategy	Dhaka Tribune, Bangladesh
Directorate of Inland Water Transport, Assam	FAO Aquastat	National Development and Reform Commission (NDRC), PRC	Daily Star, Bangladesh
Water Resources Department, Assam	International Union for Conservation of Nature (IUCN)		Kuensel, Bhutan
Bangladesh Inland Water Transport Authority (BIWTA)	International Hydropower Association (IHA)		People's Daily
North Eastern Electric Power Corporation (NEEPCO), India	Joint River Commission (JRC)		Global Times
National Hydroelectric Power Corporation (NHPC), India	South Asia Network on Dams, Rivers and People (SANDRP)		South China Morning Post, Hong Kong

Central Water Commission (CWC), India	Observer Research Foundation (ORF)		China Daily
China Institute of Water Resources and Hydropower Research	The Third Pole		Firstpost

Table A4: Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Literature type	Peer-reviewed journal (research articles)	Non-journal (reviews, reports), book, book chapters, conference proceedings
Language	English	Non-English
Timeline	Between 1969-2021	<1969
Content	Research articles focusing on BRB management, basin hydrogeopolitics and geopolitics, basic game theory solution concepts applied to benefit sharing for transboundary surface water management	Research articles focusing on dynamic optimisation, hydrological modelling, climate modelling, Graph Model Conflict Resolution (GMCR), meta-game analysis, fuzzy logic, simulations, groundwater management, water allocation, pollution, nexus trade-offs, inter-basin transfer

Table A5: Interview Questionnaire

<u>China</u>
<p>Part A: Profile of the respondent</p> <ol style="list-style-type: none"> 1. Would you like to tell us your name? (optional) 2. Where are you working and what is your area of work? 3. What are your specialisations? 4. When did you associate with the Brahmaputra River? What are your reasons for choosing this River? <p>Part B: BRB and the riparian relationship</p> <ol style="list-style-type: none"> 1. What are China's strategic interests in the Brahmaputra? 2. Do you think the benefits have been optimally utilized or there is a lot of untapped potential? 3. Is there a scope for regional integration through the sharing of the river benefits? 4. How would you define China's relationship with its co-riparians on the Brahmaputra? How are the relationships evolving and what is the current status? 5. Do you think China has done enough to garner riparians' confidence, being the major player in the BRB? 6. Are the gains from China's unilateral decisions higher? 7. What do you think is China missing out on in the absence of basin-wide cooperative development? 8. If there is a cooperative coalition amongst the other Brahmaputra riparian countries, how will China react? 9. What is China's expectation from the downstream countries so that it will induce cooperation? <p>Part C: China- India as BRB riparians- opportunities and challenges</p> <ol style="list-style-type: none"> 1. How do you see China's relationship with India on the Brahmaputra?

2. Do you think water can be a catalyst for cooperation between China and India?
3. How do you see this happening? What kind of challenges are involved and what are the main points of contestation between China and India?

Part D: Moving beyond water- issue-linkages

1. How is China expecting to be compensated by India to cooperate? Can improving trade relations or border consensus or India's support to the BRI project help?
2. Do you think water cooperation can bring peace dividends and settle matters on many other fronts? What kind of future do you perceive for China-India Brahmaputra River relations?

Bangladesh

Part A: Profile of the respondent

1. Would you like to tell us your name? (optional)
2. Where are you working and what is your area of work?
3. What are your specialisations?

Part B: BRB and the riparian relationship

1. How does Bangladesh see the Brahmaputra River and the benefits associated with the River?
2. Do you think the benefits have been optimally utilized or there are a lot of untapped potential?
3. Is there a scope for regional integration through the sharing of the river benefits?
4. How would you define Bangladesh's relationship with its co-riparians on the Brahmaputra? How are the relationships evolving and what is the current status?
5. How can Bangladesh, the most downstream riparian ensure that its interests are taken care of under any unilateral water intervention by upstream China and India? How do you see Bangladesh's role to induce China and India for joint development of the basin?
6. If China-India enters into a bilateral cooperation arrangement on the Brahmaputra, how will Bangladesh react? Will Bangladesh like to be a part of that treaty or how will Bangladesh negotiate with China and India?

Part C: India-Bangladesh as BRB riparians- opportunities and challenges

1. What according to you has sustained the fifty years of warm diplomatic relations between India and Bangladesh?
2. What do you think about the Ganges treaty and if Bangladesh decides to sign a treaty with India for the Brahmaputra what would it expect from India or what would Bangladesh like to negotiate for?
3. What do you perceive about India-Bangladesh relationship on the Brahmaputra? Is non-cooperation a strictly dominant strategy for both or only for one of them? Or, do you think they have a weakly dominant strategy, and given the incentives both players would like to cooperate?
4. Why is Bangladesh not approaching India for Brahmaputra cooperation? What are its concerns and expectations from India?
5. India claims that the construction of upstream multipurpose dams in the Brahmaputra will help Bangladesh in flood mitigation and disaster management. Does Bangladesh agree to this?
6. What role can India and Bangladesh jointly play to convince China of more transparency and accountability in sharing information given its unilateral decisions?

Part D: Moving beyond water- issue-linkages

1. What are your views on inland water navigation? Will it open further avenues of cooperation between India and Bangladesh? What are the challenges involved?
2. Can this form of cooperation be extended to include Bhutan?
3. Do you think climate change can create opportunities for Brahmaputra cooperation between India, Bhutan, and Bangladesh through the sharing of hydropower benefits?
4. In your opinion, can such a form of cooperation be a game-changer as they may together induce China to join on board for multilateral Brahmaputra cooperation?

India

Part A: Profile of the respondent

1. Would you like to tell us your name? (optional)
2. Where are you working and what is your area of work?
3. What are your specialisations?

Part B: BRB and the riparian relationship

1. How does India see the Brahmaputra River and the benefits associated with the River?
2. Do you think the benefits have been optimally utilized or there are a lot of untapped potential?
3. Is there a scope for regional integration through the sharing of the river benefits?
4. How would you define India's relationship with its co-riparians on the Brahmaputra? How are the relationships evolving and what is the current status?

Part C: India- China as BRB riparians- opportunities and challenges

1. How do you think India should react to what China is doing? Should India act unilaterally or initiate cooperative efforts?
2. What sort of compensating tactics can India adopt to incentivise China to cooperate? What are the options for issue linkages for India?
3. Do you agree that the China-India border consensus should precede any genuine water cooperation?
4. China feels that it is already shouldering much responsibility by unilaterally providing hydrological data to India at a much lesser cost but still being blamed, mostly by the media for diverting water or inducing a water war against India which further demotivates China. Do you agree with this?
5. What opportunities can India exploit by collaborating with Bhutan and Bangladesh? Why according to you India is not showing interest in that?
6. Given Xi and Modi's relatively aggressive foreign policy and also, their neighbourhood-first policy, how do you see the coming times?

Part D: India-Bangladesh as BRB riparians- opportunities and challenges

1. Do you agree that India is deliberately pursuing 'non-decision making' in the Brahmaputra with Bangladesh? Do you feel that this non-decision is a fair decision?
2. Why is India not approaching Bangladesh for cooperation in the Brahmaputra?
3. What are the challenges in developing inland water navigation between India and Bangladesh?
4. Do you see a possibility for trilateral cooperation between India, Bhutan and Bangladesh? Can such form of a cooperation induce China to join on board in the future?

Part E: India- Bhutan as BRB riparians- opportunities and challenges

1. Do you really see that the kind of cooperation that exists between Bhutan and India is sufficient? What can be done beyond this?
2. How will India react in the event of a diplomatic engagement between China and Bhutan? And how does China see the India-Bhutan relationship?

Part F: India- Assam- Arunachal Pradesh relationship in the Brahmaputra

1. How effective is China's data sharing on Brahmaputra water flow in addressing flood problems in Assam and Arunachal Pradesh?
2. Is there any water flow data sharing between Assam and Arunachal Pradesh?
3. What are the issues prevailing between the centre and the state concerning the Brahmaputra? What can be done beyond this?
4. The Brahmaputra being a transboundary river, do you think Assam and Arunachal Pradesh governments should be involved by the centre in decision-making with the other riparian national governments?

Table A6: List of Interviewees

Interviewees from China						
Code	Affiliation	Designation	Area/Interest	Date/Time	Platform	Recording
C01 AC	NTU, NUS, Singapore	Research Fellow	Transboundary resources of China, Food- water-energy security	10 Jan 2022, 11 AM(SGT)/ 8:30 AM (IST)	WebEx	Yes
C02 AC BD	Lee Kuan Yew School of Public Policy, National University of Singapore	Assistant Professor	Chinese politics and foreign policy, water disputes	24 Jan 2022, 4:30 PM(SGT)/ 2 PM (IST)	Zoom	Yes
C03 AC BD	Institute of International River and Eco-security/Asian International Rivers Center, Yunnan University, Kunming, China	Assistant Professor	International rivers, cross-border ecological security, cross-border water resource utilization, geo-cooperation	12 Feb 2022, 6 PM (CST)/ 3:30 PM (IST)	Zoom	No
C04 AC	Hainan Institute for World Watch, Haikou Shi, China	Assistant Professor	South Asian economy, politics, and diplomacy issues, transboundary waters, climate change, and energy	31 Aug 2022, 8:30 PM (CST)/6 PM (IST)	Zoom	No
C05 AC	Institute of Governance, Shandong University, China	Professor	Transboundary water management	5 Oct, 5 PM (CST)/ 2:30 PM (IST)	WebEx	No
Interviewees from Bangladesh						
Code	Affiliation	Designation	Area/Interest	Date/Time	Platform	Recording
B01 AC	Lee Kuan Yew School of Public Policy at the National University of Singapore	Senior Policy Officer	Energy cooperation in South Asia; regional issues around water	20 Jan 2022, 2 PM (SGT)/ 11:30AM (IST)	WebEx	Yes
B02 AC	Tufts University, USA	Professor	Water Diplomacy	28 Jan 2022, 9 AM (EST) / 7:30 PM (IST)	Zoom	Yes
B03 AC	Institute of Water and Flood Management, Bangladesh	Professor	Ecosystem based management, Disaster risk management,	2 Feb 2022. 12:30 PM (BDT) /	Zoom	No

BD	University of Engineering and Technology (BUET)		Climate change adaptation	12:00 PM (IST)		
B04 EB BD	Centre for Bay of Bengal Studies, Independent University, Bangladesh (IUB)	Director, Ambassador (Retd.) to the USA and the former High Commissioner to India	Diplomat	8 Feb 2022, 3:30 PM (BDT) / 3 PM (IST)	Zoom	Yes
B05 GO BD	Water Resources Planning Organization (WARPO), Ministry of Water Resources, Government of Bangladesh	Principal Scientific Officer (PSO)	Water Resources Management	22 Feb 2022	Mailed interview	NO
B06 GO	Center for Environmental and Geographic Information Services (CEGIS), Ministry of Water Resources, Government of Bangladesh; Member, National River Conservation Commission	Executive Director	Transboundary water Resources Planning and Management, Water resources engineering, Climate change studies, Information Technology	18 Oct 2022, 5:30 PM (BDT) / 5 PM (IST)	Zoom	Yes
B07 AC BD	Engineering Staff College Bangladesh (ESCB); Institute of Water Modelling (IWM); Bangladesh University of Engineering and Technology (BUET)	Rector Ex- Executive Director	Water Resources Management	27 Oct 2022	Mailed interview	NO
Interviewees from India						
Code	Affiliation	Designation	Area/Interest	Date/Time	Platform	Recording
I01 AC	IIT Roorkee, Adjunct Prof., Shiv Nadar University, Distinguished Prof.	Professor	River engineering, Concrete dams, Climate change, Watershed management and modelling, Inland navigation	3 May 2022, 1 PM (IST)	Zoom	Yes
I02 AC	(Retd.) HOD Dept. of Environmental Science, Gauhati University; John	Professor	Fluvial geomorphology of the Brahmaputra River, Geoinformatics	5 May 2022, 6:30 PM (IST)	Telephonic	Yes

	Hopkins University (USA)					
I03 AC	Department of Political Science, Cotton University	Associate Professor	International Relations, Borderland Studies and Transboundary Environmental Governance, Northeast India, Neighbourhood of South and Southeast Asian nations	22 June 2022, 11 AM (IST)	Physical	No
I04 AC	Centre for New Economic Diplomacy, Observer Research Foundation and ORF's Kolkata Centre	Director, Professor	Natural resource economics, Ecological economics, Water governance, International trade	28 June 2022, 3 PM (IST)	Zoom	Yes
I05 AC	Shiv Nadar University, India; International Relations and Governance Studies	Associate Professor	Chinese domestic politics, China-South Asia relations, Sino-Indian border areas	15 July 2022, 10:15 AM (IST)	Zoom	No
I06 MP	Senior Associate Editor, The Hindu	The Hindu, South East Asia correspondent	Foreign Affairs	20 July 2022, 11 AM (IST)	Zoom	No
I07 AC BD	Manohar Parrikar Institute for Defence Studies and Analyses	Research Fellow, commentator on transboundary water issues	Transboundary rivers, riverine neighbourhood, hydropolitics in South Asia, climate change and the Arctic	1 August 2022, 12 PM (IST)	Zoom	Yes
I08 AC	Manohar Parrikar Institute for Defence Studies and Analyses	Research Fellow and Centre Coordinator (Internal Security); co-opted as an expert by the National Security Council Secretariat (NSCS) as well as the Ministry of Home Affairs (MHA) on projects on Coastal Security	Border security and management, coastal security, drug trafficking, migration, India's Northeast, and India-Bangladesh relations	3 August 2022, 2:30 PM (IST)	Zoom	Yes
I09	Public Administration & Policy Department,	Senior Researcher	Transboundary water politics, Power, Climate	5 August 2022, 9:30 AM (IST)	Physical	Yes

AC	Wageningen University & Research, Netherlands; Institute for Environmental Sciences, University of Geneva, Switzerland		and disaster Governance, Environmental management			
I10 GO	Water Resources Department, Irrigation Department, Govt. of Assam, India	Chief Engineer (Retd.)	River engineering, Flood and river bank erosion management of Assam	13 September 2022	Mailed interview	No
I11 AC	Centre for Policy Research, New Delhi	Geostrategist, Professor Emeritus, Columnist	International security, Geostrategic affairs	15 September 2022, 2 PM (IST)	Zoom	Yes
I12 GO BD	Assam State Disaster Management Authority, Govt. of Assam, India	GIS Expert	Disaster Management	1 October 2022	Mailed interview	No
I13 GO BD	Water Resources Department, Govt. of Arunachal Pradesh, India	Chief Engineer	Planning and Design	7 October 2022	Mailed interview	No
I14 MP BD	The Third Pole, Delhi, India	South Asia Director	Environmental journalist	13 October 2022	Zoom	Yes
I15 EB	Indian Foreign Service; Symbiosis International University, Pune	Former Indian Ambassador to China (2017-18) & Bhutan (2014-15), Former Indian High Commissioner to Pakistan (2016-17); Distinguished Professor	Diplomat IFS	17 October 2022	Mailed interview	No
I16 AC	Institute of Chinese Studies (ICS), New Delhi	Visiting Research Associate	Border studies in Northeast India and trans-boundary water sharing and management issues between China, India and Bangladesh	28 October 2022	Zoom	Yes
I17 GO	Central Water Commission	Ex-Chairman	Water Resources Management	30 October 2022	Zoom	Yes

I18 GO	Water Resources Department, Govt. of Assam, India	Chief Engineer (Retd.)	Water Resources Management	6 November 2022	Mailed interview	No
T01 AC	Tibet Policy Institute, Dharamshala, India	Research Fellow	Tibet's Transboundary rivers, China's strategic interest in Mekong and Brahmaputra	14 July 2022, 11:30 AM (IST)	Zoom	Yes
T02 AC	Tibet Third Pole-International Tibet Network, Dharamshala, India	Campaign and Research Assistant	International relations, China studies-environment and geopolitics, Tibet's Transboundary rivers	2 Aug 2022, 3:30 PM (IST)	Zoom	Yes

Table A7: Benefits of Water Cooperation

Type of benefit	Challenge	Opportunities
Ecological: Increasing benefits to the river	Degraded water quality, watersheds, wetlands, and biodiversity	Improved water quality, river flow characteristics, soil conservation, biodiversity, sustainable development
Economic: Increasing benefits from the river	Increasing demands for water, suboptimal water resources management and development	Improved water resources management for hydropower and agricultural production, flood-drought management, navigation, environmental conservation, water quality, and recreation; reduced economic impacts of water-related hazards
Political: Reducing costs because of the river	Tense regional relations and political economy impacts	Policy shift to cooperation and development, away from dispute/conflict; from food (and energy) self-sufficiency to food (and energy) security; reduced dispute/conflict risk and military expenditure
Catalytic: Increasing benefits beyond the river	Regional fragmentation	Integration of regional infrastructure, markets and trade, peace and security, international reputation, climate action

Source: Adapted from Sadoff & Grey, (2002) and IUCN (2020)

Accomplishments

Referred Journals:

1. Baruah, T., Barua, A., & Vij, S. (2022). Hydropolitics intertwined with geopolitics in the Brahmaputra River Basin. *WIREs Water*. <https://doi.org/10.1002/wat2.1626>

Conference / Seminar:

1. Presented paper on “*Role of India’s National Waterway-2 in Act East Policy-driven Development: Analysing the Strategic Payoffs*” at the 24th Annual Conference of North Eastern Economic Association (NEEA), organized by the Department of Economics, SB Deorah College, Guwahati, 9-10 February 2024 and won the Best Paper Award.
2. Presented in the IHE Delft Ph.D. Symposium 2023 on “The Triple Planetary Crisis: Climate Change, Biodiversity Loss & Pollution”, 19 October 2023 (online).
3. Presented paper on “*Brahmaputra River Basin Cooperation and Sustainable Development: Realising the Opportunity*” in the International Conference on Sustainability: An Ancient Indian Approach organized by MCHV, IIM Calcutta, 11-12 August 2023.
4. Presented paper on “*Viewing the Brahmaputra as a Connectivity Corridor for Green Economy: A Game Theoretical Perspective*” in the National Seminar organized by Department of Economics, Gauhati University, 25 March 2023.
5. Presented paper on “*Brahmaputra River Basin Cooperation through Benefit Sharing: A Game Theoretic Approach*” in the 15th Doctoral Thesis Virtual Conference, organized by IBS Hyderabad, 29-30 November 2022.
6. Presented paper on “*Factoring Trust in India-Bhutan Economic Development: A Game Theoretical Study*” at the 23rd Annual Conference of North Eastern Economic Association (NEEA), organized by the Department of Economics, Tripura University, Tripura, 16-18 November 2022 and won the Best Paper Award.
7. Presented paper on “*Brahmaputra River Basin Cooperation Through Benefit Sharing: A Game Theoretic Approach*” in UPWCD (Universities Partnership for Water Cooperation and Diplomacy) Early Career Scholars Network, 7-8 July 2021 (online).

Workshops:

1. Completed the workshop on “Research Methodology for Economics and other Social Sciences”, organized by the Department of Economics, Cotton University under the sponsorship of ICSSR-NERC, Shillong, 1-7 July 2022.
2. Completed the workshop on “Game Theory & Global Commons” conducted by Global Policy Insights & Envipol in partnership with IIT Guwahati, 20 April 2022.
3. Completed the Capacity building workshop on “Application of Game Theory”, organized by the Department of Economics, Gauhati University under UGC-SAP-DRS-II, 28 March 2022.

4. Completed the online summer crash course on “Ecological and Feminist Macroeconomics” conducted by the School of Economics, University of Barcelona, 12-16 July 2021.
5. Participated in the International Webinar series on "Hydro-Diplomacy", organised by the Indian Institute of Technology Guwahati (IITG) in partnership with the 'Universities Partnership, 18 September – 2 November 2020.

MOOCS:

1. Completed NPTEL-AICTE 12-week course: “*Qualitative Research Methods and Research Writing*” (Funded by the Ministry of HRD, Govt. of India), coordinated by IIT Madras and course offered by IIT Kharagpur, with a score of 71%, Jan-April, 2021.
2. Completed NPTEL-AICTE 4-week course: “*Water, Society and Sustainability*” (Funded by the Ministry of HRD, Govt. of India), coordinated by IIT Madras and course offered by IIT Kharagpur, and topped the course with a score of 85%, Sep-Oct, 2020.
3. Completed Coursera 4-week course: “*Welcome to Game Theory*” offered by the University of Tokyo, with a score of 78.57%, July 2020.

