TRANSBOUNDARY IMPLICATIONS OF DAMMING RIVER BRAHMAPUTRA AND RESPONSE OF INDIAN GOVERNMENT

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By

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DECLARATION

I declare that the dissertation entitled “TRANSBOUNDARY IMPLICATIONS OF DAMMING RIVER BRAHMAPUTRA AND RESPONSE OF INDIAN GOVERNMENT” has been prepared by me under the guidance of Dr. Kiran K. Singh, Assistant Professor, Centre for South and Central Asian Studies, School of Global Relations, Central University of Punjab.

No part of this dissertation has formed the basis for the award of any degree or fellowship previously.

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CERTIFICATE

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ABSTRACT

Transboundary Implications of Damming River Brahmaputra and Response of Indian Government

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Rivers play an important role in the lives of the people. Rivers provide water for irrigation, potable drinking water, cheap transportation, electricity, as well as livelihoods for a large number of people. On one hand river is source of livelihood but on another it is also a source of conflict. When it is shared by two states or two nations it may raise tension on the water sharing issues. The depleting water resource, pollution and unequal regional distribution are some of the factors that pose challenge to handling such issues. When it is International River it may cause severe conflict and hence nations try to resolve the issue through treaties and agreement. Brahmaputra is one of the mighty rivers with its headwaters in Tibet. Brahmaputra has a high potential of hydropower and is one of the untapped rivers originating on the Tibetan plateau. But now the two growing economies and riparian countries i.e. India and China have proposed a large number of dams to be constructed on the river. There is a huge plan of construction work but there is an absence of any treaty between these two countries. China's dam policy has raised severe concern for the downstream countries. This study is an attempt to highlight the trans-boundary implications of the dams, how damming of the river will impact a huge proportion of world population living downstream, how it will change the river-scape and also the local environment and what is the response of lower riparian countries i.e., India. The study revolves around three objectives; To analyse the current water situation of India and China; To analyse the Impact of damming and diverting the Brahmaputra river for India; To analyse the Indian

government response on the dam construction by China on river Brahmaputra. The study is being done through consulting primary as well as secondary sources of data like, reports of Ministry of Water Resource of India, Central Electricity Authority, various related books, articles, research papers and newspapers.

Mohd. Hussain Naik Dr. Kiran K. Singh

Dedicated to the Marginalized Classes of the South Asian Region

Acknowledgement

Gratitude is the attitude of mind and heart. I owe my gratitude to the Almighty Allah for His mercy and magnanimity and who gave me courage to carry out this work.

I have accumulated a large number of debts in preparing this work. While a brief acknowledgement here in no way writes them off, it is a small courtesy whose sentiments are sincere.

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Mohd. Hussain Naik

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Serial no.	Full Form	Abbreviation
1	Affected Citizens of Teesta	ACT
2	Asian Development Bank	ADB
3	China Civil Engineering Society	CCES
4	Communist Party of China	CPC
5	Environmental Impact Assessment	EIA
6	Expert Level Mechanism	ELM
7	Environmental News Service	ENS
8	Foreign Direct Investment	FDI
9	Flood Plain	FP
10	Five Year Plan	FYP
11	Ganga-Brahmaputra-Meghna	GBM
12	General Circulation Model	GCM
13	Green House Gas	GHG
14	Geographical Information System	GIS
15	Giga Watt	GW
16	Himalayan Belt	HB
17	Installed Capacity	IC
18	Institute for Defence Studies and Analysis	IDSA
19	Institute of Peace and Conflict Studies	IPCS
20	Indian Space Research Organisation	ISRO

21	Krishak Mukti Sangram Samiti	KMSS
22	Kilowatt hour	Kwh
23	Meters Above Sea Level	MASL
24	Memorandum of Understanding	MoU
25	Mega Watt	MW
26	Ministry of Water Resources	MWR
27	National Technical Research Organisation	NTRO
28	Organisation for Economic Co-operation and Development	OECD
29	People's Republic of China	PRC
30	River Basin Commission	RBC
31	Reservoir Induced Seismicity	RIS
32	South Asia Network on Dams, Rivers and People	SANDRP
33	Tibet Autonomous Region	TAR
34	Tibetan Plateau	TP
35	Tunnel and Underground Works Branch	TUWB
36	Upper Brahmaputra River Basin	UBRB
37	World Commission on Dams	WCD

Chapter 1

Introduction and the Area of Study

1 Introduction

Water is an important resource as there is no substitute for water. It is central to all aspects of life ranging from agriculture to domestic to industry etc. It is a renewable but a finite resource. Around the world, human water use exceeds sustainable levels. The global hydrological cycle annually makes available several times more fresh water than is needed to sustain the current world population of about seven billion people. But this resource is not evenly distributed in time and space and much of it is inaccessible for human use (Postel, 2000). The countries like India and China with huge population size are facing water shortages in populated areas. Although these countries have enough water resources in the form of rainfall, springs, streams, glaciers etc. But as mentioned earlier like any other part of the world, water varies temporally as well as spatially in China as well as in India also.

China's southern part is abundant in water resources but has very less population while northern parts are highly populous but are facing water shortages. In order to deal with the water shortages in the populated areas, China has dammed its rivers and is now focussing on the untapped rivers like Brahmaputra and Mekong descending down from Tibetan plateau. China has also started a water diversion project commonly known as South-North Water Diversion Project to divert water from the water surplus Yangtze and Mekong rivers in the south to yellow river basin in north (International Rivers, 2013). South-North Water diversion project has three routes: eastern route, central route and western route. First stage of the eastern route has started the water supply to the provinces of Jiangsu, Anhui and Shandong in 2013. Middle route is expected to supply water to Beijing from this year i.e. 2014. The western route is still in planning stage. This route is controversial as it is going to divert water from the Tibetan rivers. (Wang, 2013). The damming and diversion of Tibetan rivers will have very negative impacts on the lower riparian states as well as on the ecosystems.

China is an important player in the international arena as it controls the Asia's water tower i.e. Tibet. Tibetan plateau is the source of Asia's ten major rivers. Its

waters flow down to eleven countries and are said to bring fresh water to over 85 percent of Asia's population and approximately 50 percent of the world's population (Arpi, 2008). It is therefore imperative for the policy makers of the riparian countries to be aware of the Chinese actions and their potential consequences on their countries as China's usable water resources are declining. China will employ more proactive policies to address these shortages (Williams, 2013).

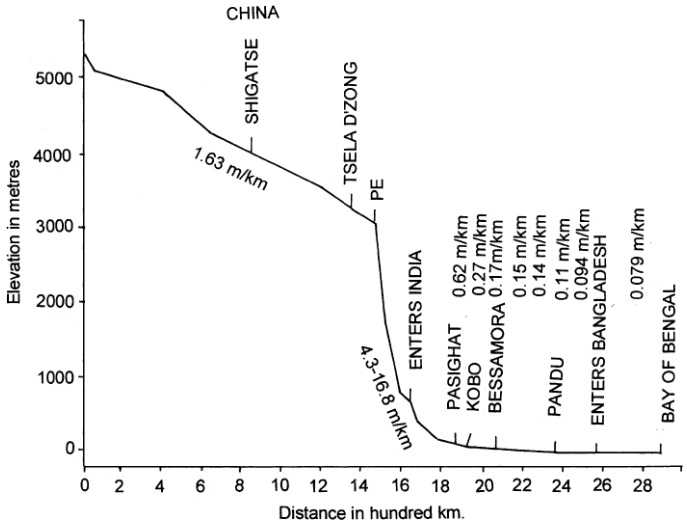
Out of ten major rivers of the world four rivers viz. the Brahmaputra (or Yarlung Tsangpo as it is known in Tibet), the Yangtze, the Mekong and the Huang Ho (or Yellow River) have their origin on the Tibetan Plateau. Brahmaputra is the largest river on the Tibetan plateau, originating from Angsi glacier near Mt Kailash at an altitude of about 5300 m a s l. It is considered to be the highest river on earth with an average altitude of 4,000 meters. It runs for about 1625 kms parallel to the Himalayan range in Tibet before flowing into India. It takes the sharp U turn known as the great bend at the proximity of Mt. Namcha Barwa (7,782 meters) near the Indian border and enters India. Brahmaputra is the lifeline of people of north-east India and Bangladesh, but China has started construction of hydropower projects on the middle reaches of Brahmaputra and is planning to construct the world's largest hydroelectric power project with a capacity of about 38,000 MW and diversion of the water to the north to feed the arid north western region and Yellow river basin (Watts, 2010). If the diversion happens it will divert 200 billion m^3 of water to the north and will cause water shortages in India and Bangladesh (Williams, 2013). The issue of damming and diversion of Brahmaputra by China has evoked a lot of concern in India and has been taken up by New Delhi with Beijing. In 2010 Indian External Affairs Minister S M Krishna was assured by His Chinese counterpart that the dam it was building on the Brahmaputra would not affect the flow of the Brahmaputra. But China's reluctance to share information and absence of water sharing agreement between India and China is a major concern for India (Malhotra, 2010). Another issue is that China can use its upper riparian advantage to control the water resources to India and as such can be a potential non-traditional weapon against India. The construction of dams and water diversion projects will also lead to the many environmental and geological risks in the region like earthquakes and pollution (Tsering, 2011).

1.1 Brahmaputra Basin

Brahmaputra basin covers four countries and drains an area of around 5,30,000 km^2, with China covering 50.5% of the total catchment area, India covering 33.6%, Bangladesh covering 8.1% and Bhutan covering 7.8%. In India the Brahmaputra Basin covers the states of Arunachal Pradesh, Assam, Nagaland, Meghalaya and West Bengal and Sikkim and drains an area of 1,94,413 km^2 (Mahanta, 2006) Average discharge of the Brahmaputra is approximately 20,000 $m^3 s^{-1}$ (Immerzeel, 2008). Average annual runoff at Pasighat and Pandu in India are 1,86,290 and 4,94,357 million m^3 respectively.

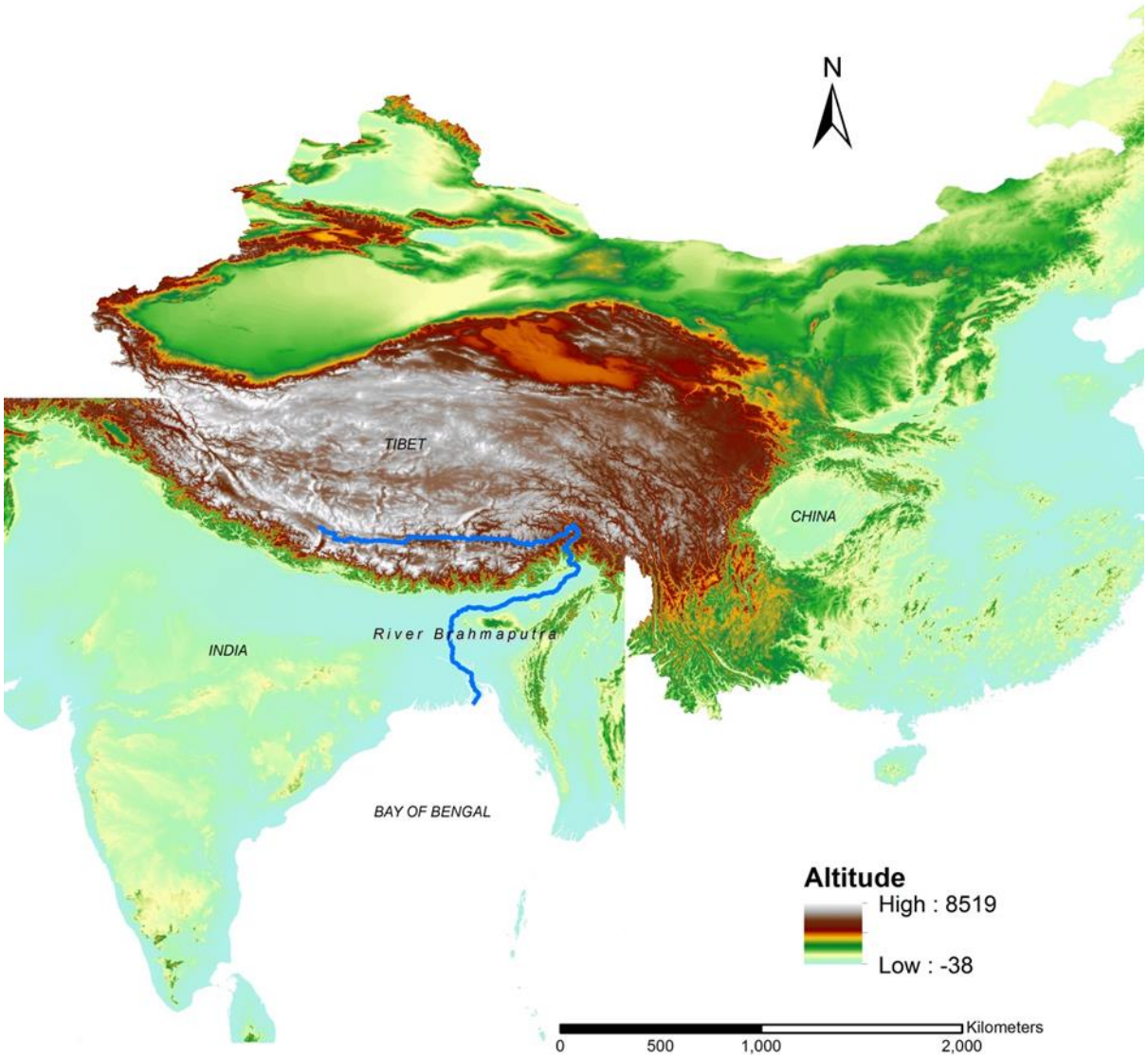
The climate of the basin is monsoon driven with a distinct wet season from May to September, which accounts for 60–70% of the annual rainfall. Annual rainfall in the Brahmaputra basin varies from 400 mm to 6,000 mm with an average rainfall of 2300 mm. Immerzeel (2008) categorized the Brahmaputra basin into three different physiographic zones: Tibetan Plateau (TP), Himalayan belt (HB), and the floodplain (FP). These zones respond differently to the anticipated climate change. The TP covers 44.4% of the basin, with elevations of 3500 m and above, whereas, HB covers 28.6% of the basin with elevations ranging from 100 m a s l to 3500 m a s l. The area with an elevation of less than 100 m a s l is considered as FP and comprises about 27% of the entire basin.

Figure 1: Longitudinal Profile of Brahmaputra River



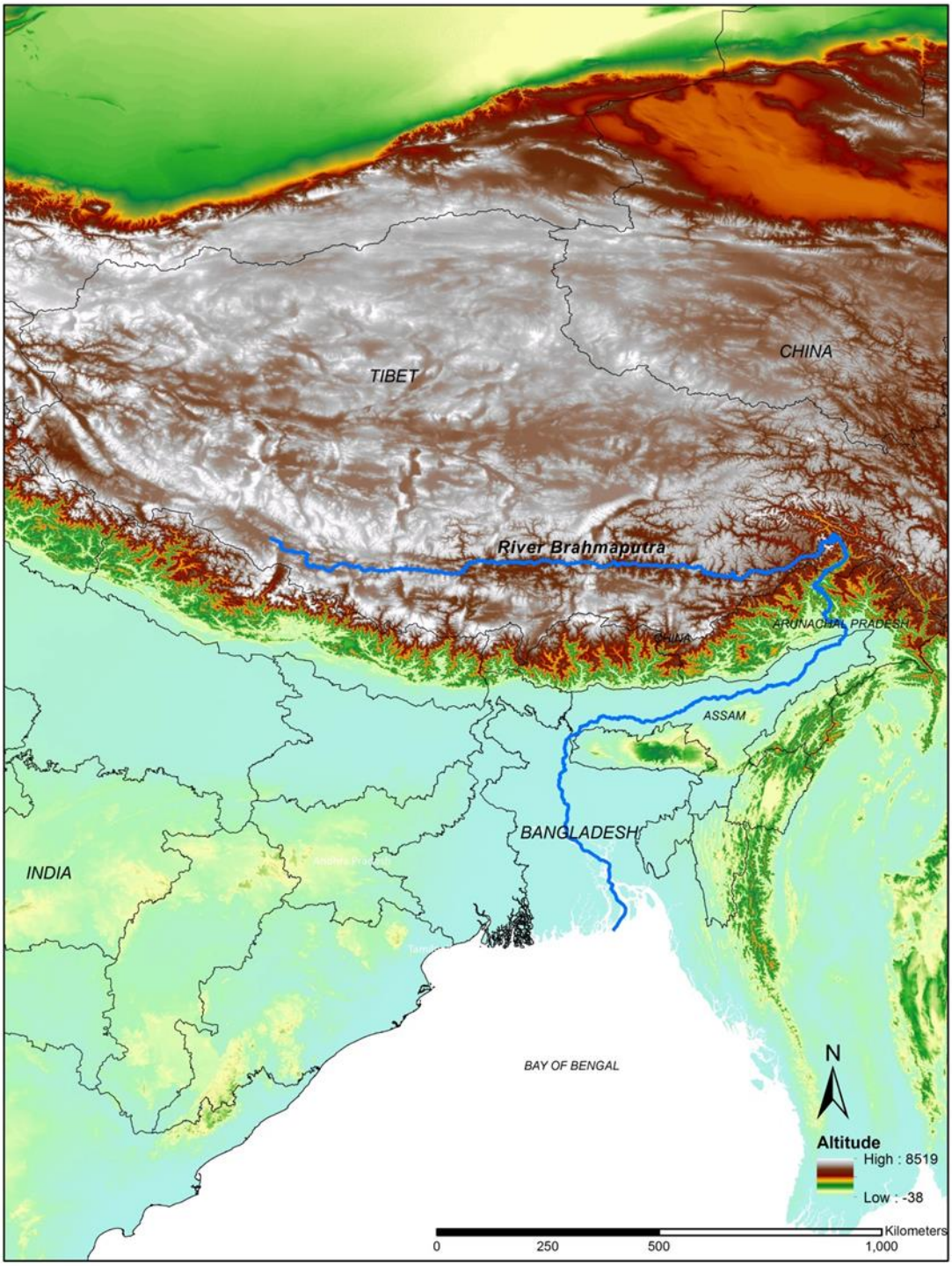
Source: Sarma, 1993.

Figure 2: Map Showing the Study Area and course of Brahmaputra River (the river is overlaid on Digital Elevation Models of China and India.



Courtesy: GIS, Central University of Punjab, Bathinda (November, 2013).

Figure 3: Brahmaputra River flows in three countries (China, India and Bangladesh).



Courtesy: GIS, Central University of Punjab, Bathinda (November, 2013).

The major discharge measuring station of the lower Brahmaputra is in Bahadurabad (Bangladesh). This is the only station in the lower Brahmaputra for which long-term observed records are available through the Bangladesh Water Development Board. The data are of high quality and are used in major hydrological studies for flood forecasting and other planning purposes.

1.1.1 Features of Brahmaputra Basin

Against the India's annual national per capita water availability of 2208 m^3, Barak and Brahmaputra rivers have an average annual per capita availability of 16589 m^3 and average water availability per hectare is 44,180 m^3. Brahmaputra basin is the least developed river basin in India in terms of water resources utilisation (Mahanta, 2013). The basin has a ground and surface water storage potential of 88.01km^3 and an average annual sediment load of about 735 million metric tonnes (Datta and Singh 2004). Groundwater abstraction ratio is 4%, which is lowest among river basins of India (Amarasinghe, 2005). The basin is highly influenced by extreme monsoon rainfall and flooding (Mirza 2002; Warrick et al. 1996) and a specific flood discharge of 0.149m^3/sec/km^2 (Datta and Singh 2004).

1.1.2 Current water demand in Brahmaputra Basin in India

Largest water demand in the basin is from agricultural sector. Out of total water withdrawals of 9.9 km^3, irrigation accounts for 81% and overall irrigation efficiency[1] is 32% and rest is lost through various processes like evapotranspiration from irrigation fields, water withdrawal for domestic and industrial purposes etc. (Mahanta, 2006). Total estimated utilizable water resources in the basin are 59.07 Km^3, out of which 24 Km^3 are surface water and 35.07 Km^3 are groundwater. But so far only 4% has been utilized, due to topographical constraints and spatio-temporal variability (Gaur and Amerasinghe, 2011). Annual potential evapotranspiration is 1,144 mm which is lowest among the river basins in India (Amarasinghe, 2005). Environmental flow requirement in the Brahmaputra Basin is 27% of the renewable water resources (Smakhtin et al, 2004).

[1] The ratio between irrigation water actually utilized by growing crops and water diverted from a source (as a stream) in order to supply such irrigation water (Meriam Webstar Dictionary).

1.1.3 Future Water Demand in Brahmaputra Basin in India

Gross domestic water requirement for meeting domestic, industrial, livestock, and agricultural demands by 2050 is projected to be 62.4 bcm (Mohile, 2001). Total water requirement for 3.70 million hectare irrigable area would be 52 billion m^3 out of which 35.15 billion m^3 would be met from surface water and 16.93 billion m^3 from ground water. With 11% development of water resources, Brahmaputra Basin is least developed basin in terms of water utilisation.

1.2 Objectives

This study has already revealed its aim in the previous pages and will go on with the following objectives:

i. To study the water resources and hydropolitics of China.
ii. To analyse the impact of damming and diverting the Brahmaputra river for downstream countries.
iii. To analyse the response of Indian Government on the dam construction by China on River Brahmaputra.

1.3 Data Sources

The study is based on the primary as well as secondary sources of data. The primary sources from which the data has been collected include experts' opinion through online survey by circulating questionnaire and personal/phone contacts with the resource persons, annual reports of Ministry of External Affairs, statements of Prime Minister's Office and press release by the Press Information Bureau and various newspapers. The secondary sources which have been referred include books, reports, articles of different think tanks like IPCS, IDSA, research articles published in different national and international journals, magazines, various reports and articles published by different organizations working on environmental protection especially in the Himalayas like KMSS, SANDRP, Kalpavriksh, Affected Citizens of Teesta (ACT) Sikkim, Aaranyak, International Rivers etc.

1.4 Methodology

A thorough literature survey has been carried out to conduct this study. After collection of literature, information was segregated into three different sections for

analysis like China's water scarcity and hydro politics, India's water resources development in north east and its local as well as trans boundary impacts of damming Brahmaputra and the response of the Indian government which is mostly based on the media reportage. The newspapers have been reviewed since November 2010 when the issue of damming Brahmaputra River by China was picked up by Indian media from the international media. The newspapers which have been reviewed include 'The Hindu', 'The Economic Times' and 'Times of India' from India, 'China Daily' from China and 'The Guardian' from UK. One local newspaper 'The Assam Tribune' of northeast India was also thoroughly studied. After collection of related news which surfaced from time to time have been collected, they have been arranged in a chronological order for the better understanding of the events taking place, so that the issue could be understood in an easy way and the collected information had also been helpful in understanding the China's behaviour with regard to the transboundary issues with its neighbours in general and behaviour regarding the sharing of information on its transboundary rivers in particular. A set of questions were also prepared and sent to the experts of this area through email. Mails were sent to 50 experts (from India and China) but only 4 responses were received. Response of these experts brought more clarity to this issue and helped a lot in carrying out this study.

Literature collection was followed by interpretation and compilation. While interpreting the data, the overall perspective of the study has been kept in mind. The study has been carried out by assessing China's water situation and its potential transboundary implications. India's and China's current water situation has been examined to determine the extent and severity of their water problems. The recent measures taken by the Chinese government to address water related issues have also been examined to determine the effects, or intended effects, these policies could have on the lower riparian states especially India. The causal implications that these policies may have and how India has been reacting in response to China's actions has also been examined.

Vector data of Diva GIS portal has been used for preparing the maps of study area using ArcGIS software. The course of the Brahmaputra River has been digitized using Google Earth as base map zooming it to an altitude of 4.92 kms as some stretches of the river course were covered by coarse resolution imageries.

1.5 Knowledge Gap

The literature available on the issue has so far looked into social, economic and environmental issues of damming the river. No study has looked into the response of Indian government regarding the damming of river Brahmaputra by China. This study will contribute a bit by looking into the response of Indian government on the damming of river Brahmaputra.

Chapter 2

Literature Review

Some 261 of the world's rivers are shared by two or more countries. These international watersheds account for about 60 percent of the world's freshwater supply and are home to approximately 40 percent of the world's people. The water conflicts are not a contemporary phenomenon but we have historical examples of water conflicts dating as far back as 3000 BC e.g. the conflict between Ea and Noah, Lagash and Umma (2500 BC) etc. (Gleick, 2008). Despite the absence of full-scale water wars till date, unresolved tensions over water have persistently irritated relations, fuelled other hostilities, and occasionally led to military action that risked provoking a larger conflict e.g. in May 1943 British Royal Air Forces bombed dams on the Mohne, Sorpe and Elder rivers in Germany, which is believed to be one of the causes for the downfall of Germany (Gleick, 2008). It is rather that unilateral actions to construct a dam or river diversion in the absence of a treaty or institutional mechanism that safeguards the interests of other countries in the basin is highly destabilizing a region, often spurring decades of hostility before cooperation is pursued. In other words, the red flag for water-related tension between countries is not water stress per se (as is the case within countries), but rather a unilateral attempt to develop an international river, usually by a regional power. Similar scenarios have unfolded in a number of other river basins. India unilaterally constructed a barrage during the 1960s and early 1970s on the Ganges River at Farakka, near the border with Bangladesh, in order to channel more river water to the port of Calcutta. This diversion left Bangladesh with significantly less water for irrigation during the dry season (Postel and Wolf, 2001). A 20-year period of intermittent hostility and instability ensued, including increased migration of desperate Bangladeshis across the border to India.

These conflicts share a common trajectory: unilateral construction of a big dam or other development project, leading to a protracted period of regional insecurity and hostility, typically followed by a long and arduous process of dispute resolution. A two-year study of conflict and cooperation within international river basins by researchers at Oregon State University found that the likelihood of conflict increases significantly whenever two factors come into play. The first is that some large or rapid change occurs in the basin's physical setting (typically the

construction of a dam, river diversion, or irrigation scheme) or in its political setting, especially the breakup of a nation that results in new international rivers. Secondly, existing institutions are unable to absorb and effectively manage that change i.e. absence of a water sharing treaty or cooperation between the riparian nations (Wolf, 2007).

Similarly China has started harnessing the hydropower potential of river Brahmaputra or Yarlung Tsangpo as it is known in Tibet unilaterally and started construction of dams on the river without informing India. China informed India only after starting the construction work on one of its projects viz. Zangmu on the middle reaches of Brahmaputra in November 2010. In January 2013 China approved three more projects for construction on the middle reaches of Brahmaputra.

There is a plethora of literature available on China and its water resources but few papers have looked into the china's water situation and its international implications especially on India. The paucity of literature is because the issue (damming of Brahmaputra by China) is relatively contemporary which came to light only after China started construction of a dam on the middle reaches of Brahmaputra. However there are various articles, newspaper reports and blogs which have focussed on the issue. Holslag (2011) in his paper "Assessing the Sino-Indian Water Dispute" has highlighted various reasons that complicate the coordination and cooperation between India and China like water shortages in china, recognition of water as a matter of national security by both Indian and Chinese authorities. The author has also highlighted the ambition of influential hydropower and construction companies to setup more hydropower projects in Tibet. The engineers and companies are confident that they can overcome the technical problems associated with major diversion projects. The author has also highlighted the views of various Chinese scholars on the damming and diversion of Brahmaputra River. The scholars have asserted that New Delhi has no legitimacy to demand China's restraint, because India itself uses large volumes of water otherwise destined for Bangladesh and Pakistan. Bhattarai (2009) in his article "An Analysis of Transboundary Water Resources: A Case Study of River Brahmaputra" has explored the three major trans-boundary issues that need to be addressed in the whole Brahmaputra river basin. These issues are sharing of

water resources, sharing of basic data and information and protection and preservation of ecosystem. The author also gave the reasons for selecting the above mentioned three issues like sharing of water resources improve the lives of millions of people by exploiting the said resource. Sharing of data can save thousands of lives and property which are damaged due to the flooding of Brahmaputra and its tributaries. Construction of dams and water diversions can impact the hydrology of freshwater systems; disconnect rivers from floodplains and wetlands etc. which can affect the seasonal flow and sediment transport of rivers downstream, impact on fish migrations and changing the composition of riparian ecosystems. The author has also analysed the past controversial legal issues between the riparian nations which has prompted the scope for integrated management approach to the Brahmaputra river basin. A critical analysis was also made by the author to understand the principles, approaches and instruments to address the above problems like engagement of third party like United Nations etc. Arpi (2008) in his article “Himalayan Rivers: Geoplitics and Strategic Perspectives” has highlighted the strategic importance of Tibetan waters as it is the principal watershed of Asia because Asia’s major rivers have their origin in Tibet. The author has highlighted the importance of Brahmaputra in the context of India and Bangladesh as millions of people depend on the river for their livelihood. The author has pointed out the enormity of the projects like the construction of world’s largest hydroelectric dam and diversion project for South Asia in general and India in particular. Williams (2013) in her essay, “The International Implications of China’s Water Policies”, examine the government’s policies with regard to conservation and managment of water resources and assess their international implications. The author has examined the China’s forign policy with America and India because America being the sole super power of the world and India the other emerging power of the region. The author has highlighted the China’s water problems like inadequate portable water, unequal distribution of water rersources, pollution etc. and their negative impacts on industry, agriculture etc. The author has paid due attention to various Chinese policies that directly look at tackling the water, water cricis and water conservation which are clearly reflected in the China’s 12th five year plan, South North Water Diversion Project and dam construction on various international rivers. The author has also highlighted its potentional international impacts which can lead to rising tensions between China

and its neighbours. The author mainly focused on the dam construction and water diversion project on Yarlung Tsangpo or Brahmaputra River as it will significantly reduce the water flow to the downstream India and Bangladesh.

Rahaman & Varis (2009) in their paper "Integrated Water Management of Brahmaputra Basin: Perspectives and Hope for Regional Development" have analysed the status of Brahmaputra water resources. They analysed the benefits of integrated water management and development and also categorised the benefits into four categories i.e. ecological, economic, political and catalytic. They have analysed the country wise drainage area of brahmaptra basin and also the hydro power potential in each county in the Brahmaputra basin. The authors have highligted the perspectives of each country regarding the Brahmaputra basin water resources like in case of Bangladesh, two barrages were constructed by Bangladesh; one across the Brahmaputra and other across the Ganges and a link canal between the two to transfer water from Brahmaputra and Ganges to water deficit areas. Similarly India advocated the inter-linking of rivers project to transfer the surplus water from Brahmaputra basin to the Ganges basin during the peak flow season. China like India also proposed a water diversion project commonly known as South North water Diversion Project. The authors in this paper have also highlighted the hydropower potential of Brahmaputra basin in all the countries falling within it. They also gave suggestions like sharing of hydrometeorologial, physical and environmental data but did not put forward the mechanism with which it can be achieved. This paper also analysed the absence of integrated management of water resources in the Brahamaputra basin due to lack of coordination or water treaty among the riparian states which includes three South Asian and one East Asian country. This paper has highlighted the macro level transboundary issues like the South-North Water Transfer Project and Peaceful Nuclear Explosions but did not touch the micro level issues like social, economic and environmental impacts.

Salehin et al. (2011) in their paper "Opportunities for Transboundary Water Sharing in the Ganges, The Brahmaputra and the Meghna Basins" have highlighted the water resource management issues in countries falling within the Ganga-Brahmaputra- Meghna basins like, variation between peak and low flow periods which causes various problems like flooding during the peak flow period

and water scarcity during the lean period in countries like India and Bangladesh. In Bhutan the problem includes increasing pressure on the water resources due to increasing demands from dfferent sectors, temporal and spatial variation of flows between peak and low flow seasons. The authors in this paper have also highlighted different policies and plans adopted by different countries for the development and management of water resources in the basin in their respective countries. This paper has focussed on different bilateral treaties signed by various countries in the basin like Mahakali treaty between Nepal and India, Ganges Water treaty between India and Bangladesh etc. The paper also highlighted National River Linking Project in India and North South Water Diversion Project in China from water surplus areas to water deficit areas. The authors have put forward various suggestions regarding shared water resources development in the Ganga Brahmaputra Meghna basin like nepal has the potential to provide hydroelectricity and water storage benefits to India while as India has potential to supply navigation and transit facilities as well as financial support and expertise to Nepal. The authors have suggested for a multiateral cooperation as the transboundary rivers generally cocerns the interests of more than two countries.

Jiang (2009) in his paper “China’s Water Scarcity” has highlighted the increasing water scarcity in China especially in north China. The author in this paper has attempted to develop an understanding of current water issues and also the causes of water scarcity in China like spatio-temporal variability, water shortages, overexploitation, ground water depletion, salinity intrusion in coastal areas and degraded water quality due to rapid urbanization, industrialization, inefficient water use and inadequate water pricing. The author has also highlighted the future challenges of water resources in China like rapid economic dvelopment, growing population and urbanization. At the end the author also suggest some measures to deal wih the water scarcity problems like effective water resource management, establishment or improvement of institutional system that register and regulate water withdrawal and water use. The author also suggested for a market based approach i.e. more emphasis should be on water pricing because it will cover not only water supply cost but also restrict the demand for water as opposed to engineering approach which puts more emphasis on the engineering projects which could have serious negative socio-economic and environmental impacts.

Shalizi (2006) in a World Bank working paper entitled “Addressing China’s Water Shortages and Associated Social and Environmental Crisis” highlighted the issues of water problems in China. This has been highlighted by carrying out per capita water availability and population growth. The author declared that China will be water stressed country in East and South east Asian region. In the next section of paper the author highlighted the spatio-temporal variation in the availabilty of water resources in China. This has been shown by gross renewable water resources in nine river basins. The spatio-temporal variability leads to surface water diversion which badly affect the water flows to flush channels and downstream supply and ecosystems. Ground water is also being depleted which leads to the subsidence of land and salinity intrusion in coastal areas. The also gave due treatment to the problem of pollution which also leads to the deterioration of water resources due to water quality issues. In the third section the author showed the trend of water demand in different sectors from 1980 to 2002. The trend shows that there is a tremendous increase of water use in industries and urban areas though agriculture is still the dominant consumer of water in China. In the next section the author focussed on different policies intiated by Chinese government to cope with the above mentioned problems like using municipal and industrial waste water for irrigation after treatment, increase in prices and improvement in efficiency.

Shao et al. (2003) in their paper “Interbasin Transfer Projects and their Implications: A China Case Study” have highlighted the water scarcity in northern China. In order to overcome the water scarcity in northern China interbasin water transfer projects seems to be the ultimate solution for large countries like China with huge spatio-temporal variation in the availability water resources. China’s southern regions are water surplus whereas northern parts are water deficit. Water from the surplus south will be transferred to the water deficit north. But the author pointed out environmental and geological problems especially of the middle route like soil salinization because of rise of water table, formation of swamps due to channel leakage associated with these projects. The author also pointed out that China’s water use doctrine fails to provide adequate protection for the instream use of water to maintain the proper functioning of rivers like sediment transportation, debris flushing etc. The author has also examined the environmental and health hazards of interbasin water transfer projects like impact

on the area from which water is diverted and also the impact on recieving area. In the last section the author put forward some suggestions like improvement in the land and water use practices and increase in the irrigation efficiency.

Vagholikar and Das (2010) in their paper “Damming the Northeast- Juggernaut of Hydropower Projects Threatens Environmental Security of the Region” gave a brief overview of the region like geography, environment, social setup etc. They argued that northeast of India is the future power house of India and gave statistics of the hydro power potential of the north eastern region. They have highlighted the feasibility of these projects in the region as the region is biological as well as socially diverse. The authors have also pointed out the drawbacks of Environmental Impact Assessment Reports carried out for the dams in the region. The authors have also highlighted the social impacts of these hydropower projects in the region especially on local communities because the communities will lost their livelihood as a result of these dams as these dams will submerge the valuable pasture lands in the area. These projects will also reduce the jhum cultivation area and it will subsequently increase the pressure on the surrounding areas. The authors also gave due treatment to the conflicts over these projects in the region and suggested alternative methods of the so called development for the region like integrated resource planning.

South Asian Trans-boundary Rivers are inextricably linked to regional geopolitics since they are circum-Himalayan and involve countries that are unequal in size and power. The Indus basin connects China, Afghanistan, Pakistan and India, while the Brahmaputra and the Ganga connect China, Bhutan, India, Nepal and Bangladesh. India has been involved in military conflict with China and Pakistan and water-related tensions with Pakistan and Bangladesh. India regards Nepal as its special sphere of influence and has very strong interests in Nepal’s rivers.

According to Siwakoti (2011), the most crucial geo-political aspect of the trans-boundary South Asian basins is the hydrological dependence of all of them on China. The second major geo-political factor is that the three countries of South Asia, Bangladesh, India and Pakistan, were administratively a single unit under the British Empire, before being divided first into two and then three countries under hostile circumstances. With the first division into India and Pakistan in 1947, both the Indus basin and the Ganga-Brahmaputra basin were divided between the two

countries. Subsequently, Bangladesh, where the Ganga-Brahmaputra-Meghna system flows into the Bay of Bengal, was created out of East Pakistan in 1971.

Indus Water Treaty (1960), With regard to the sharing of Trans boundary waters, was signed between India and Pakistan in 1960 is regarded as a role model. It has survived many political strifes and armed conflicts between the two countries (Akhtar, 2010). Indus water Treaty shares the waters of Indus basin between India and Pakistan. The three eastern rivers i.e. the Sutlej, the Beas and the Ravi were given to India for unrestricted use and three western rivers i.e. the Indus, the Jhelum and the Chenab were given to Pakistan for unrestricted use. However India can use the western rivers for the following uses without materially changing the flow of any channel and harming the interests of other party which are defined in articles I to IV of the treaty.

i) Domestic use (drinking, washing, bathing, recreation, sanitation, stock and poultry, household and municipal purposes and industrial purposes
ii) Non-consumptive use (navigation, floating of timber, flood protection, fishing, wildlife etc.)
iii) Agricultural use (use of water for irrigation, except for irrigation of household gardens and public recreational gardens)
iv) Generation of hydroelectric power

Article VI of treaty explains the exchange of data. According to this article the data regarding daily gauge and discharge relating to flow of the rivers at all observation sites, daily extractions for or releases from reservoirs, daily withdrawals at the heads of all canals operated by government or by a government agency including link canals, daily escapages from all canals including link canals and daily deliveries from link canals will be shared on monthly basis. Article VII explains the future cooperation in undertaking the engineering works on the rivers. Article VIII of the treaty explains the establishment of permanent Indus Water Commission to look into the matters relating to the implementation of treaty like exchange of data. Indus Water Commission meets at least once a year alternatively in India and Pakistan. Article IX explains the settlement of differences and disputes. In case a dispute arises between the two countries, it shall first be examined by the commission and if the commission failed to reach on any agreement, the dispute is

then referred to a neutral expert which in this case is World Bank (also a signatory and broker of the treaty). Sarfraz (2013) in his paper “Revisiting the 1960 Indus Water Treaty” analyses pros and cons of this treaty in the present context. He argued that Indus Water Treaty is still relevant to a large extent but it should incorporate in it the present challenges like environmental degradation, increase in population, climate change, global warming and the associated challenges like glacial lake outbursts etc. The population of the basin increased three fold since the signing of treaty in 1960, so we should take into account the present water demand in the basin. Similarly Kokab and Nawaz (2013) argue that it does not allow for the joint development of the Indus basin nor does it eliminate the grounds for conflict over water distribution between India and Pakistan since it is a plan for the separate development of the basin. Environmental and ecological changes like climate change in the basin also call for the reconsideration of the treaty.

Ganges Water Treaty (1996) is an agreement signed between the Governments of Bangladesh and India. The treaty was signed by Prime Minister of Bangladesh Sheikh Hasina and Prime Minister of India H. D. Deve Gowda. The treaty concentrates on the sharing of water during dry season between 1st January and 31st May on a ten day basis. According to this treaty, if the flow will be less than 70000 cusecs both countries will get 50%, if the flow will be between 70000 and 75000 cusecs Bangladesh will receive 35000 cusecs and India the rest and if the flow will be greater than 75000 cusecs 40000 cusecs will be received by India and Bangladesh the rest. The treaty is valid for a period of thirty years, though there is a provision of review of treaty after five years but so far no party has asked for a review. The sharing of water is monitored by the joint commission comprising of the members of Joint River Commission. Apart from these two major water sharing agreements, there are water sharing agreements between India and Nepal on Mahakali River known as Mahakali treaty. This treaty was also signed in February 1996 and came into force in June 1997. The treaty was related to the integrated development of Mahakali River. Also a MoU was signed on river Sutlej with China in April 2005 for supply of hydrological information during flood season. The MoU was signed by Shri MK Narayanan, National Security Advisor Government of

India, and Mr. Dai Bingguo, Chinese Special Representative during the visit of Chinese premier Wen Jiabao from 9-12th April 2005.

Chapter 3

China's Water Resource and Hydro-Politics

China is the fourth largest country in the world. Nature has endowed this country with rich resources especially after the annexation of Tibet as the Tibetan plateau is rich in minerals like copper, iron, zinc, uranium, gold etc. The plateau is also rich in water resources and is known as the third pole (Chellaney, 2011). According to Bulletin of First National Census for Water, Ministry of Water Resources, Government of People Republic of China 2011 (carried out between 2010 and 2012), there are about 70,000 rivers with a catchment area ranging between 50 km^2 to more than 10,000 km^2. Some of these rivers are transboundary rivers and flow to different countries of South Asia, Central Asia, Southeast Asia, Russia etc. China has not signed water sharing treaty with South and Southeast Asian neighbours, but the rivers flowing to these countries have some agreements on the sharing of hydrological data which sours the issue of water allocation of these countries with China as well as among themselves (Wouters, 2013). There are also more than 2800 perennial lakes with a surface area of 1 km^2 or more. Apart from rivers and lakes, China has built more than 98000 reservoirs, with a combined storage capacity of 932.312 billion m^3. Among these reservoirs more than 97000 are completed with a total storage capacity of 810.410 billion m^3 and 756 are under construction with a total storage capacity of 121.902 billion m^3 (Ministry of Water Resources PRC and National Bureau of Statistics PRC, 2011).

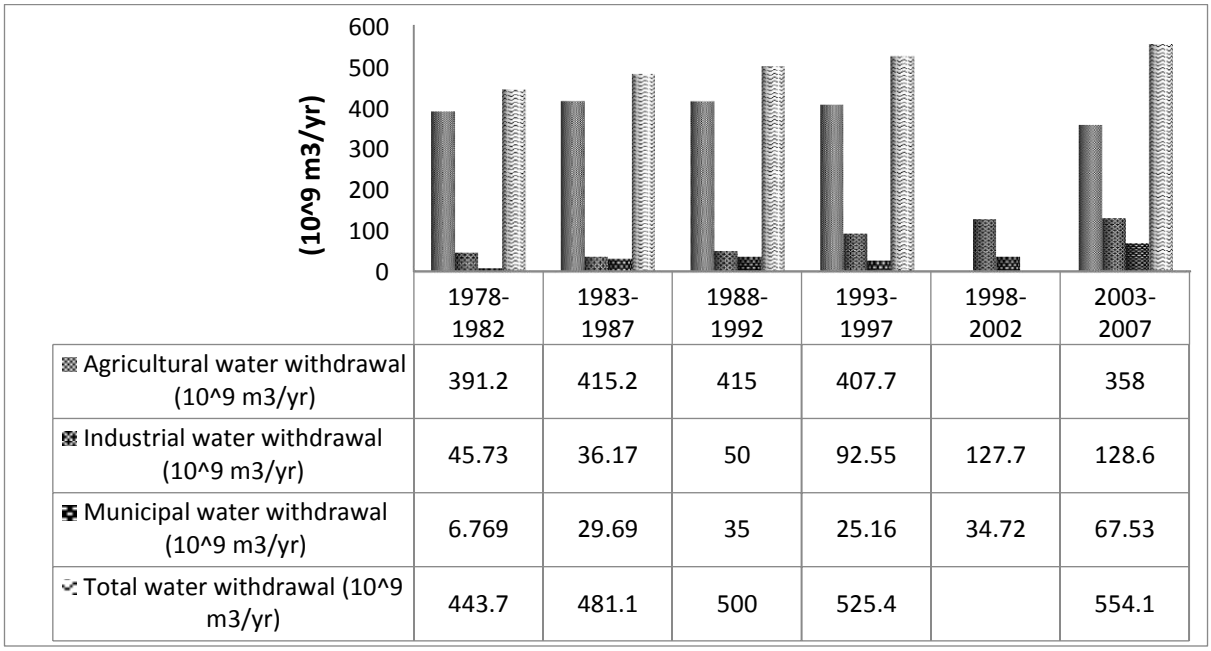
3.1 An Overview of Water Resources

According to Ministry of Water Resources the People's Republic of China, in 2007, the mean annual precipitation was 606.3 mm, which was converted into a total amount of annual precipitation of 5,741 billion $m^{3.}$ In 2007, the amount of water that flowed into the territory of the People's Republic of China from outside the territory was 15.7 billion m^3. The amount of water that flowed out of the territory of the People's Republic of China was 569.9 billion m^3. The amount of water that flowed into the boundary rivers was 67.4 billion m^3. The amount of water that flowed into seas was 1,435.3 billion m^3. In the same year the total amount of

surface water resources in China was 2,376.4 billion m^3.[2] The available water resource per capita was 1,869 m^3 in average.

The amount of total water supply reached 578.9 billion m^3 in 2007, of which surface water was 470.4 billion m^3, groundwater 105.8 billion m^3 and other water sources 2.7 billion m^3, or surface water accounted for 81.2% of the total water supply, groundwater 18.3% and other water sources 0.5%. According to statistics domestic water use was totalled 71.2 billion m^3 (in which water use in townships accounted for 57.8%); industrial water use was 135.8 billion m^3, agricultural water use was 361.6 billion m^3 and ecological water use was 10.3 billion m^3, or accounted for 12.3%, 23.4%, 62.5% and 1.8% of the total respectively.

Figure 4: Water Withdrawal in China in Different Sectors.



	1978-1982	1983-1987	1988-1992	1993-1997	1998-2002	2003-2007
Agricultural water withdrawal (10^9 m3/yr)	391.2	415.2	415	407.7		358
Industrial water withdrawal (10^9 m3/yr)	45.73	36.17	50	92.55	127.7	128.6
Municipal water withdrawal (10^9 m3/yr)	6.769	29.69	35	25.16	34.72	67.53
Total water withdrawal (10^9 m3/yr)	443.7	481.1	500	525.4		554.1

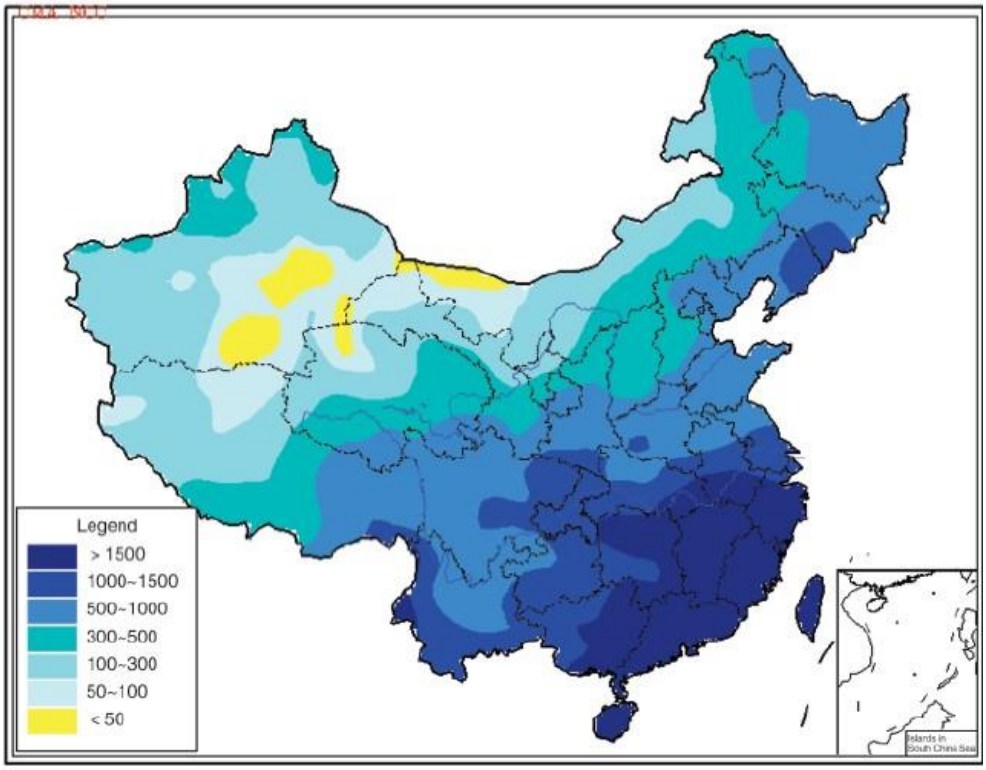
Source: FAOStat

In absolute terms, China's water resources are huge; China possesses freshwater reserves totalling 2.81 trillion cubic meters, the fourth richest such reserves in the world after Brazil, Russia and Canada; however, the country's per capita water resources quota is only 2,300 cubic meters, 25 percent of the world's average (Worldwatch Institute, 2005). The sparsely populated southern regions have 25000 m^3/ person/year while as densely populated northern China has less than

[2] All the data and figures are from the Ministry of Water Resources, People's Republic of China, Annual report 2007-2008, pp 9-10. Retrieved from: http://www.mwr.gov.cn/english/2007-2008.doc. Retrieved on 10/08/2013.

500m^3/person/year (Moore, 2012). Furthermore, China suffers a major imbalance in water resources, both in time and space. On a seasonal basis, the monsoon climate generates summer floods and springtime drought, while on a regional basis, the substantial decline in rainfall from south to north and from east to west, results in a water surplus in the south-east and a water deficiency in the north and west (Figure 5). So great are the regional differences that while the Chang Jiang and other drainage basins in southern China discharge 75 per cent of China's total surface run-off, the rivers of the North China Plain-the Huai He, Huang He, Hai He and Luan He-account for only 5 per cent of the country's total discharge. The availability varies significantly throughout China with per capita water volume in the north only about 10 percent of the global average. David F. Hales at Worldwatch Institute, and the 'People's Daily' now contends that the major constraint on economic development in this region is the shortage of water. According to Li (2005), the problem has national as well as regional significance, for the North China Plain is one of the nation's key economic areas, holding some 40 per cent of the country's population and almost 37 per cent of the cultivated land.

Figure 5: Precipitation Distribution in China in 2010

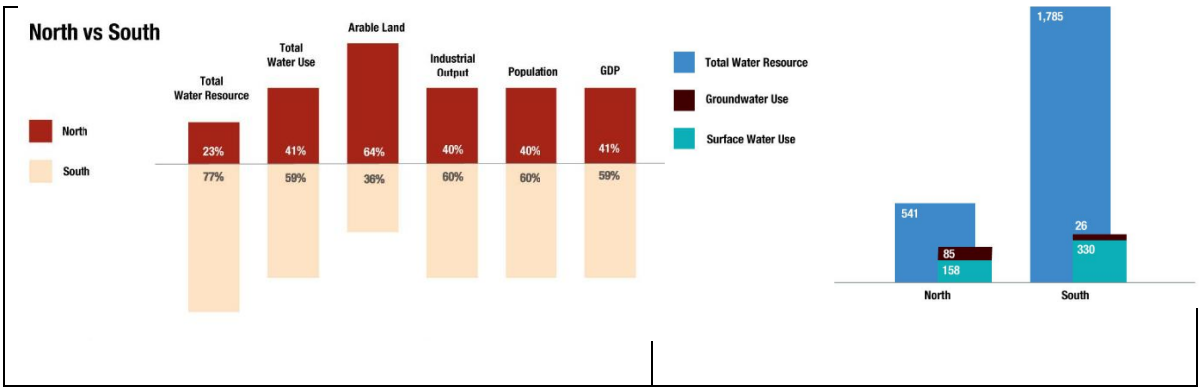


Source: Ministry of Environmental Protection, People's Republic of China.

3.2 Water Security Concern

China is the biggest water consumer, with freshwater usage reaching 621.32 billion m^3 in 2011 (Ministry of Water Resources PRC and National Bureau of Statistics PRC, 2011). China's current water crisis is driven by two primary factors. The first of these is China's uneven distribution of water. China with its huge geographical size has a very large and diverse geography. It is because of this large and diverse geography that China has a wide spectrum of terrains and climate zones (Sekiguchi, 2006). While southern and eastern China enjoys abundant rainfall, the northern and western regions of the country receive very little. In the north, the demand for water surpasses the available supply, largely because it has about 37% of China's total cropland and 40 percent of its population, but only 14 percent of its water supply. Farmers in the north are also facing losses of irrigation water both from aquifer depletion and from the diversion to cities and industries. (Brown, 2000). Industrial water demand is projected to increase from 591 billion m^3 in 2010 to 691 billion m^3 in 2020 (Schneider, 2011). It is predicted that by 2030 per capita water supply in China may drop from 2,300 m^3 to below 1,700 m^3 (Brooks, 2007), which would be equal to the supply of a water scarce country, as defined by the World Bank.

Figure 6: North v/s South Water Use (China)



Source: http://chinawaterrisk.org

The second factor of China's water crisis is pollution which occurs as a result of number of factors like growing population, urbanization, industrialization etc. Most of the water bodies in China are polluted and some water bodies are so much contaminated that water in these water bodies are not even fit for touch (Circle of Blue, 2013; Tan, 2013).

Though there are great variations in the water availability in north and south but one thing that is noted for north and south is that the total water resources are greater than water use, but most of the water is unavailable due to pollution in the north (Circle of Blue, 2013; Tan, 2013) and is inaccessible in the form of glaciers in the south (figure 5).

National conservation policies have helped to limit increases, water consumption nevertheless has climbed to a record 591 billion cubic meters in 2011, which is 42 billion cubic meters (11 trillion gallons) more than in 2000. Over the next decade, according to government projections, China's water consumption will reach 620 billion to 630 billion cubic meters annually—40 billion cubic meters a year more than in 2011. This demand is driven by increasing coal-fired power production (Schneider et al., 2010). An announcement earlier in 2011 by the government indicates water use could reach as high as 670 billion cubic meters (177 trillion gallons) annually over the next ten years (Schneider et al. 2010).

3.3 Water Policies

In order to solve the problem of water scarcity, Chinese government adopted several policy measures like water pricing reforms, conservation, and recycling. During the period of economic reforms, various economic instruments were applied in Chinese water management among which are standards with economic incentives, licensing the management of water-abstraction and wastewater-discharge restrictions (also with economic incentives), user charges, and a water pollution levy. These instruments were introduced through a variety of ministerial policy papers and regulations, especially since the second half of 1980s Zhong & Mol (2010). According to Lieberthal (2004) the problem of water pricing in urban sector in china faced various problems due to ineffectiveness and inefficiency of and lack of coordination among different conflicting governmental organizations as water management was subject to different ministries and commissions.

China's water policy is overseen by the Ministry of Water Resources (MWR).

Ministry of Water Resources manages the overall administration of water resources in China alongside the seven River Basin Commissions (RBCs). In addition to the MWR, there are eight more bureaus involved in water policy

under the State Council.[3] This complex system has been nicknamed, 'the nine dragons who administer water' (Yan et al. 2006).

In December 2010 China made a decision to accelerate reform and development of water resources, known as the No.1 Document in 2011. The document focuses on three 'red lines': over-exploitation, usage efficiency, pollution. But this Document (which for the first time focused on water), have been heavily criticised for not going far enough to protect China's water resources. In January 2013, Ministry of Water Resources, Government of PRC announced Water-for-Coal Plan to allocate water for the development of coal bases. The plan sets the quota for the provinces to meet the three red lines i.e. national water use quotas for 2015, 2020 and 2030 and signalled water allocation and water efficiency ratios between industry, agriculture and municipality. This plan is pertaining to the development of large scale coal bases in China and includes the following:

- Total water allocation control for coal bases to be "taken seriously";
- Water use must be within provincial quotas;
- Coal mines & coal fired power plants must coordinate water usage;
- Implementation of water efficiency measures for the development of coal bases;
- Construction of coal mines must complete feasibility reports to be submitted to the MWR & other bodies for approval;
- Implementation of water efficiency measures for new build coal-fired power with a "first save water, then use water mentality"; power plants in particular those located in the North to prioritise water reuse & water efficient technologies encouraged;
- Stricter use of surface water;
- Prohibited use of groundwater with the exception of mine drainage;
- Water pollution control for coal bases & coal-fired power plants through treatment of wastewater & mine drainage;
- Restrictions on the transfer of water use rights by the coal base.

[3] These are the State Reform and Development Commission (SDRC), the State Environmental Protection Administration (SEPA), the Ministry of Construction (MOC), and the Ministry of Agriculture (MOA), the State Forest Bureau, the State Electric Power Company, the Ministry of Transportation, and the Ministry of Health.

In short this plan indicates that, in future coal development plans will be dictated by the regional water availability.[4] This does not mean that China will stop mining of coal in the water deficient areas but miners will recycle the water and use water efficient technology for coal mining.

According to Jiao Yong, China's Vice Minister of Water Resources,

> *40% of China's rivers are already polluted due to the country's rapid economic growth, and "Industrialization, urbanization, including ensuring grain and food security, are exerting higher demands on water supplies… while our water use remains crude and wasteful. He goes on to say that over 46,000 reservoirs in China need to be rebuilt or reinforced to ensure that surrounding farmlands and communities are safe from flooding and have enough water for irrigation.*

China held its first water conservation conference in 2011, attendees included President Hu Jintao who called water a "strategic resource" and compared its importance and impact on economic and national security to that of food and oil. He also outlined six major tasks for the country: "(1) improving irrigation and water conservancy infrastructure, (2) enhancing anti-flood capability, (3) constructing water resource allocation facilities, (4) promoting water ecology protection and governance of the water environment, (5) implementing stringent water resource management systems, and (6) improving water technology" (Jain-Cocks, 2011; Want China Times, 2011).

To date, China has managed largely to evade the water-energy collision. Once regarded as one of the world's worst water wasters, China has enacted and enforced water efficiency and conservation measures for industries, agriculture, and cities since the mid-1990s. Industrial plants are required to prove that there is enough water to operate prior to construction and then must recycle water used for manufacturing and processing. Cities, led by Beijing, are recycling wastewater to use it as "grey water" for flushing toilets, greening urban parks, and car washes (Xuejing, 2010). New buildings are designed to include separate grey water plumbing systems. One highly encouraging target that was reached during the

[4] MWR Announces Water-for-Coal Plan (17/12/2013). Retrieved from: http://chinawaterrisk.org/notices/mwr-announces-for-coal-plan/. Retrieved on: 13/01/2014.

Eleventh Five-Year Plan was a leap from treatment of 55% of wastewater to seventy-five percent nationwide.

According to Schneider et al (2011), the water conservation trends are encouraging, but they are not enough to handle the steep growth in energy demand and production. China is undertaking another massive water project called the South-North water diversion, where China intends to engineer three new waterways to carry water from China's wet south to its dry north. A Chinese hydraulics engineer, Professor Liu Zihui, speaking about the largest hydraulics project in the history of humanity, a $63 billion canal that would bring water from southern China to the country's increasingly desertifying north, commented,

> *I don't feel we are conquering nature. We think nature itself isn't fair. God isn't fair. What is that? He's given Southern China so much water but given the North so little. It's good land – nice flat land – up there. But it's got so little water. So we say, as God isn't fair, we are trying to balance out God's unfairness (Paskal, 2010).*

This project began in 2002 and is projected to cost $60 billion (though it is already over budget) (Environmental News Network, 2004). The south-to-north water diversion project was designed to take water from China's largest river, the Yangtze, to the arid northern regions. It is expected to be completed by 2050 and would eventually divert about 44.8 billion cubic meter of water to the north annually (Water Technology, 2013). The northward-bound water has three routes - an eastern route, a middle route and a western route. The project started with the construction of the eastern route in 2002. The construction of the middle route followed in 2003 which will come into service after 2014's flood season. It is expected to handle 9.5 billion cubic meters of water annually. By the end of 2010, 115 billion Yuan had been spent and 40 projects were started making a new annual record. The western route is controversial owing to political and strategic ramification for China's riparian neighbours particularly on the Mekong and the Brahmaputra. However, in spite the sensitivity, China has not stated that it will not go ahead with the western route. Though still in the planning stage, it involves working in the Qinghai-Tibet Plateau (3,000m–5,000 m a s l). Sinha (2012), argued that once the western route is completed in 2050, it will bring 4 billion m^3 of

water from the Tongtian, Yarlung and Dadu rivers across 500 km to northwest China.

China is world's fastest growing economy and hence the energy demand is also growing. With real gross domestic product growing at a rate of 8-10% a year, China's need for energy is projected to increase by 150 percent by 2020 (Luft, 2006). To meet this growing energy demand china will have to diverse its sources of energy. To sustain its growth China requires increasing amounts of oil. China is compelled to develop its hydroelectricity as a clean and renewable source. Its exploitable hydropower is estimated to be around 378GW with an annual power supply of 1.92 trillion KWh (Our Energy, 2008). According to Sinha (2012) huge hydroelectricity projects for energy and water diversion schemes for food sufficiency are strategic measures to China's growth path.

Figure 7: South-North Water Diversion Project

Source: http://www.futuretimeline.net/21stcentury/2050-2059.htm

A study by the World Commission on Dams placed China's large dam total at over 22,000—the most in the world. Large dams are those roughly four stories or taller. Most of China's were built after 1949. And as the study points out, that translates into one large dam built per day, every day since the emergence of modern China. There are as many as 48,000 dams over 15m high worldwide. About half of these are in China (Chellaney, 2011). China has completed its largest, most ambitious dam ever, the Three Gorges Dam. China claims the dam will generate the electricity of 15 power plants—enough to pay for half of the project's cost—and will reduce the country's annual coal usage by 50 million metric tons, therefore diminishing a major source of air pollution and greenhouse gas emissions (The Economist, 2006).

The dams which China is building/approved (Zangmu, Dagu, Jiacha and Jiexu) or plans to construct (Motuo and Daduqai) at the great bend can be used to transfer a sizeable volume of water northwards (Chellaney, 2011). The ambitious plan to divert the Brahmaputra by damming the river at the Great Bend to its thirsty North through the western route of South-North Water Transfers Project could have serious implications for the downstream countries because Brahmaputra is the lifeline for farmers in India's northeast and Bangladesh (Ranjan, 2010). This ambitious project was first reported in an article published in *Scientific American* by Horgan in June 1996. The article stated:

> *China's Northwest Territory, which includes the Gobi Desert, contains almost half of that country's total landmass but only 7 percent of its freshwater. Recently some Chinese engineers proposed diverting water into this arid area from the mighty Brahmaputra River, which skirts China's southern border before dipping into India and Bangladesh. Such a feat would be "impossible" with conventional methods, engineers stated at a meeting held last December (1995) at the Chinese Academy of Engineering Physics in Beijing. But they added that "we can certainly accomplish this project"--with nuclear explosives.*

The article further states that though this project is impossible by the conventional methods due to inaccessible and difficult topography of the region, but China with its technological and economic strength can go for such ambitious projects in

order to deal with her own problems like water scarcity, growing energy demands, etc. Arpi (2003), argued that Chinese technologists and officials have touted the potential of nuclear blasts for carrying out non-military goals and it may be the reason for China's refusal to ratify the Comprehensive Test Ban Treaty to keep the ways open for carrying out such nuclear blasts.

In its 12th five year plan period from 2011-2015, China has pushed forward the hydropower generation on the middle reaches of Brahmaputra (Turner et al 2013). The guardian (2008) writes "*China Plans String of Dams in South Tibet.*" China was considering the construction of dams on Tibetan rivers since 2003 when a study of Ministry of Water suggested that it could generate 1800 billion kwh a year in Tibet.

These dams could have negative impacts on the downstream countries especially India. Besides China has strategic interests in India's northeast, especially Arunachal Pradesh which China since 2006 is calling southern Tibet and claiming about 90,000 km^2 (Jabin, 2011),[5] because of its rich natural resources and strategic location. Besides China has objected the funding of a flood management project from ADB under ADB's Country Partnership Strategy for 2009-2012 in Arunachal Pradesh by saying that the project falls under a disputed area (Hanghal, 2013). From the security point of view China can use the dams on the Brahmaputra especially a mega dam and the World's biggest with a capacity of 38GW of hydropower generation in the Great Bend area as a bargaining tool and a potential non-traditional weapon against India because of the strategic location of the dam close to the Indian border. In case of war China can use the dams as non-traditional weapons against India by releasing the water suddenly which can bring havoc to India as well as Bangladesh (Williams, 2013; Arpi, 2008).

3.4 China's Energy Demand

By 2030, global energy demand is predicted to grow by as much as 55%, with China and India accounting for 45% of the increase (World Water Assessment Programme, 2009). Qing, Executive Vice President of the State Grid Corporation of China said at the International Energy Week in Singapore in October 2013 that energy demand is growing by over 4% annually in the present decade and will be

[5] Crisis in South Asia and East Asia. Retrieved from: http://fletcher.tufts.edu/Simulex/Scenario-Background. Retrieved on: 02/12/2013.

highest sometimes between 2030 and 2040 (Global Times, 2013). Rising energy production and usage in the region are increasing Asia's greenhouse gas (GHG) emissions and contribution to climate change significantly. China is now the world's number one GHG emitter, with its emissions projected to double by 2030 (European Commission, 2009). From 2006–2030, 89% of the cumulative increase in CO_2 emissions will come from non-OECD countries, primarily in Asia (International Energy Agency, 2008). While China and other Asian countries are taking significant steps toward development of renewable energy sources, GHGs are still projected to grow for some time. According to a news published in International Business Times in October 2013, China issued a directive to completely ban the use of coal in 2500 boilers and 300 industrial furnaces that use coal by 2017 and will raise the capacity of natural sources of energy like wind power (will increase from 64 GW to 100 GW by 2015), solar power (will increase from 6.6GW to 35 GW by 2015).

The direction of the Post-Kyoto Climate Change negotiations and what forms mitigation (especially the obligations of developing countries) will greatly influence the pace at which GHGs increase in Asia.

In order to meet the energy demands China is looking for the non-polluting sources of energy as the international pressure grows regarding the greenhouse gases. The surging demand for energy in China is also leading to the construction of dams on the transboundary rivers like Brahmaputra, Mekong etc. The rapid rate of hydropower development is creating the emergence of private investors looking for projects without considering energy demand or potential environmental and social impacts (Cronin, 2009). Overall, China is believed to have more than 80,000 dams. Flood control and irrigation are cited as China's top two purposes for building large dams like the Three Gorges Dam on the Yangtze River and the Xiaolangdi Dam on the Yellow River (Fu, 1998).

3.5 Chinese Hydro-Politics

In October 2010, the Communist Party of China's (CPC) Central Committee approved the guiding principles of China's 12th Five-Year Plan for National Economic and Social Development (FYP) (2011-2015). The government announced that hydropower's capacity will increase by 50 percent by 2015 (APCO

Worldwide[6], 2010). The water crisis is clearly recognized in the plan which urges that the construction of water conservation structures is enhanced, irrigation is improved and rivers/lakes are cleaned up and properly treated. It also proposes accelerating the construction of wastewater treatment and recycling pipes.

3.6 12th Plan Stresses Hydropower from Yarlung Zangbo/Brahmaputra

China is now predictably casting its eyes on the Brahmaputra's hydropower potential on its side of the border. China has given approval for the construction of three new hydropower dams on the middle reaches of the Brahmaputra river, ending a two-year halt in approving new projects on the river amid concerns from India and environmental groups. The three new dams have been approved by the State Council, or Cabinet, under a new energy development plan for 2015 that was released on 23rd January 2013 (The Hindu k, 2013). China has, so far begun construction on one hydropower project on the middle reaches of the Brahmaputra or Yarlung Zangbo as it is known in China – a 510 MW project in Zangmu in the Tibet Autonomous Region (TAR), the construction of which began in 2010. The three new dams viz. Dagu, Jiexu and Jiacha will also be built on the middle reaches of Brahmaputra (fig. 7). One of the three newly approved dams (Dagu) is bigger than the Zangmu project (fig. 8).

A 640 MW Dagu dam lies 18 km upstream of Zangmu. Another 320 MW dam will be built at Jiacha, downstream of Zangmu. A third dam will be built at Jiexu, 11 km upstream of Zangmu. The capacity of the Jiexu dam is, as yet, unconfirmed. The three projects were listed in the State Council's energy plan for the Twelfth Five Year Plan period (2011-15), which was released on January 23.

According to Tibetan researcher Tashi Tsering, China has already constructed ten dams on tributaries of the upper Brahmaputra, with three more under construction, seven more under consideration, and yet eight more proposed (Tsering, 2010). Those dams already built are small in scale and, since none are on the main Brahmaputra, have stirred little interest outside China. However, China's plans apparently include building five major dams directly on the Brahmaputra mainstream. Completion of construction on the first of them, the $1.18 billion 510

[6] APCO Worldwide is an independent, global communication, stakeholder engagement and business strategy firm.

MW Zangmu hydropower project in the middle reaches of the river, is expected by 2014. It was reported in May 2010 that research had indeed been carried out for a massive project with a capacity of 38,000 MW at the great bend (Watts, 2010).

Figure 8: Proposed/Approved dams on the Brahmaputra in Tibet.

Source: SANDRP

This has also been supported by a Tibetan researcher Tsering who predicts that China is likely to construct 38,000 MW hydropower station and large storage dam near Motuo (Tsering, 2010) and, if built, “China will gain significant capacity to control the Brahmaputra’s flow. Basically, India will become dependent on China for flow of what is now a free-flowing international river” (The Hindustan Times, 2010).

3.7 India’s Water Resources and Policies

India has had a considerable impact on the global water supply and demand projections due to a number of reasons like its population size and an increasing trend in the population, increasing urbanization, economic growth especially during the previous decade besides the global melt down, changing lifestyle and food consumption pattern of the people and the most critical spatio-temporal variation of population and water resources (Amarasinghe et al. 2005). All this leads to the unsustainable use of water resources which gives rise to the problem of water scarcity. They also pose a serious challenge to the water security of India.

Besides the socio-economic factors, India also faces the natural challenges to the water scarcity like global warming, climate change and the related problems like sea level rise and salinity intrusion.

Figure 9: Location of Zangmu Dam on Brahmaputra River in Gyaca prefecture in the Tibet Autonomous Region of China as seen from different resolutions.

Source: Google Earth.

India has more than 18% of the world's population but less than 4% of the renewable water resources of the world (Ministry of Water Resources India, 2002). India receives an average annual precipitation of about 4,000 km^3, out of which

700 km^3 is lost to the atmosphere, 2,150 km^3 soaks into the ground and 1,150 km^3 flows as surface runoff. Nearly 62% or 1,202 km^3 of the total water resources is available in the Ganga-Brahmaputra-Meghna basin. The remaining 23 basins have 751 km^3 of the total water resources[7]. In order to deal with the challenges to the water security, Central Ground Water Board, Government of India adopted National Water Policy in 1987, which with the passage of time has been reviewed and updated from time to time due to a number of challenges and issues which have emerged. National water policy has been reviewed in 2012 in which some newly emerged issues like climate change adaptation, water pricing, management of transboundary rivers etc. have been added (National Water Policy, 2012). According to the national water policy 2012, negotiations about sharing and management of water of international rivers should be done on bilateral basis in consultative association with riparian States keeping paramount the national interest. Adequate institutional arrangements at the Centre should be set up to implement international agreements. Though India has bilateral agreements with its lower riparian neighbours, but has remained unsuccessful in negotiating with China with regard to the Brahmaputra and other rivers coming in from China. Water is not the only issue between India and China, but it is likely to become a source of another tension between India and China. Judging by its latest actions, China is set to embark on a series of river diversion plans including on the Indus and Sutlej, and especially the Yarlung Tsangpo (Brahmaputra River) plan. Yarlung Tsangpo project has been in the drawing boards of Chinese planners for several decades. But on October 14, 2008, Chinese engineers began digging a tunnel through Tibet's Galung La Mountain in Nyingchi Prefecture to build the most difficult highway to China's last road-less Medog County located 30 kilometres from India's border (CCES-TUWB, 2010).[8] The road construction was completed in December, 2010 (People's Daily Online, 2013) and is linked to the proposed dam construction at the Great Bend of Brahmaputra. China's increased infrastructure activities near the Great Bend are even visible on Google Maps (Stobdan, 2009).

[7] National Institute of Hydrology: Retrieved from: http://www.nih.ernet.in/rbis/india_information/Water%C2%A0Budget.htm. Retrieved on: 19/12/2013.

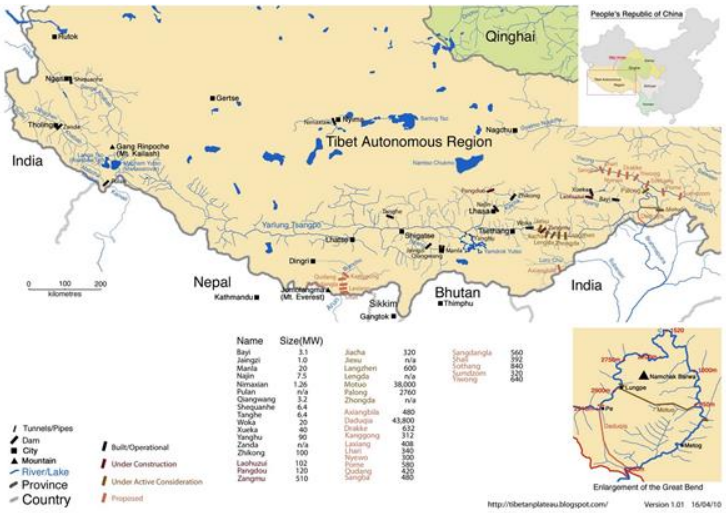
[8] CCES-TUWB: China Civil Engineering Society-Tunnel and Underground Works Branch

Tibetan waters are becoming a key issue in the Sino-India relationship. The bilateral relations between the two remained tense since 1962 war. India is concerned about the dam construction by China on Brahmaputra River. In absence of any water treaty between the two, India fears that these dams apart from the above vulnerability i.e. India will become dependent on China for the flow of Brahmaputra river especially during the dry season, may also be used for water diversion by China to the water scarce north without informing India.

But India has made a historical blunder by accepting Tibet as part of China in April 1954 under Sino-Indian agreement in which India formally recognized Tibet as part of China. India has to pay a huge price for this blunder. Before the annexation of Tibet by China, Tibet was a natural buffer zone between India and China and Himalayas were regarded as the natural frontier in India. But after the China's annexation of Tibet, China has come far south of the Himalayan watershed. China is now claiming the territories far south of the Himalayas like Arunachal Pradesh (Arpi, 2008). China has more strategic interests in Tibet rather than historic or ideological. This has been for the first time highlighted by Ginsburg and Mathos in the following lines

> *He who holds Tibet dominates the Himalayan piedmont, he who dominates the Himalayan piedmont threatens the Indian subcontinent and he who threatens the Indian subcontinent may well have all of South Asia within his reach and with that all of Asia.*

Figure 10: Hydropower Projects on the Yarlung Tsangpo in Tibet



Source: Tibetan Plateau blog: http://tibetanplateau.blogspot.in/2010/05/damming-tibets-yarlung-tsangpo.html

Chapter 4

Damming and Diverting River Brahmaputra: Implications for Downstream Countries

Water shortage is worsening in China. According to the government statistics published in The Verge, more than 27,000 rivers with a catchment area of 100 km^2 or more, dried up in China since 1950's and there is a decline in the water levels of major rivers of China especially in the north where rivers are drying up or turning into seasonal rivers (Toor, 2013). In order to deal with the problem, China has started damming and diverting the rivers in the south originating from glaciers of Tibetan plateau.

4 Transboundary Aspects of River like Brahmaputra

Brahmaputra River is a trans-boundary river, flowing through China, India, and Bangladesh. A large proportion of population depends on the river for their survival and livelihoods by exploiting the resources of the river like fish, sand mining, water for agriculture etc. Flows of glacier-fed rivers like Brahmaputra are very crucial for the people during dry season when water is most needed for agricultural purposes. Any alteration with the flow of the river could have very devastating effects on the lives of people who depend on the river for their water supply. The situation turns out to be critical when the river crosses the national borders into some other country as is the case of Brahmaputra.

4.1 Extremely Large and Variable Flows

In the study of Immerzeel (2008), the General Circulation Model[9] simulations show an accelerated increase in both temperature and precipitation. Projected changes on the Tibetan Plateau are more profound than in the other two physiographic zones. The widening distribution of summer precipitation indicates a potential increase in extreme events. The analysis predicts accelerated seasonal increases in both temperature and precipitation from 2000 to 2100. The largest changes occur on the Tibetan Plateau and the smallest on the Flood Plains. The strongest increases are projected for the monsoon season and the largest threat of climate change lies in the associated flooding in the densely populated Flood Plains. Immerzeel et al. (2010) estimated that snow and glacier melt contribution,

[9] General Circulation Model is a mathematical model of the general circulation of a planetary atmosphere and/or ocean

compared to total runoff generated below 2,000 m is about 27%. Projected rise in temperature will lead to increased glacial and snow melt leading to retreat of glaciers.

The hydrologic consequences of the observed effects of climate change are expected to be an insignificant change in stream flows in the watersheds drained by the upper Brahmaputra River but a perceptible increase in river discharges in the watersheds drained by the middle Brahmaputra River and its tributaries, particularly within the upper and lower catchments of the middle Brahmaputra Basin (Mukhopadhyay, 2012).

4.1.1 Significant Rates of Sediment Discharge

Brahmaputra is one of the highly sediment laden rivers of the world. There are various factors responsible for the high sedimentation rates in a river like channel gradient, relief ratio, runoff, lithology of the basin and active seismicity (Islam et al1999; Milliman and Syvitski 1992). Brahmaputra is second only to the Yellow river in terms of sediment transport per unit drainage area. It has a sediment yield of 1128 metric tons/km^2. It supplies about 1000 million tons of suspended material to Bay of Bengal and if the bed load is also included then this volume would be doubled (S. K. Singh 2006; Milliman and Syvitski 1992; Milliman and Meade 1983). Maximum sediment discharge by the river to ocean is contributed during the south west monsoon season (May-November) due to heavy rainfall during this season in the basin. But the river deposits the sediments on its bed and banks during the low discharge periods (Subramanian, 1993) due to less carrying capacity during that period.

4.1.2 Rapid Channel Aggradations

Aggradation of river beds rapidly reduces the silt and water carrying capacity of rivers as a result of which the water overflows the banks and cause severe damage during the flood season in the flood plains. The floods then became a curse rather than a blessing. Channel aggradation is one of the main problems of Brahmaputra River. Between 1971 and 1979 the Brahmaputra channel aggraded about 16 cms. in 607 kms stretch in Assam (Sarma, 2005).[10] Dam Construction on

[10] Goswami, Dulal C. The Brahmaputra River India. Retrieved from: http://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&cad=rja&ved=0CEcQFjAE&url=htt

the Brahmaputra River on a large scale will aggravate the problem because damming will reduce the flow of the river which will reduce the silt and water carrying of river Brahmaputra and the river will deposit the silt on river bed. The river bed will be raised which will cause severity of floods during the flooding season due to channel aggradation (Hassan, 2012). Rapid channel aggradation reduces the navigation capacity of the river. From 1970's the navigable water ways of have shrunk due to consistent siltation and aggradation of the river bed (Islam et al., 1999).

4.1.3 Climate Change

According to Gain et al. (2011) Climate change is likely to have significant effects on the hydrology. The Ganges-Brahmaputra river basin is one of the most vulnerable areas in the world as it is subject to the combined effects of glacier melt, extreme monsoon rainfall and sea level rise. Their analysis shows that extreme low flow conditions are likely to occur less frequent in the future. However very strong increases in peak flows are projected, which may, in combination with projected sea level change, have devastating effects for Bangladesh.

Climate change will have effects on the hydrology of the Brahmaputra basin. Large parts of the basin depend on the Brahmaputra discharge for irrigation while the lower part of the basin is vulnerable to flooding (Saikia, 2013). Especially Bangladesh suffered severe flooding in 1987, 1988, 1998 and 2004 (Mirza, 2003). Climate change will affect the discharge characteristics significantly and will lead to more severe and more frequent flooding (Warrick et al., 1996) both through alterations in climatic conditions and sea level rise. Projected rise in temperature will lead to increased glacial and snow melt, which could lead to increased summer flows in some river systems for a few decades, followed by a reduction in flow as the glaciers disappear and snowfall diminishes. Satellite records have shown a decrease in snow cover extent of about 10% in the Northern hemisphere related to temperature increases in spring and summer since 1966 (Robinson, 1997 &1999). To what extent increased glacial and snow melt influence stream flow is varying strongly in space.

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p%3A%2F%2Fwww.nih.ernet.in%2Frbis%2FBrahmaputra-Goswami.doc&ei=fNzgUqm5GIzpkQfP24DICQ&usg=AFQjCNHGIGvGMyQWDmMZFlPRKppBoTcjqA&bvm=bv.59568121,d.bmk. Retrieved on: 08/10/2013.

Total annual precipitation follows the east to west gradient. Therefore stream flow in basins in the west is for a major part determined by melt water while in the east run-off generated by monsoonal precipitation is the most important constituent of downstream discharge. (Rees & Collins, 2006) also argue that glaciers experience winter accumulation and summer ablation in the west, but there is predominantly synchronous summer accumulation and summer melt in the east. Singh & Bengtsson (2005) confirm the strong dependence of stream flow on melt water in basins originating in the western part of the basin and stress the difference in melt water contribution to stream flow between rain fed, snow fed and glacial fed river basins. The Brahmaputra basin is located in the eastern Himalayas and river discharges are predominantly rain fed.

Climate change variations in both intensity and reliability in monsoon, will affect both high and low flows leading to increased flooding but possibly also to increased variability of available water, both in space and time (Postel and Wolf, 2001). Frauenfelder and Kaab (2009) estimated that total glacier area has been decreasing 7 to 13% per decade in the Upper Brahmaputra River basin (UBRB) for the period from 1970/80 to 2000.

4.1.4 Large Hydropower Development Upstream

With an estimated hydropower potential of 66,092 MW, a series of dams and reservoirs being constructed has implications on the river downstream. China's 12th Fiver Year Plan stresses hydropower development from Yarlung Zangbo implying fresh concerns for India. China proposed a number of hydropower projects in the region and has already built a number of dams (most of them on the tributaries of Brahmaputra) on Brahmaputra which are all located upstream from the great bend like Pangduo, Zangmu, Yamdrok Tso, Wolka, Drikong etc (Chellaney, 2011). The construction work on Zangmu dam (which is on the main stream) started in November 2010 (The Hindu a, 2010) and is expected to be completed by 2015. These dams in Brahmaputra basin will have negative social & environmental impacts in local environs as well as strategic implications for downstream states.

According to International Policy Digest (2013) China is planning to build the world's largest dam and hydropower station on the Brahmaputra at the Great Bend

where the river takes a U-turn around mount Namcha Barwa to enter the plains of Assam via Arunachal Pradesh. Approximately, 354 billion cubic metres (BCM) of water flows from Tibet to India out of which 131 BCM is accounted in the Brahmaputra River; on this river alone China is allegedly planning to build twenty-eight dams (India Today, 2012).

4.2 Impacts of Hydropower Development

Brahmaputra basin is traversed by two biodiversity hotspots i.e. Indo-Myanmar and Eastern Himalayas. Dam construction in the region will have serious negative impacts on the environment as opposed to the popular myth that *Himalayan power sites are, from a social and environmental perspective, among the most benign in the world* (Briscoe and Malik, 2006). Dam building in the Himalayas will have many impacts like submergence of pristine forest land, water pollution due to the constructional activities like blasting, excavation and solid waste disposal, disruption in riverine ecosystems etc. These activities will have serious negative impacts on the local ecology. Another negative impact of dam construction in the region is seismic activity. The region lies in seismically active zone (zone V), therefore the area is not suitable for construction of big dams as it may cause huge damage to both property and human lives in case a big earth quake hits the area (Dharmadhikary, 2008). The region is tectonically very active as it lies in the vicinity of the plate boundary. Big dams in the area can trigger earthquakes of high magnitude as these dams will increase the load on the bed. A recent reminder of dam induced earthquake in 2008 is 7.9 magnitude Sichuan earthquake which is believed to be triggered by construction of the Zipingpu Dam, as the dam reservoir is only 5 kms away from the epicentre of the earthquake. In this earthquake about eighty thousand people died. Dams induce earthquakes by a phenomenon known as Reservoir-Induced Seismicity (RIS). The load of water exerts extra pressure on the already under tectonic-strain rocks. The water acts as a lubricant in the faults and induces seismic activity.[11] God forbids, if a dam breaks due to an earthquake, it will cause havoc like flash floods and domino effect of dam breaks in the downstream areas (Williams, 2013). Lan (2012) raised his concerns about the geological risk and biodiversity of this basin. The complex geology of this basin

[11] International Rivers. Earthquakes Triggered by Dams. Retrieved from: http://www.internationalrivers.org/earthquakes-triggered-by-dams. Retrieved on 12/12/2013.

and dams building in the Great Bend can cause seismic activity. In a worst-case scenario, the dams could collapse, creating a giant wave and destroying anything in its path, which may cause a domino effect (ENS, 2012), destroying downstream dams, which could be devastating to Arunachal Pradesh, Assam and Bangladesh.

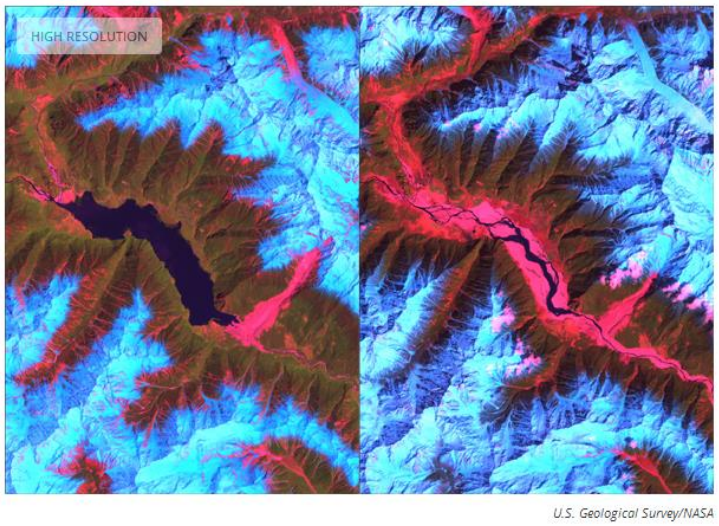
According to India Today news of June 2001 *"Made in China: Floods ravage Himachal and Arunachal Pradesh, satellite pictures suggest China's hand".* Indian Express (2000) and International Policy Digest (October, 2013), and several other newspapers reported that the flash floods in Himachal Pradesh and Arunachal Pradesh in 2000 were triggered by blasting of dams in Tibet by China. Tibet Environmental Watch reported that a Chinese official confirmed that a dam breach in Tibet caused floods that wreaked havoc in Northeastern India, claiming 30 lives and leaving more than 100 missing (Tibet Environmental Watch, 2000). Although China, in the beginning, had denied this by saying that there were no floods or rains in Tibet at that point of time and these floods may be caused by natural processes on Indian side. But there were no rains or cloud bursting in either of the states in India also that is why there were no flood warnings issued by either of the states. But Chinese claims have been countered by ISRO officials after a careful examination of satellite data. They claimed that there were two water bodies in Sutlej and Siang basins before the incident and suddenly these water bodies disappeared after the incident took place. These flash floods washed away more than 120 kilometres of strategic highway in Himachal Pradesh and three big strategic bridges in Arunachal Pradesh besides human lives and property worth crores (Gupta, 2001).

The news released on the Website of Washington University in 2012 also confirms this event (Stricherz, 2012). Montgomery[12] in his study of landslide erosion along rivers in the eastern Himalayan region of southern Asia using images of 15000 landslides found that Images showed a huge landslide in early 2000 and created a gigantic dam on a stretch of the Po Tsangpo. The dam failed catastrophically in June of that year, and the ensuing flood caused a number of fatalities and much property damage downstream. They found that small increases in slope angle

[12] The work was presented online May 27, 2012 in Nature Geoscience. Retrieved from: http://www.sciencenewsline.com/articles/2012053117370087.html. Retrieved on: 28/12/2013.

above about 30 degrees translated into large increases in landslide erosion as the stress of gravity exceeded the strength of the bedrock.

Figure 11: The Landsat satellite image at left shows a huge lake on the Tsangpo River behind a dam created by a landslide (in red, lower right of the lake) in early 2000. The image at right shows the river following a catastrophic breach of the dam in June 2000.



Source: http://www.sciencenewsline.com/articles/2012053117370087.html

It is believed that this dam was blasted by china deliberately which caused the flash floods downstream (Arpi, 2008). Reverse can also happen during dry periods as Brahmaputra almost dried up suddenly in Pashighat a town in Arunachal Pradesh in 2012. People in the town of East Siang district has also observed receding water level in Brahamaputra river writes (The Economic Times c, 2012). Dams also reduce the valuable nutrient rich silt by obstructing it behind the reservoir, which were being brought by the river and used to deposit it in the flood plains during the annual flood cycle. These nutrient rich sediments are essential for agriculture not only in India but also in Bangladesh. So reduced silt quantity can adversely affect the agriculture in the basin which could raise the issue of food security in the region (Williams, 2013). Also the river is main source of protein for the poor people of Brahmaputra basin. Damming the river in the upstream areas will reduce the fish catch in the downstream areas because as mentioned earlier dams would reduce the nutrient supply and also interrupt the migration cycle of the migratory species that have to migrate for spawning (World Commission on Dams,

2000). Another impact which the downstream countries are facing is the pollution resulting from constructional activities of these dams. The upstream dam construction requires a lot of human intervention at the construction sites like excavation, clearing of the forest lands etc. human intervention on such a large scale pollute the downstream waters by increasing the turbidity level of water, solid waste disposal etc. Besides dam construction, mining on the Tibetan Plateau also leads to the water pollution. The plateau is not the storehouse of water resources only but also valuable minerals and metals like boron, corundum, sulphur, uranium, gold, lithium etc. China is the world's largest exporter of lithium-ion batteries as it has the largest reserves (247 km^2 Chabyer bittern salt lake) of lithium in the world (Chellaney, 2011). Water pollution leads to the depletion of fish downstream due to increase in turbidity levels of water, depletion of valuable nutrients etc. Pollution also leads to the scarcity of portable water as water becomes unsuitable for human consumption. Solid waste generated by the workers at the dam sites also leads to water pollution.

One of the common myths is that hydropower is pollution free source of energy, but that is not true. Over a period of time dams emit greenhouse gases like methane, carbon dioxide etc. These gases are formed in reservoirs due to decomposition of organic material in anaerobic conditions. These gases add to the global warming effect (Dharmadhikary, 2008). According to an estimate of World Commission on Dams, hydropower reservoirs may account for between 1% and 28% of the global warming potential of GHG emissions. Greenhouse gases especially methane and carbon dioxide is formed in reservoirs due to decomposition of organic material in anaerobic conditions. The large dams in India are responsible for about a fifth of the country's total global warming impact (World Commission on Dams, 2000). Now the dam proliferation is rapidly increasing in the Himalayan region, it will have negative impacts on the water resources of Tibetan plateau, which is source of Asia's major rivers. All the Himalayan states are in a dam building race in this ecologically and geologically fragile region.

4.2.1 Social Impacts

Dams have both positive and negative social impacts. Positive impacts include the development of infrastructure like roads, bridges, provision of water, electricity and many other multiplier effects like growth of markets through which people are

benefited directly and indirectly in the remote areas etc. But on the other hand dams also have negative impacts which are probably more than positive impacts. In the following section social impacts of dams will be discussed.

Brahmaputra River plays an important role in the socio-economic life of people living along its course. It provides sustenance to the people living in its basin. But dam building process in the basin has negative impacts on the livelihoods of people both upstream and downstream. First and foremost social impact of dam building in the region is displacement of the tribal people (World Commission on Dams, 2000). The region is mostly inhabited by indigenous groups who are very much attached to their ancestral lands. These groups are closely tied to these lands, rivers, forests etc. traditionally as well as religiously e.g. the construction of Dibang multipurpose project will displace the Idu Mishmi tribe in Arunachal Pradesh (Vagholikar and Das,2010).

They face a lot of difficulties in the relocated areas. As Thukral & Sakate notes,

> *Persons who are uprooted and rehabilitated in another place have to undergo the entire process of re-socialisation and adjustment. Traditional social relations and community networks break down as a result of displacement, leading to physical and psychological stress. It also leads to economic disruption, often resulting in impoverishment and insecurity. Inadequate and unplanned resettlement, with little or no share in the benefits from the project that has caused this displacement, further increases the misery of those affected. A hostile host population in the new area only serves to aggravate the trauma. Fall out in the form of alcoholism, gambling, prostitution and even morbidity is not unknown.*

According to an interim report of Independent People's Tribunal on Dams in Arunachal Pradesh, these dams are likely to have serious environmental and social problems not only at the constructional sites but also in downstream as well as in upstream areas. These dam projects are going to employ large number of labourers from outside, as the region is sparsely populated. This process is going to have very negative impacts on the tribal population (Benjamin et al. 2008)**.** The total population of these indigenous groups is often small and are thus vulnerable

to the huge influx of outside labourers during the constructional activity. This will change the demographic profile of the region and is going to have serious impacts for these tribals. e.g. Raju Mimi a local activist against dam construction and journalist in Dibang valley believes that,

> *Huge influx of outsiders will create a demographic problem. The Idu Mishmi population is just 11,021. According to EIA of the Dibang project, about 5800 workforce will come from outside. You can imagine how we will become outsiders in our own lands. As our tribe has been declared as an endangered tribe by the United Nations, we need protection.*

Similarly Tony Mickrow, general secretary of the All Idu Mishmi Student Union also comments that,

> *A huge number of labour will be coming in from outside. Most of them will be coming from Bangladesh as there the cheapest labour is available. Our community will be compelled to move closer to China. The government of India is encouraging militancy.*

It is now clear that there is a serious threat to the culture and identity of the local population both, due to the influx of people from outside in large numbers as well as due to the destruction of natural resources which are not only resources but are part of the culture and identity of the local people (Dharmadhikary, 2008).

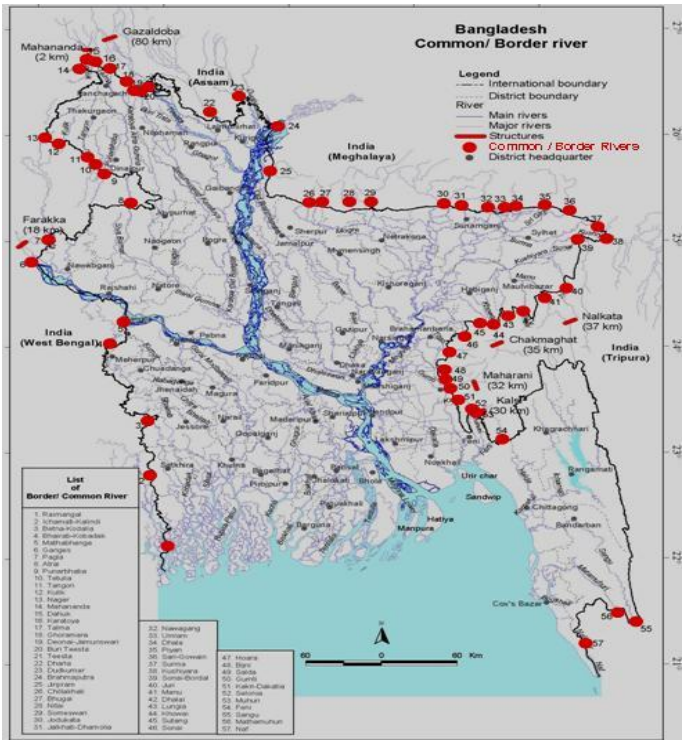
Another social impact of the dam building in Brahmaputra basin is loss of livelihood due to loss of resources on which people were sustaining e.g. their agricultural lands will be submerged, fish catch will decrease and also there will be shortage of fresh water supply as people of the basin are dependent on the River for their water supply because of these projects thereby increasing the vulnerability of food security in the basin. Besides they will be deprived of the forest resources like timber, fruits, fodder etc. due to submergence of forest land. Each tribal or indigenous group has its ancestrally demarcated area. Displacement or relocation of one tribe from their areas into the areas which belong to the some other tribe can lead to the ethnic tensions in the Himalayan region. Building of dams in the basin will also lead to the submergence of places of religious importance of these indigenous groups (Dharmadhikary, 2008). These dams

would seriously alter the flow of river downstream thereby affecting the quantity, quality as well as water flow patterns of river e.g. 2005 flash floods of Arunachal Pradesh took a heavy toll of life as well as property. Such drastic changes in flow pattern will increase the vulnerability and have serious negative impacts on people living downstream. As Brahmaputra River is a trans-boundary river, damming it will have far reaching social, environmental as well as political consequences.

4.3 International Relations

India and Bangladesh may be at the mercy of China for their water supply in Brahmaputra basin especially during the dry season. India is not as vulnerable for the water supply in the basin as is Bangladesh because Bangladesh is not only dependent on China but also on India for its surface water supply. It has one of the highest trans-boundary water dependencies in the world (Chellaney, 2011). Bangladesh has 57 transboundary rivers (See figure 12) out of which 54 come from India and the remaining three from Myanmar.[13]

Figure 12: Map Showing the Transboundary Rivers of Bangladesh



Source: http://www.farakkacommittee.com/Maps.php

[13] Ministry of Water Resources, Joint Rivers Commission Bangladesh. Retrieved from: http://www.jrcb.gov.bd/. Retrieved on 10/01/2014.

Table 1: List of Trans-boundary Rivers of Bangladesh

1	Raimangal	16	Karatoya	31	Jalokhali-Dhamalia	46	Sonai
2	Ichamati-Kalindi	17	Talma	32	Nawagang	47	Haora
3	Betna-Kodalia	18	Ghoramara	33	Umiam	48	Bijni
4	Bhairab-Kobadak	19	Deonai-Jamuneswari	34	Dhala	49	Salda
5	Mathabhanga	20	Buri-Teesta	35	Piyan	50	Gumti
6	Ganges	21	Teesta	36	Sari-Gowain	51	Kakri-Dakatia
7	Pagla	22	Dharla	37	Suma	52	Selonia
8	Atrai	23	Dudhkumar	38	Kushiara	53	Muhuri
9	Punarbhaba	24	Brahmaputra	39	Sonai-Bardal	54	Feni
10	Tentulia	25	Jinjiram	40	Juri	55	Sangu
11	Tangon	26	Chillakhali	41	Manu	56	Mathamuhuri
12	Kulik	27	Bhogai	42	Dhalai	57	Naf
13	Nagar	28	Nitai	43	Lungla		
14	Mohananda	29	Someswari	44	Khowi		
15	dahuk	30	jadukata	45	sutang		

Source: http://www.jrcb.gov.bd/57rivers.html

4.4 Implications of Dam Construction by China on India

Implications of dam construction on river Brahmaputra by China will be more of strategic importance than others for India, because Brahmaputra's major volume of water is generated from Indian side of border. Northeast region has a strategic significance because of rich natural resources like water, forests etc. (World Bank, 2007) i.e. why India's neighbours were interested in the region even in the past. Myanmar ruled a large part of the region including Assam and Manipur till 1826 before they lose it to the British after signing the Treaty of Yandabo (Mathur, 2011; Ojha and Singh, 2004). China's intentions are clear about the region. China is claiming Arunachal Pradesh as part of Tibet since 2006 and calling it as southern Tibet (Mathur, 2011).

China has started the construction of hydropower projects on Brahmaputra in Tibet. According to China, the dams being constructed or are planned on Brahmaputra are run of the river projects i.e. "*A power station utilizing the run of the river flows for generation of power with sufficient pondage for supplying water for meeting diurnal (daily) or weekly fluctuations of demand. In such stations, the*

normal course of the river is not materially altered (BIS: 4410)[14]." But the track record of China is very bad with its neighbours. China carry out the projects secretly without informing the downstream states e.g. till 2009 China was denying the plans of damming Brahmaputra but in 2010 China admitted the construction of first project i.e. Zangmu on the main stream of Brahmaputra during the India's Foreign Minister's (S M Krishna) visit to China in 2010 (Bhat, 2011). In news published in China Dialogue, Li Chaoyi, chief engineer at China Huaneng Group, the project's main contractor, told China Daily

> *The river will not be stopped during construction. After the project becomes operational, the river water will flow downstream through water turbines and sluices. So the water volume downstream will not be cut.*

But India is worried, particularly about one part of the Xinhua report, which said the project "can also be used for flood control and irrigation". This would require diversion and storage of water, experts have pointed out. There will be major impact downstream if water that flows down the Brahmaputra into India every year is diverted or reduced. "The biodiversity which have evolved over millions of years in the region be damaged," the Global Times quoted Wang Yongchen, the founder of Beijing-based Green Earth Volunteers, as saying (Gupta, 2010).

In January 2013 China approved the construction of three more hydropower projects on the middle reaches of the Brahmaputra in Tibet as part of its energy development plan for 2011-15 at Dagu, Jiacha and Jiexu on the river (Ronamai, 2013). This will affect the environment and livelihood of the people living downstream in India and Bangladesh which are mostly the poor sections of the society. The big hydropower projects will have very negative impacts on the lower riparian states as well as on the ecology and environment of the area. As the Brahmaputra flows through one of the biodiversity hotspots of the world, construction of dams would have negative impacts on the fluvial and aquatic ecosystems even if it would be the run-of-the-river project (Sethi, 2013). China can also use these dams as weapons against India in case of war due to their strategic location in the great bend area. The slope is very steep with a gradient of 4.3-16.8m/km. The river falls from more than 3000 meters to less than 1000 meters in

[14] Bureau of Indian Standards: http://www.bis.org.in/index.asp

less than a hundred kilometres distance as it crosses Indian border (Sarma, 1993). With such a steep slope water can cause a huge devastation when released suddenly.

According to Williams (2013), the Western line of the South-North Water Diversion Project is the line that will have the most impact on India. Although Beijing denies that it is considering diverting the Tsangpo (Jha, 2011). Authorities close to the government, however, say the line will be built and it has been approved in China's 12FYP (Schneider et al, 2011). Many commentators also believe it is a matter of when, not if, the line will be built (Wirsing, 2012). Brahma Chellaney (2011), one of India's foremost strategic thinkers, has also argued that it is not a question of "if but when" China will go ahead with the proposed diversion of Brahmaputra waters to its parched north. And he warns, that such a diversion "would constitute the declaration of a water war on lower-riparian India and Bangladesh."

4.5 Dam Construction by India on Brahmaputra

India being a middle riparian country on most of its transboundary rivers like Indus, Brahmaputra etc. is also constructing dams on its stretch of rivers. Till last century the construction of dams was concentrated on the rivers of north, central and south India. Brahmaputra basin in the northeast caught the attention of Indian government with the turn of century when Central Water Commission ranked the basin as number one in its preliminary ranking study in 2003 in terms of hydroelectric potential. 168 projects were identified in the basin with assessed power potential of 63,257 MW which is around 43% of the all India potential (Central Water Commission, 2009). Arunachal Pradesh alone has a capacity of 50328 MW which is about 80% of the total potential of the region (Ministry of Development of North Eastern Region, 2012).

These projects will greatly alter the river scape of the Brahmaputra and its tributaries in northeast. The projects which are under construction or proposed are considered as *fait accompli* by both state governments as well as the developers because the agreements of these projects have been accompanied by huge financial advances taken from project developers at the time of signing the deal, even before carrying out any Environmental Impact Assessment (KMSS, 2010).

The Government of Arunachal Pradesh has so far allotted about 140 hydropower projects with the total installed capacity (IC) of 41500 MW that is to be developed on various rivers, rivulets and nalahs in 7 major river basins viz. Tawang, Kameng, Dikrong, Subansiri, Siang, Dibang and Lohit. Out of these 140 projects 44 projects are of more than 100 MW each accounting for about 37, 000 MW which is round about 90% of the total allotted installed capacity. 50 projects with installed capacity of less than 25 MW comprise the remaining 10% (Ministry of Development of Northeastern Region, 2012).

4.6 Implications for Bangladesh

Bangladesh is a low lying riverine country formed by the confluence of three rivers of South Asia viz. Ganga, Brahmaputra and Meghna. These rivers are the lifeline to the people of Bangladesh as they provide waters for the agriculture, fish an important source of protein for the poorer sections of the society and replenish the soil during the annual flooding cycle. But these rivers originate outside Bangladesh. Bangladesh has one of the highest water dependencies in the world (91.44%).[15] Brahmaputra contributes the biggest volume of water in Bangladesh. Brahmaputra brings in about 600 km^3 per year or 54% of the total volume, the Ganges brings in about 344 km^3 per year or 31% and the Meghna brings in about 163 km^3per year or 15% of the total volume[16].

Any damming or diversion of the waters of Brahmaputra would bring catastrophe in Bangladesh. First the reduced volume of the fresh water to the delta would lead to the salinity incursion in the coastal areas which will lead to many problems like increased soil salinity, health issues e.g. high blood pressure, miscarriage among pregnant women, skin diseases etc. (Khan and Islam, 2011). Damming will also have negative impacts on the river's hydrology, sediment load and water quality. Increased salinity will also impact the mangroves in the delta, which act as barrier to the hurricanes and salinity incursion. Besides they are the home to many species of fish, plants and animals both big and small like Royal Bengal Tiger, Spotted deer, barking deer, jungle cats, fishing cat, monkey, Bengal fox, jackal, water monitor etc. Among the plants the most dominant species is Sundari tree

[15] http://www.fao.org/nr/water/aquastat/data/wrs/readPdf.html?f=WRS_BGD_en.pdf
[16] Hydro Projects in Tibet: Why China's Neighbors are Worried. Retrieved from: http://goodpal.hubpages.com/hub/Hydro-Projects-in-Tibet-Thirsty-Dragon-Restless-Neighbors. Retrieved on 18/12/2013.

which covers about 70% area of the delta. Fresh water inflow plays a very important role in determining the species diversity, biomass and forest structure of the delta (Rahman and Asaduzzaman, 2010). Reduced water levels will also have an impact on the agriculture as the quantity of silt and vital nutrients will be reduced by the Chinese and Indian dams on Brahmaputra. Domestic stability is directly correlated with the growth in agricultural sector which includes not only farming but fisheries, livestock and forestry (Ahmed, 2011), because the economy of Bangladesh is dominated by agricultural sector like any other country of the region (South Asia).

Fluctuating water levels during different seasons of the year is another problem which Bangladesh faces i.e. too much water during monsoon season and too little water during late fall and early summer (Titumir et al, 2012). Any damming of the river in the upper reaches would aggravate the problem by further reducing the water during dry season and increased volume during wet season (Chellaney, 2011). Normally the floods in Brahmaputra are not due to the snow or glacial melt but due to the monsoonal precipitation on the southern Himalayan slopes. China is building the dams in seismically active and geologically weak area. The region is hit by strong earthquakes. Big dams in the area will increase the risk of earthquakes which can lead to the dam break. Any dam break in the area will have a cascading effect because it will lead the break of more dams as dams are being built in a staircase manner (Peryman, 2013; Arpi, 2012). In that case worst hit country will be Bangladesh because Bangladesh has very high density of population as compared to the northeast India which is sparsely populated area.

4.7 Water Relations Tension between India and Bangladesh

India and Bangladesh share about fifty seven rivers, but there is only one water sharing treaty between the two that too was signed as late as 1996 (Hukil, 2013; Ray, 2012; Khalequzzaman and Islam, 2012). Water related tensions between India and East Pakistan (Bangladesh) surfaced for the first time in October 1951 when the Pakistan government raised the issue of construction of Farakka barrage which India was planning to construct in West Bengal with Indian government (Hossain, 1998; Islam, 1987). The motive behind the construction was to flush the silt form the Calcutta port and to supply fresh water to Calcutta (Tabassum, 2003). Negotiations started in 1960 and between 1960 and 1970 ten meetings were held

at various levels between India and Pakistan (Hossain, 1998). In 1970 it was settled that water will be delivered to East Pakistan through Farakka barrage. These agreements became base for the creation of Joint River Commission in 1972 to monitor the India-Bangladesh agreements on Ganges waters (Dutta, 2010). The Farakka barrage and feeder canal were commissioned in 1975. An agreement, which fixed the share of Bangladesh and India during the lean period (i.e. between January and May) was signed between India and Bangladesh in New Delhi in November 1975 valid for a period of forty days (Hossain, 1998).

Table 2: Share of water for India and Bangladesh from 21st April-31st May 1975 under the interim Agreement

Ten day period 1975	Total Dependable supply at Farakka	Amount for India		Amount for Bangladesh	
		Cusecs	%	Cusecs	%
21st-30th April	55,000	11000	20	44000	80
1-10 May	56500	12000	20.4	45000	79.6
11-20 May	59250	15000	25.3	44250	74.7
21-31 May	65500	16000	24.4	49500	75.6

Source: Hossain, (1998).

Bangladesh tried to internationalize the issue but failed. Bangladesh highlighted the issue at the 31st session of the United Nations General Assembly in 1976, but on the proposals of Senegal, Australia and Sri Lanka (Political Committee of the UN General Assembly), the issue was postponed to give the two countries time to solve it bilaterally. In 1977, the two countries signed the first treaty for a period of five years. In this treaty water at Farakka was divided in a ratio of 60:40 for Bangladesh and India between 1st January and 31st May, based on the availability of recorded flows at Farakka between 1948 and 1973.

In 1996 Bangladesh and India signed a new treaty. This treaty established a new formula for sharing of water at Farakka in dry season. According to this treaty, if the flow at Farakka is 70000 cusecs or less, 50% will be received by each country, if the flow is between 70000 & 75000 cusecs Bangladesh will receive 35000 cusecs and rest by India and if the flow is more than 75000 cusecs India will receive 40000 cusecs and rest by Bangladesh (Khalequzzaman and Islam, 2012; Sands, 1997).

But India is violating the clauses of Ganges Water Treaty by releasing excess water during monsoon season and reduced volumes during the dry season e.g. an analysis of the data carried out by Khalequzzaman and Zahidul Islam in 2012 revealed that during 2008, 2009 and 2011 Bangladesh received the right share of water during twelve out of fifteen intervals, while as in 2010 Bangladesh received the right share only in nine out of fifteen intervals (Islam and Khaliquzzaman, 2012). Such fluctuations in the flow of the river water volume will strain the relations between the two.

Table 3: Sharing of water between India and Bangladesh according to 1977 Agreement

Period	Flows Reaching Farakka (Based on 75% availability from observed data, 1948-73). (Cusecs)	Withdrawal by India at Farakka (Cusecs)	Release to Bangladesh (Cusecs)
January 1-10	98,500	40,000	58,500
11-20	89,750	38,500	51,250
21-31	82,500	35,000	47,500
February 1-10	79250	33000	46250
11-20	74000	31500	42500
21-28/29	70000	30750	39250
March 1-10	62250	26750	38500
11-20	63560	25000	38000
21-31	61000	25000	36000
April 1-10	59000	24000	35000
11-20	55500	20750	34750
21-30	55000	20500	34500
May 1-10	56500	21500	35000
11-20	59250	24000	35250
21-31	65500	26750	38750

Source: Ministry of Foreign Affairs, Government of Bangladesh.

Another point of contention between the two is Teesta river. Teesta after originating in Sikkim passes through northern parts of West Bengal and then to Bangladesh to merge with Brahmaputra (Ray, 2012; Rao, 2011). There is no

permanent agreement or treaty between India and Bangladesh to share the waters of Teesta. However an ad hoc agreement was signed between the two in 1983 for sharing of water during the dry season as there is no dearth of water during the monsoon season, according to which 36% is allocated for Bangladesh and 39% for India and the rest to be decided upon later (Rao, 2011). India and Bangladesh were set to sign a treaty on Teesta in September 2011, when Prime Minister of India Dr. Manmohan Singh was ready to sign a pact with Bangladeshi Prime Minister Sheikh Hasina regarding access to and use of Teesta water during his visit to Bangladesh. But the West Bengal Chief Minister Ms. Mumta Banerjee refused to approve the pact fearing the loss of water to the downstream Bangladesh during the dry season (Ray, 2012). In 2012, during the visit of Bangladeshi Foreign Minister Ms. Dipu Moni to India, She hinted that the bilateral relations will complicate if India cannot deliver on Teesta agreement (Times of India d, 2012).

The proposed Tipaimukh dam is another point of contention between India and Bangladesh. India unilaterally planned to build the dam just 100 kms from Bangladeshi border town of Sylhet (Askari, 2012). India did not inform Bangladesh about the project e.g. a member of Joint River Commission Mir Sajjad Hossain said "*we don't know what is going on there. He added that we came to know from our sources that India is planning a hydroelectric plant.*" The same point was reiterated by two ministers Abul Mal Muhith and Nurul Islam Nahid. Bangladesh also demanded data about Tipaimukh twice during the JRC meeting in 2003 and 2005, but India didn't provide us the data (Alamgir, 2009). India emphasises that the dam is meant for the generation of hydropower and flood control. This project is going to affect two important rivers of northeast Bangladesh i.e. Surma and Kushiara (Bisht, 2012) as it will reduce the water flow to these rivers which in turn will affect the water flow to Meghna river. It will have a profound impact on the environment and economy of at least seven northeastern districts of Bangladesh viz Sylhet, Sunamganj, Moulavibazar Habiganj, Brahmanbaria, Kishoreganj and Netrokona etc. (Zakaria, 2012; Hossain, 2006). It will endanger wildlife, agriculture and freshwater fisheries in a vast area especially in northeast Bangladesh due to regulated flows of the river Barak on which the dam is proposed which will lead to droughts and floods in dry and wet seasons alternatively (Askari, 2012).

All this is leading to the growing anti-India sentiments in Bangladesh besides the facts that India is allowing duty free access to 10 million pieces of readymade garments from Bangladesh, providing Nepal and Bhutan transit access to Bangladesh, promising to invest in Bangladesh's infrastructure sector, 225 Indian firms promising to invest Rs. 558.77 million as FDI in Bangladesh etc. (Das, 2012).

There are different international laws for the utilization of international water courses like Helsinki Rules, 1966 and UN Convention on the non-navigation use of international water courses 1997. According to article V of the UN Convention on the Non-navigation Use of International Water Courses

> *International water course shall be developed by water course states with a view to attaining optimal and sustainable utilization thereof and benefits therefrom, taking into account the interests of the water course states concerned, consistent with adequate protection of the water course.*
>
> *Watercourse States shall participate in the use, development and protection of an international watercourse in an equitable and reasonable manner. Such participation includes both the right to utilize the watercourse and the duty to cooperate in the protection and development thereof, as provided in the present Convention.*

Similarly according to article VII of Helsinki rules 1966

> *An existing reasonable use may continue in operation unless the factors justifying its continuance are outweighed by other factors leading to the conclusion that it be modified or terminated so as to accommodate a competing incompatible use.*

But no one cares about these laws and follows the dictum "might is right". The powerful states are pushing the weaker ones aside without caring about their fate. India is doing the same thing. It is building the dam unilaterally without caring the consequences the dam has not only on the downstream Bangladesh but also the local area (Hasan, 2012). India is also facing the same problem in the northeastern region, where China is constructing dams on the Brahmaputra river or Yarlung Tsangpo as it is known in Tibet on its stretch of Brahmaputra.

Chapter 5

Response of Indian Government

Indo-China water relations are not as old as their other political relations. The reason is that water was not regarded as important as it is now due to its dwindling supply. Many rivers of India have their origin from Tibetan water tower which is under control of China. China started damming the middle reaches of the Brahmaputra River, or the Yarlung Tsangpo as it is known in Tibet, with the inauguration of 510 MW Zangmu hydropower project on 8th November 2010 and now the approval of three more projects in January 2013 has raised concerns in India. The following paragraphs explain India China water related issues through analysing different MoUs signed by these two countries which will be followed by the response of Central and State governments on damming river Brahmaputra.

5.1 MOU's Between India and China

Indo-China water relations came to the fore when flash floods hit the Indian states of Himachal Pradesh and Arunachal Pradesh in 2000 (India Today, 2001). These floods originated in China due to breaching of dams. However China refused, but it was later on confirmed by the ISRO that these floods originated in China (Tibet Environmental Watch, 2000). Government of India took up the matter with China and in 2002 a Memorandum of Understanding was signed between governments of India and China regarding the provision of hydrological information (water level, discharge and rainfall in respect of three stations, namely, Nugesha, Yangcun and Nuxia) on Brahmaputra from 1st June to 15th October (Ranjan, 2013). This MoU expired in 2007. In April 2005 when Chinese Premier visited India, a Memorandum of Understanding was signed for the supply of hydrological data from China to India in flood season in respect of river Sutlej.

A new MoU was agreed between Ministry of Water Resources, Republic of India and Ministry of water Resources, People's Republic of China in 2010 (Press Information Bureau, 2013). In June 2008 during the visit of External Affairs Minister of India Pranab Mukherjee to China, the 2002 MoU was renewed for a period of five years which expired in 2007 and during the visit of Chinese Premier Li Kegiang to India in May last year (2013), this MoU has been renewed and will expire in June 2018. Earlier the data was shared between 1st June and 15th

October every year, but now the period has been extended and now the data will be shared between 15th May and 15th October every year, The MOU will be effective from May 2014. This was agreed when Indian Prime Minister Dr. Manmohan Singh visited China in October 2013 (SANDRP, 2013). Table 4 below shows the chronology of the MoU's signed between the two countries.

The Hon'ble President of the PRC paid a state visit to India from November 20-23, 2006. During the visit, it is was agreed to set up an Expert-Level Mechanism to discuss interaction and cooperation on provision of flood season hydrological data, emergency management and other issues regarding trans-border rivers as agreed between them. Accordingly, the two sides have set up the Joint Expert Level Mechanism. The Expert Group from Indian side is led by Joint Secretary level officers. Seven meetings of ELM have been held so far (see table 5 below).

5.2 Assurance over Contradiction

Dam construction was for the first time admitted by China to India during the visit of S. M. Krishna, Foreign Minister of India to China in April 2010. China said that apart from Zangmu, there will be four more projects on Brahmaputra (The Economic Times a, 2010; The Assam Tribune b, 2010). These projects will be run-of-the-river projects meant only for hydroelectric power generation, and are neither storage projects nor designed for water diversion. Officials at India's Ministry of External Affairs have, however, raised concerns over China's general lack of willingness to share information regarding the Zangmu project, meaning they had little means to verify claims on the construction plans and impact on flows (The Hindu a, 2010). Arunachal Pradesh government also raised its concerns regarding the Chinese dam building. They constituted an experts' technical committee comprising members from the Central Water Commission to study the downstream impact of the Chinese dam (The Assam Tribune c, 2010).

But China has said that it will build a run-of-the-river project on the river that will not affect the flow of the river, commented the then Water Resources Minister Pawan Kumar Bansal (The Assam Tribune d, 2010).

Table 4: Chronology of MoUs signed between India and China on Brahmaputra.

S. No.	Date	MoU	Venue
1.	2002	Government of India and China signed an MoU for provision of Hydrological information on Yaluzangbu/Brahmaputra River in flood season by China to India during the visit of Chinese Premier Zhu Rongji's six day visit to India in January 2002. Accordance to the MoU, the Chinese side provided hydrological data (Water Level, Discharge and Rainfall) in respect of three stations, namely, Nugesha, Yangcun and Nuxia located on river Brahmaputra from 1st June to 15th October every year, which was utilized in the formulation of flood forecasts by the Central Water Commission. This MoU expired in 2007.	New Delhi
2.	2008	On 5th June, India signed a new MoU upon Provision of Hydrological information of the Brahmaputra /Yaluzangbu river in flood season by China to India with a validity of five years with China. This was done during the visit of External Affairs Minister of India Shri Pranab Mukherjee to Beijing from June 4-7. Under this China has provided the hydrological data of the three stations during the monsoon season of 2010 onwards.	Beijing
3.	2013	During the visit of Chinese Premier Li Kegiang to India the MoU of 2008 has been extended till 5th June 2018.	New Delhi
4.	2013	During the visit of Prime Minister of India, Dr. Manmohan Singh to China in October, 2013, the Chinese side agreed to extend the data provision period agreed upon in the above MOU that is to start from May 15th May instead of 1st June to October 15th of the relevant year, from 2014 onwards.	Beijing

Source: Ministry of Water Resources, India

Table 5: Chronology of Expert-Level Mechanism Meetings

Meeting	Date	ELM	Venue
1st	19th-21st September, 2007.	Issues related to bilateral cooperation on exchange of hydrological information between the two countries were discussed.	Beijing
2nd	10th-12th April, 2008.	Work regulations of the Expert Level Mechanism were agreed and signed by the two sides. It has been agreed that the Expert Level Mechanism shall meet once every year.	New Delhi
3rd	21st-25th April, 2009.	Helped in understanding of each other's position for smooth transmission of flood season hydrological data.	Beijing
4th	26th-29th April, 2010.	Implementation plan on provision of Hydrological information on Yaluzangbu/Brahmaputra River in flood season was signed between the two countries.	New Delhi
5th	19th-22nd April, 2011.	Implementation Plan in respect of MoU on Sutlej was signed between the two countries.	Beijing
6th	17-20 July, 2012	Both the countries reached at several important understandings and a significant one of those understandings is – "The two sides recognized that trans-border rivers and related natural resources and the environment are assets of immense value to the socio-economic development of all riparian countries."	New Delhi
7th	14-18 May, 2013	Draft MoU and Implementation Plan on Brahmaputra river were finalized.	Beijing

Source: Press Information Bureau.

Arunachal Pradesh Power Minister Jabron Gamlin said on the sidelines of the two-day North East Power Minister's meet in Arunachal Pradesh that India should negotiate with China as well as the international community to ensure that the dam doesn't affect the flow of the river downstream (The Assam Tribune e, 2010). India also fears the water diversion from Brahmaputra to north China; however Inter-Ministerial Expert Group found that there is no water diversion project on the river till now (Assam Tribune f, 2010). Likewise the former Water Resource Secretary of the Government of India Ramaswamy R. Iyer raised his concern by saying that quantum of possible diversion and its impact should be examined (The Hindu a, 2010). The matter of water diversion was took up by Foreign Secretary Nirupama Rao on 16th November 2010 during the fourth round of the two countries' strategic dialogue which was held in Beijing over China's construction of a dam on the Brahmaputra River. She said she was assured by Chinese Vice-Foreign Minister Zhang Zhijun, that "Zangmu project was not designed to divert water" and would not affect "the welfare and availability of water to the population living in the lower reaches of the Brahmaputra". China also expressed its willingness to continue share hydrological data and flood management through the joint expert-level mechanism set up by the two countries in 2003 (The Hindu b, 2010; The Assam Tribune g, 2010). Assam Chief Minister Tarun Gogoi also cautioned the Central Government over the Chinese projects on Brahmaputra. He also stressed for a water sharing treaty between India and China on Brahmaputra (The Hindu d, 2010; The Assam Tribune h, 2010). Preneet Kaur, Minister of State for External Affairs, said that Foreign Minister of China has clarified that the construction of Zangmu dam would not have adverse impacts on the downstream areas as it would not store or regulate the volume of water, but Michael Buckley, a Canada-based writer and photographer who researched on the dams across the Tibetan Autonomous Region and made a film "Meltdown in Tibet" revealed that the dam may eventually affect the flow of water downstream as the dam is half way across the river (The Assam Tribune i, 2010). On January 2nd 2011 Sushil Kumar Shinde, the then Union Minister of Power told journalists in Agartala that India was not aware of any dam being constructed by China on Brahmaputra (The Assam Tribune j, 2011). Zhang Boting, Deputy Secretary-General of the Chinese Society of Hydropower Engineers, told The Hindu in an interview that power shortages means we have to build more dams on Brahmaputra. So far we have focussed on

Yellow and Yangtze rivers. But with growing power shortages, together with growing international pressure on China to reduce carbon emissions, it can no longer afford to leave the Tsangpo's potential untapped. Mr. Zhang further said that countries in the lower reaches will feel anxieties, but there will be no negative impact on the downstream countries. Mr. Zhang said that regardless of India's concerns, "*it was a question of when and not if*" the projects could go ahead. To save energy, we have to tap these south-western rivers (The Hindu e, 2011). Prime Minister Manmohan Singh in response to the China's move informed Rajya Sabha that we trust China as it will do nothing that will go against India's interests and it is in our interest to have best possible relations with China. This statement was given by intervening in the reply to a question put to External Affairs Minister, S.M. Krishna. The External Affairs Minister added that 'we trust but we verify'. Indian government is verifying Chinese claims on the dam being run-of-the-river project and a constant surveillance is kept across the border (The Assam Tribune n, 2011).

Even though China is admitting that under the situation of energy crisis tapping of river Brahmaputra will be a good option, the Central Government of India is assuring everyone about no such possibility. How far India can trust China under several experiences of distrust is a matter of question. It is actually just about overlooking the whole strategic situation. In all the dialogues on this damming issue the geology and biodiversity are never taken seriously. Several national and International agencies like Sichuan bureau of Geological Exploration and Exploration of Mineral Resources have raised their concern over damming a river in earthquake prone area. Even if China assures that no damage will be caused by the damming but the area, naturally prone to disasters will have severe ramifications. Apart from these concerns a question is about the surveillance mechanism kept across the border. It is nowhere clear that any monitoring is being done. Similar concerns were raised by Thailand, Laos, Vietnam and Cambodia over the construction of eight dams on Mekong River. But Chinese Government defended its dam projects on Brahmaputra and Mekong Rivers by assuring downstream countries that downstream flows will not be affected (The Hindu c, 2010).

Till now China has ruled out any water diversion plans from the Brahmaputra River. Hong Lei, Foreign Ministry spokesperson of Peoples Republic of China said in response to India's concerns about water diversion from Brahmaputra that, "We adopt a policy that protection goes together with development, and take into full consideration the interests of downstream countries" (The Assam Tribune p, 2012). China's water resource ministry has also ruled out any water diversion plan from Brahmaputra citing technical difficulties and relations with the neighbouring India as reasons.

According to The Economic Times, Brahmaputra almost dried up in Pashighat (Arunachal Pradesh) in March 2012. Taku Dabi, Political advisor to CM Nabam Tuki apprehended that river could have been diverted or artificially blocked (The Economic Times b, 2011). But Minister of State for Water Resources Vincet H. Pala said in a written reply to Rajya Sabha that there is no evidence of drying up of Brahmaputra in Arunachal Pradesh but the average monthly flows in Jan/Feb 2012 were at least 50 to 100 per cent higher than the corresponding average monthly flows during the previous years (2007-2011) (The Economic Times d, 2012). Pawan Kumar Bansal, the then Union Minister of Water Resources of India said that so far we have not find any such activity through which we believe that China has diverted Brahmaputra river. He said that various government agencies like NTRO,[17] National Remote Sensing Agency etc. are keeping a close eye on the activities on the Chinese side of Brahmaputra River (The Economic Times e, 2012). Hong Lei, Foreign ministry spokesperson of the People's Republic of China, told media reporters that our projects have not affected downstream areas. Other Chinese officials and engineers have time and again rejected water diversion project on Brahmaputra by saying that terrain of the area is difficult. Also Chinese vice Minister of water resources Jiao Yong rejected the diversion plan, citing the reasons like difficult terrain, environmental impact and political relations with the riparian states (The Hindu h, 2011).

According to D'souza (2012) China has never been daunted by engineering. They have carried out engineering projects like Great Wall, Three Gorges Dam, The Grand Canal etc. Wang Guangqian, who is the director of Tsinghua University's

[17] National Technical Research Organisation is a technical Intelligence agency under the National Security Adviser in the Prime Minister's Office, India.

State Key Laboratory of Hydro-science and Engineering, said that we can go for such projects with recent technological developments (The Hindu h, 2011).

In this ways several possibilities are coming in the way. Dam construction is being done and possibility of diversion plans is ruled out but engineering experts are admitting the feasibility of diversion in a difficult terrain. Indian government ignores the power and technological advancement and achievements of China.

5.3 Indian Government Senses no Harm from Chinese built Dams and River Diversion

Indian government downplayed the fears that dam construction at Zangmu on Brahmaputra river by China would impact the country because it is a run-of-the-river project, said S M Krishna the then External Affairs Minister. He said that we confirmed it from our own sources that Zangmu is a run-of-the-river project (The Assam Tribune k, 2011). But Professor Dulal Goswami argued that the design of the dam is that of a diversion project and Indian government should engage China in a serious dialogue over the issue by joining hands with other riparian countries of the basin (The Assam Tribune l, 2011). After a break of two years in approving the new hydropower projects on Brahmaputra River or Yarlung Tsangpo, China approved the construction of three new dams on 30th January 2013. These projects have been approved by the state council under the new energy development plan for the twelfth five year plan (2011-2015). Two of these dams (Jiexu and Dagu) lie upstream of the Zangmu project and one (Jiacha) lies downstream of it (The Hindu j, 2013; The Assam Tribune p, 2013). Official spokesperson in the Ministry of External Affairs said that government has conveyed its “views and concerns” to the Chinese authorities, including at the highest levels regarding the construction of three dams on the Brahmaputra in Tibet (The Hindu k, 2013; The Assam Tribune q, 2013). Assam CM Tarun Gogoi requested the Prime Minister Dr. Manmohan Singh to take up the matter with China to safeguard the interests of Assam and Northeast region (The Assam Tribune r, 2013).

China has shared little specific information regarding the status of approved or proposed projects with India. The issue was also taken up by National Security Adviser of India Shivshankar Menon with Chinese State Councillor Dai Bingguo in

December 2012 (The Hindu k, 2013). He said that the flows are as they were in the past. He also mentioned that there is no existing structure that can control the flow of river. China also said that its projects on Brahmaputra will not have negative impacts on the downstream countries but many of the China's neighbours in the past have raised concerns at the lack of information on new projects e.g. China's projects in the Xinjiang have raised concerns in Kazakhstan. Similarly the projects on Mekong River have raised concerns in Laos, Thailand, Vietnam and Cambodia due to lack of information sharing (The Hindu m, 2013). Same is the case with projects on Brahmaputra River, because China is not ready to enter into water sharing treaty with India or for that matter any of the lower riparian countries in South and Southeast Asia. China is sharing only a limited hydrological data for a limited period with India on Brahmaputra. In response to the China's three new projects on Brahmaputra, the then Union Water Resources Minister of India Harish Rawat said on 5th April 2013 that these projects would not impact the flow to India as they are Run-of-the-River Projects (The Hindu o, 2013). With China's approval of three more projects on Brahmaputra, Indian government also gave clearance to the 800 MW Tawang-II hydropower project in Arunachal Pradesh (The Assam Tribune s, 2013). Assam Chief Minister Tarun Gogoi in a meeting with the Union Water Resources Minister Harish Rawat stressed that government of India should take immediate steps to ensure international cooperation to thwart any action which could have negative impacts on the sustainability of the river. He also stressed that all the riparian countries should reach an understanding to ensure the regular water flow of the river so that environment and water balance in the region is sustained (The Assam Tribune u, 2013).

5.4 Absence of Water Treaty

In words of Mr. Iyer, the former Water Resource Secretary of the Government of India, the larger concern for India is the absence of any water treaty with China and so India has no power to object the Chinese move on river Brahmaputra. Unlike Indus river treaty where rules are defined for India and Pakistan, India cannot address water related issue. Also, China is not a signatory to the UN Convention on the non-navigation use of international rivers. India can only raise the issue in bilateral talks. The then Minister of External Affairs, S. M. Krishna,

instead of engaging China, has asked the state governments of Assam and Arunachal Pradesh that they should tap the waters of Brahmaputra as 80% of the catchment of Brahmaputra lies within India (The Hindu g, 2011; The Assam Tribune m, 2011).

5.5 Dam Unilateralism

Prime Minister Manmohan Singh also took up the matter with Chinese president Xi Jinping on 8th March 2013 on the sidelines of the 5th BRICS summit held at Durban South Africa. Prime Minister Dr. Manmohan Singh said that, he was assured by Chinese President Xi Jinping that his government was “quite conscious” of its responsibilities and the interests of lower riparian countries. The then Water Resources Minister Harish Rawat also said that the three new projects which are coming up on the Brahmaputra will not affect water flows to India as most of the water in the river comes from Arunachal Pradesh (The Hindu n, 2013, The Assam Tribune v, 2013). Prime Minister also said that there was no reason to worry about the China’s projects especially in the great Bend area as these projects are Run-of-the-River projects. India also uses this logic to defend its own projects on the international Rivers (The Hindu n, 2013). But the Inter-Ministerial Expert Group (comprising the officials from Ministry of External Affairs, Ministry of Defence and Department of Space) recommended the further monitoring of the Chinese activities on the Brahmaputra as the dam related peripheral activities had gathered speed at many places and advised that the matter should be taken up with China at proper levels (The Hindu p, 2013). India was pressing China to have either a water commission or a treaty or an inter-governmental dialogue to deal with the water issues between the two countries. This was done in response to the approval of three projects by China on Brahmaputra in January 2013.The issue was also taken up when an official from Chinese embassy met Ministry of External Affairs to give the details on the construction proposal of three projects (The Assam Tribune t, 2013). But China has rejected the proposal of India to have either a water commission or an intergovernmental dialogue or a treaty to deal with the water issues between the two countries. However China conveyed that current mechanism i.e. sharing of hydrological data during the rainy season was sufficient (The Hindu q, 2013). In May 2013 a group of experts visited China to review the data of water flow under the agreement, which was signed between the

two countries in 2008 and also convey its concerns over the construction of three new dams on the middle reaches of Brahmaputra. This was coincided by the visit of Chinese Premier Li Keqiang to India starting from 19th May 2013 (The Hindu r, 2013; The Economic Times g, 2013; The Assam Tribune w, 2013). During the visit of Chinese Premier to India, India and China renewed the pact for a period of five years on data sharing on the Brahmaputra which was expiring on 4th June 2013 (The Economic Times i, 2013). The new pact was signed by Chinese Ambassador to India Wei Wei and Water Resources Secretary of India S K Sarkar in presence of Dr. Manmohan Singh and Mr. Li Keqiang. Both the leaders expressed their willingness to expand cooperation on transboundary rivers. Chinese Premier Mr. Li Keqiang said he was ready to share more information on hydrology and rivers, but there was no word on setting up a joint mechanism which India is seeking for the transparency of thirty nine projects coming up on Brahmaputra and its tributaries in Tibet to address India's concerns (The Hindu s, 2013; The Economic Times h, 2013). On 23rd October 2013 India and China signed a new agreement on trans-border rivers aimed to relieve India's concerns over the construction of new dams on Brahmaputra during the visit of India's Prime Minister to China. In this agreement the period of data sharing was extended for fifteen days. Earlier the data was shared between 1st June and 15th October, now the data will be shared between 15th may and 15th October and also the data on emergency management (Press Information Bureau, 2013). In December 2013, China was planning three more projects on Brahmaputra river. This has been confirmed by the Indian government. This was said by the then Union Water Resources Minister Harish Rawat in reply to a Lok Sabha question by Ramen Deka. The Minister said that India has urged China to ensure that the interests of the lower riparian states are not harmed by their activities (The Assam Tribune x, 2013).

5.6 Opposite Side of the Coin

Indian government is taking the damming and diversion issue without any major implications so far. There are some allegations on the Indian government that the issue is being exaggerated to put more pressure on china because India itself had proposed a number of dams in Arunachal Pradesh (The Hindu t, 2013). As the river generates more water in Assam and Arunachal Pradesh than China so the people of these two states have the user rights. This is the reason why numerous

hydropower projects should be approved and constructed, according to the state government, in these two states. India is engaged in a massive dam-building exercise in Arunachal at the moment, ranging from mega dams to micro- and mini-hydel projects. This total more than 160 in number and it is not entirely certain that best practices are being followed in their construction. There have been complaints about taking into account the interests of the populations that are likely to be affected, in terms of providing proper information, and in ensuring adequate compensation, rehabilitation and resettlement processes. There are also doubts in many instances whether EIA studies have been conducted correctly, if at all. If the Indian government move is analysed other way round then proposal of more than 160 dams will have severe implications for Bangladesh and the issue has already been raised by the people of north-east of India. In fact it could raise the potential for conflict and bring regional instability. The whole issue gives some clarity. Being in the middle reaches of the river, India also plans to tap and utilise the water potential. In this way India cannot or should not put objection on dam construction by China.

Chapter 6

Conclusion and Recommendations

“Water which supports a boat can also sink it” is a Chinese proverb. It means that water which supports life can also threaten it, if not managed properly. Countries like India and China with huge population size are facing water shortages in populated areas. In order to deal with the problems of water shortage, both countries have started damming the transboundary rivers which is threating the survival of the people living downstream. China and India along with Bangladesh share Brahmaputra, one of the largest rivers of world. Brahmaputra being a transboundary river is very sensitive for the development because if one country will exploit the potential of the river without considering its impacts on the lower riparian states, there are chances of political strifes in the region.

Brahmaputra being a transboundary river is very crucial for the survival of people who depend on the river not only for the water supply but nutrient rich sediments brought down by the river during annual flooding cycle, as well as other resources. But the source of the river on the Tibetan plateau is threatened not only by the climate change and global warming, but also by the human intervention like construction of roads, railways, dams, mining etc. on the plateau. This will force authorities of these countries to frame policies through which they can secure their share of water without taking the downstream countries into consideration. Any reduction in the flow of river will have negative impacts on the downstream communities as well as on the river as reduced flows will result in the channel aggradation which could have devastating effects during flood season as main river channel will hold less water and it will inundate more areas. It will also reduce the navigation capacity of the river.

There is also a spatio-temporal variation in the availability of water resources in India as well as in China. China is facing water shortage problems in northern and western regions and its southern and eastern regions are water surplus. In order to deal with the problems of water shortages in the populous regions and also for generation of hydroelectricity to fuel their economies, both China and India have planned gargantuan projects on the river to deal with the problems of water shortage. China has started the great South-North water diversion project to divert

water from the water surplus south to parched north. Also dam building is carried out by both India and China.

The dam building spree and diversion plans by China to meet growing industrial, agricultural, and domestic/urban demands have the potential to trigger far-reaching economic, social, and environmental challenges. India has also proposed a dam building spree on Brahmaputra and its tributaries in the northeast, without considering the fate of the people of the region as well as Bangladesh. India has intensified its dam building plan on Brahmaputra in northeast to claim the first/prior user rights from china. But instead of gaining the prior appropriation, there should be an equitable distribution of transboundary water resources according to the internationally accepted principles like Helsinki Rules, 1967 and 1997 UN Convention on the non-navigation use of international water courses. Although there are some bilateral treaties signed in South Asia between India and her neighbours, but they need a review as they didn't fulfil the water needs of the people living in these basins. These treaties have been signed during the past century and since then the demand for water has increased manifold in these basins and these treaties should be reviewed according to the present water needs of the basins. Also these treaties are signed for separate development of the basins and not the joint development by the respective countries. The dam building spree by these countries on river Brahmaputra could have serious socio-political and environmental impacts as the river is transboundary in nature.

Apart from dealing with water shortages and generation of hydroelectricity, China has also political interests in dam construction in southeast Tibet on Brahmaputra. China is interested in strategically important India's northeast especially Arunachal Pradesh which China, since 2006, is calling southern Tibet, because of the rich natural resources like forests and water.

Problems related to International River cannot be handled by a country alone. When it comes to upstream downstream relationship of two countries water sharing issue becomes very crucial. Brahmaputra river water sharing and unilateral damming issues have yet not received much attention in both the countries at centre level. All the political dialogues and negotiations just remain on the table. Certain events like flood and ministerial or secretary level visits to China or India raised the issue of dam construction by China. China makes assurance

that no harm from the construction will be made and India is annoyed due to its incapacity to convince China to a river treaty or even a water-sharing agreement. Additionally, all efforts for a water commission or even an institutional arrangement for an inter-governmental dialogue on rivers has similarly come to grief.

Till date India and China have signed five MoUs/ /agreements on transboundary rivers with provisions to sharing Hydrological information in flood season. The question is how far India can trust on this information. India faced severe flood in the state of Himachal Pradesh in 2000, China did not share timely information with India about the creation of an artificial lake in Tibet. These activities by China have serious consequences for India's water and food security. It means that there remained many unaddressed issues related to water sharing agreement. Flood causes menace everywhere and becomes very difficult to manage. In fact flood monitoring system in India has not been efficient enough to give early warning. In the backdrop of past bitter relationship between India and China, India needs to establish climatic and hydrological monitoring stations at some places in north east of India. India has local weather report and forecast stations at Passighat and Guwahati but has no station that can monitor surface flow of river Brahmaputra. The accuracy of precipitation and river flow data depends primarily on the number of data-collection stations, and the number of rainfall stations is quite high in Bangladesh (Bahadurabad) but not in India. In fact, satellite based water flow can be used to find dynamical surface flow information in data scarce regions. Carrying out and funding research on the river flow dynamics are very important in order to manage disasters. Even though India is in middle reaches of the river but damage may be higher than anywhere else. Reliance only on the data provided by China may bring India into situation of extreme difficulty.

In any of the dialogue the third riparian country that is Bangladesh is not being involved. Flood in India will also have serious repercussion in Bangladesh. It is not only river Brahmaputra which require attention but all the rivers coming out from Tibet need river water agreements. Change in the flow in river Indus will create problem in Pakistan.

6.1 Hydrological Secrecy

It is not only the South Asian countries who maintain hydrological secrecy but the whole world does. All the upstream countries treat river flow data as secret issue. Hiding data causes disasters like disruption to farming and unnecessary damage and deaths from flooding. Bringing transparency and sharing hydrological data may build confidence among the countries and may resolve several expected conflicts.

6.2 Facilitating Cooperation between India and China

Although there is some sort of cooperation between India and China with regard to the exchange of hydrological data during the flood season on Brahmaputra and Sutlej, but India should pursue a higher level of cooperation on sharing of water resources with China. Both countries should cooperate in those areas which are a potential threat to both countries e.g. the problem of global warming and climate change is a major threat to the water resources of the region on which both countries depend. Both countries should cooperate with each other along with other countries of the region to mitigate the problems of climate change and global warming through research and technological exchange. India and China can share with each other the techniques of management of wastewater, as both countries are facing the problems of water scarcity and China tops the list of water wasters.

6.3 From Bilateralism to Multilateralism (India-China-Bangladesh-Nepal-Bhutan)

Most of the water treaties/agreements in South Asia are bilateral like the bilateral political relations of India. The rivers flowing from Tibet flows through more than two countries like in case of river Indus, it is flowing through China, India and Pakistan. Similar is the case with river Brahmaputra, which is flowing through China, India and Bangladesh. Any unilateral or bilateral development of the river by upper riparian country/countries would be disastrous for the lower riparian countries. All the countries sharing the river or water course should be taken into confidence before carrying out any developmental projects on such rivers like e.g. in case of Brahmaputra, all the riparian countries should be involved in the resolution of conflicts arising from the developmental projects or sharing of water resources.

Refrences

Ahmed, K. S. (2011). *Economical Development of Bangladesh- Problems & Its Solutions.* Retrieved from: http://www.theseus.fi/bitstream/handle/10024/38338/Ahmed_Kazi%20Siam.pdf?sequence=1. Retrieved on: 08/10/2013.

Akhtar, S. (2010). Emerging Challenges to Indus Water Treaty, Issues of compliance & transboundary impacts of Indian hydro projects on the Western Rivers. Institute of Regional Studies. *Quarterly Journal of the Institute of Regional Studies, 28*(4), 3-66.

Amarasinghe, U. A., Sharma, B. R., Aloysius, N., Scott, C., Smakhtin, V., & De Fraiture, C. (2005). *Spatial variation of water supply and demand across river basins of India.* Research Report 83. Colombo: International Water Management Institute, pp. 1-24.

Alamgir, M. (2009). *India's Tipaimukh dam: another Farakka for Bangladesh in the offing?* 12th-18th June 2009. BanglaPraxis: Research, Policy Analysis, Solidarity. Retrieved from: http://banglapraxis.wordpress.com/2009/06/12/indias-tipaimukh-dam-another-farakka-for-bangladesh-in-the-offing/. Retrieved on 10/01/2014.

Amarasinghe, U. A. (2005). *Spatial variation in water supply and demand across river basins of India.* Colombo, Sri Lanka: International Water Management Institute.

APCO Worldwide (2010, December 10). China's 12th Five-Year Plan: How it actually works and what's in store for the next five years. Retrieved from: http://apcoworldwide.com/content/PDFs/Chinas_12th_Five-Year_Plan.pdf. Accessed on 22/12/2013.

Arpi, C. (2012). *Feverish dam building*. Retrieved from: http://claudearpi.blogspot.in/2012/04/feverish-dam-building.html. Retrieved on: 07/11/2013.

—— (2008). Himalayan Rivers: Geoplitics and Strategic Perspectives. *Indian Defense Review, 23*(2), 57-65.

—— (2003, October 23). *Diverting the Brahmaputra: Declaration of War?* Rediffmail.com. Retrieved from: http://www.rediff.com/news/2003/oct/27spec.htm. Retrieved on: 05/10/2013.

Askari, R. (2012). *Tipaimukh Dam and Indian Hydropolitics*. Retrieved from: http://archive.thedailystar.net/forum/2012/January/tipaimukh.htm. Retrieved on: 10/01/2014.

Benjamin, V. M., Mow, S., Mihu, J., & Pralo, E. (2008). *Independent people's tribunal on dams in Arunachal Pradesh*. New Delhi: Human Rights Law Network, pp. 1-22.

Bhattarai, D. P. (2009). An Analysis of Transboundary Water Resources: A Case Study of River Brahmaputra. *Journal of the Institute of Engineering, 7*(1), 135-141.

Bisht, M. (2012). *Tipaimukh Dam: Some Myths, Some Facts*. Retrieved from: http://www.idsa.in/idsacomments/TipaimukhDam_mbisht_250412. Retrieved on: 02/12/2013.

Briscoe, J., and Malik, R. P. S. (2006). *India's water economy, bracing for a turbulent future*. New Delhi: Oxford University Press.

Brooks, N. (2007). *Impending Water Crisis in China*. Retrieved from: http://www.arlingtoninstitute.org/wbp/global-water-crisis/457#_ftn30. Retrieved on: 12/01/2014.

Brown, L. (2000). Falling water tables in China may soon raise food prices everywhere. *Chairman of the Board Worldwatch Issue Alert*.

CCES-TUWB (2010, December 21). *Breakthrough of Galongla Tunnel on Medong Highway in Tibet: the most difficult tunnel built in the world*. China Civil Engineering Society-Tunnel and Underground Works Branch. Retrieved from: http://www.cces-tuwb.com/En/shownews.asp?id=401. Retrieved on: 27/12/2013.

Central Water Commission. (2009). *National Register of Large Dams-2009.* Retrieved from: http://www.cwc.nic.in/main/downloads/National%20Register%20of%20Large%20Dams%202009.pdf. Retrieved on: 25/11/2013.

Chellaney, B. (2011). *Water: Asia's New Battle Ground*. Noida: HarperCollins Publishers.

Circle of Blue (2013, February 28). *China's Polluted Waters*. Retrieved from: http://www.circleofblue.org/waternews/2013/world/photo-slideshow-chinas-polluted-waters/. Retrieved on: 15/01/2014.

Cronin, R. (2009). Natural Resources and the Development-Environment Dilemma. In Richard Cronin and Amit Pandya, Henry L. (Eds.), *Exploiting Natural Resources: Growth, Instability, and Conflict in the Middle East and Asia* (pp. 63–81). Washington, DC: Stimson Center.

Das, P. (2012). *Check the Downslide in India-Bangladesh Relations*. Retrieved from: http://www.idsa.in/idsacomments/ChecktheDownslideinIndiaBangladeshRelations_pdas_040112. Retrieved on: 14/01/2014.

Datta, B., and Singh, V. P. (2004). Hydrology. In Singh, V. P., Sharma, N. and Ojha, C. S. P. (Eds.), *The Brahmaputra basin water resources* (pp. 139-195.). The Netherlands: Kluwer Academic Publishers.

Dharmadhikary, S. (2008). *Mountains of Concrete: Dam Building in the Himalayas*. Berkeley: International Rivers.

D'souza, R. (2012, January 1st). How not to discuss water with China. *The Hindu*. Retrieved from: http://www.thehindubusinessline.com/opinion/columns/how-not-to-discuss-water-with-china/article2766410.ece?ref=relatedNews. Retrieved on: 12/08/2013.

Dutta, P. (2010). *India-Bangladesh Relations: Issues, Problems and Recent Developments*. New Delhi: Institute of Peace and Conflict Studies.

Environmental News Network (2004, November 17). *China's Massive South-North Water Diversion Project Facing Money Woes.* Retrieved from: http://www.enn.com/top_stories/article/384. Retrieved on: 02/08/2013.

Environmental News Service (2012). *China Builds Scores of Dams in Earthquake Hazard Zones*, ENS 4th April 2012. Retrieved from: http://ens-newswire.com/2012/04/04/china-builds-scores-of-dams-in-earthquake-hazard-zones/. Retrieved on: 12/11/2013.

European Commission (2009, May 29). *China's CO_2 emissions to double by 2030*. Retrieved from: http://ec.europa.eu/environment/ecoap/about-eco-innovation/policies-matters/eu/390_en.htm. Retrieved on: 02/01/2014.

Frauenfelder, R., & Kaab, A. (2009). *Glacier mapping from multitemporal optical remote sensing data within the Brahmaputra river basin*. Paper presented at the 33rd International Symposium on Remote Sensing of Environment. Retrieved from:

http://folk.uio.no/kaeaeb/publications/299_R.Frauenfelder.pdf. Retrieved on 02/01/2014

Fu, S. (1998). A Profile of Dams in China. In D. Qing, J. G. Thibodeau and P. B. Williams (Eds.), *The River Dragon Has Come!: The Three Gorges Dam and the Fate of China's Yangtze River and its People* (pp. 18-24). USA, International Rivers Network.

Gain, A., Immerzeel, W., Sperna-Weiland, F., & Bierkens, M. (2011). Impact of climate change on the stream flow of lower Brahmaputra: trends in high and low flows based on discharge-weighted ensemble modelling. *Hydrology and Earth System Sciences Discussions, 8*(1), 365-390.

Gaur, A., & Amerasinghe, P. (2011). *A River Basin Perspective of Water Resources and Challenges*. India Infrastructure Report. New Delhi: Oxford University Press, pp. 3-17.

Gingsburg , G., and Mathos, M. (1964). *Communist China and Tibet*. The Hague: Nijhoff.

Gleick, P. H. (2009). *Three Gorges Dam project, Yangtze River, China, Water Brief 3.* Retrieved from: http://www.worldwater.org/data20082009/WB03.pdf. Retrieved on: 5/12/2013.

—— (2008). *Water Conflict Chronology*. Pacific Institute for Studies in Development, Environment, and Security.

Gupta, J. (2010). Nervous Neighbours. *Chinadialogue*. Retrieved from: https://www.chinadialogue.net/article/show/single/en/3959. Retrieved on: 20/08/2013.

Hanghal, N. (2013, November 15). *Mini Hydro Projects to Arunachal Pradesh's Rescue.* The Third Pole. Retrieved from: http://www.thethirdpole.net/mini-hydro-projects-to-arunachal-pradeshs-rescue/. Retrieved on: 20/12/2013.

Hasan, H. (2012). *Tipaimukh Dam: Disaster for Bangladesh*. Retrieved from: http://hasanuzzamanhasan.blogspot.in/2012/05/tipaimukh-dam-disaster-for-bangladesh.html. Retrieved on: 15/01/2014.

Holslag, J. (2011). Assesing the Sino-Indian Water Dispute. *Journal of International Affairs, 64*(2), 19-35.

Horgan, J. (1996). "Peaceful" Nuclear Explosions. *Scientific American, 274*(6), 14-16.

Hossain, M. A. (2006). Tipaimukh Dam of India: Probable Disaster for Bangladesh. Retrieved from: http://archive.riversymposium.com/2006/index.php?element=06HOSSAIN+MAnowar. Retrieved on: 15/01/2014.

Hossain, I. (1998). Bangladesh-India Relations: The Ganges Water-Sharing Treaty and Beyond. *Asian Affairs, 25*(3), 131-150.

Hukil, R. (2013, February 25). Teesta Water Accord: Expectations for Indo-Bangladesh Water Diplomacy. *Institute of Peace and Conflict Studies*.

Immerzeel, W. (2008). Historical trends and future predictions of climate variability in the Brahmaputra basin. *International Journal of Climatology, 28*(2), 243-254.

Immerzeel, W. W., van Beek, L. P., & Bierkens, M. F. (2010). Climate change will affect the Asian water towers. *Science, 328*(5984), 1382-1385.

India Today (2012, March 2). *China diverting Tibet water northwards*. Retrieved from: http://indiatoday.intoday.in/story/china-diverting-tibet-water-northwards/1/176206.html. Retrieved on: 23/11/2013.

India Today (2001). *Made in China: Floods ravage Himachal and Arunachal Pradesh, satellite pictures suggest China's hand*. Retrieved from: http://indiatoday.intoday.in/story/floods-ravage-himachal-and-arunachal-pradesh-satellite-pictures-suggest-china-hand/1/232112.html. Retrieved on: 25/11/2013.

.International Energy Agency. (2008). *World Energy Outlook*. Retrieved from: http://www.worldenergyoutlook.org/media/weowebsite/2008-1994/WEO2008.pdf. Retrieved on: 20/12/2013.

International Law association. (1967). *The Helsinki Rules on the Uses of the Waters of International Rivers*. Retrieved from: http://webworld.unesco.org/water/wwap/pccp/cd/pdf/educational_tools/course_modules/reference_documents/internationalregionconventions/helsinkirules.pdf. Retrieved on: 16/12/2013.

International Policy Digest (2013). *China's Dams: A Security Challenge for South Asia*. Retrieved from: http://www.internationalpolicydigest.org/2013/10/01/chinas-dams-security-challenge-south-asia/. Retrieved on: 23/11/2013

Islam, M. R., Begum, S. F., Yamaguchi, Y., & Ogawa, K. (1999). The Ganges and Brahmaputra rivers in Bangladesh: basin denudation and sedimentation. *Hydrological Processes, 13*(17), 2907-2923.

Islam, M. R. (1987). The Ganges Water Dispute: An Appraisal of a Third Party Settlement. *Asian Survey, 27*(8), 918-934.

Islam, Z., & Khalequzzaman, M. (2012, June 11). Ganges Water Treaty: Dead or Just Dying. *bdnews24.com*. Retrieved from: http://opinion.bdnews24.com/2012/06/11/ganges-water-treaty-dead-or-just-dying/. Retrieved on: 10/01/2014.

Jacob, J. T. (2011). The Sino-Indian Boundary Dispute: Sub-National Units as Ice-Breakers. *Eurasia Border Review, 2*(1), 35-45.

Jain-Cocks, K. (2011). *China's Decade Plan for Water*. Retrieved from: http://blogs.ei.columbia.edu/2011/10/24/chinas-decade-plan-for-water/. Retrieved on: 15/09/2013.

Jha. H. B. (2011). Diversion of the Brahmaputra: Myth or Reality? *Institute for Defence Studies and Analysis*. Retrieved from: http://www.idsa.in/idsacomments/DiversionoftheBrahmaputraMythorReality_hbjha_090811. Retrieved on: 12th November 2013.

Jiang, Y. (2009). China's water scarcity. *Journal of Environmental Management, 90*(11), 3185-3196.

jing, Y. X. (2010). The Utilization Rate of Recycling Wastewater in Beijing Achieves 65%, Ranks the Top of China, *Beijing Daily*, Mar. 27, 2010. Retrieved from: http://news.qq.com/a/20100327/000553.htm. Retrieved on: 02/12/2013.

Khalequzzaman and Islam Z. (2012, November 2nd). *Success and failure of the Ganges Water-sharing Treaty*. Retrieved from: http://wreforum.org/khaleq/blog/5689. Retrieved on: 10/01/2014.

Khan, A. E., and Islam, M. I. (2011, June 5). Water salinity and maternal health. *The Daily Star*. Retrieved from: http://archive.thedailystar.net/newDesign/news-details.php?nid=188591. Retrieved on: 18/12/2013.

Kokab, R., and Nawaz, A. (2013). Indus Water Treaty: Need for Review. *Asian Journal of Social Sciences & Humanities, 2*(2), 210-218.

Krishak Mukti Sangram Samiti (2010). Press Release, Seeking a moratorium on clearances for large dams in Northeast India. India Water Portal. Retrieved from: http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Seeking%20a%20moratorium%20on%20clearances%20for%20large%20dams%20in%20Northeast%20India_Press%20release_KMSS_23%20Nov%202010.pdf. Retrieved on: 02/11/2013.

Lan M. (2012). Geological Expert Yang Yong on the Challenges Facing China's Most Controversial Dam Projects. *Probe International.* Retrieved from: http://journal.probeinternational.org/2012/01/05/geology-expert-yang-yong-on-the-challenges-facing-chinas-most-controversial-dam-projects/. Retrieved on: 12/11/2013.

Li, Z. (2005, December 6). Expert: Half of Chinese Cities Have Polluted Groundwater. *Worldwatch Institute*. Retrieved from: http://www.worldwatch.org/expert-half-chinese-cities-have-polluted-groundwater. Retrieved on: 21/09/2013.

Lieberthal, K. (2004). *Governing China. From revolution through reform*. New York: Norton Publishers.

Luft, G. (2006). *Fueling the dragon: China's race into the oil market*. Institute for the Analysis of Global Security. Retrieved from: http://www.iags.org/china.htm. Retrieved on: 24/09/2013.

Mahanta, C. (2013, May 18). Data and information management for transboundary rivers in India. Asia Pacific Water Summit 2013. Retrieved from: http://info.apwatersummit2.org/. retrieved on: 19/10/2013.

—— (2006). Water Resources of the Northeast: State of the Knowledge Base. C Mahanta - Background Paper 2, 2006. Retrieved from: http://siteresources.worldbank.org/INTSAREGTOPWATRES/Resources/Background_Paper_2.pdf. Retrieved on: 10/01/2014.

Malhotra, P. (2010, June 30). China's Dam on the Brahmaputra: Cause for Concern? *Institute of Peace and Conflict Studies*.

Milliman, J. D., & Meade, R. H. (1983). World-Wide Delivery of River Sediment to the Oceans. *The Journal of Geology, 91*(1), 1-21.

Milliman, J. D., & Syvitski, J. P. (1992). Geomorphic/tectonic control of sediment discharge to the ocean: the importance of small mountainous rivers. The *Journal of Geology, 100,* 525-544.

Ministry of Development of North Eastern Region (2012). Development of Hydropower. Retrieved from: http://www.mdoner.gov.in/content/hydro-power-projects. Retrieved on: 20/11/2013.

Ministry of Water Resources (2002). *National Water Policy*. Retrieved from: http://wrmin.nic.in/writereaddata/linkimages/nwp20025617515534.pdf. Retrieved on: 19/12/2013.

Ministry of Water Resources PRC and National Bureau of Statistics PRC (2011). China Census for Water: Bulletin of First national Census for Water. Retrieved from: http://www.mwr.gov.cn/2013pcgb/merge1.pdf. Retrieved on: 28/11/2013.

Mirza, M. M. Q. (2003). Three recent extreme floods in Bangladesh: a hydro-meteorological analysis. *Natural Hazards, 28*(1), 35-64.

—— (2002). Global warming and changes in the probability of occurrence of floods in Bangladesh and implications. *Global Environmental Change, 12*(2), 127-138.

Mohile, A. D. (2001). Brahmaputra: Issues in Development. In: Biswas, A. K. and Uitto, J. I. (Eds.), 2001. *Sustainable Development of the Ganges-Brahmaputra-Meghna Basins* (pp. 58-79). Tokyo, United Nations University Press.

Moore, S. (2013, February 12). Issue Brief: Water Resource Issues, Policy and Politics in China. Retrieved from: http://web.mit.edu/mission/www/m2017/pdfs/china.pdf. Retrieved on: 02/10/2013.

Mukhopadhyay, B. (2013). Signature and hydrologic consequences of climate change within the upper-middle Brahmaputra Basin. *Hydrological Processes, 27*(15), 2126-2143.

Our Energy (2008, March 21). China – Hydropower as the right solution? Retrieved from: http://www.our-energy.com/china_hydropower_as_the_right_solution.html. Retrieved on: 08/08/2013.

Paskal, C. (2010). *Global warring: How environmental, economic, and political crises will redraw the world map*.New York: Palgrave Macmillan.

Peryman, L. (2013). Too Dam Much. Retrieved from: http://journal.probeinternational.org/2013/02/09/too-dam-much/. Retrieved on: 05/11/2013.

Postel, S. L. (2000). Entering an era of water scarcity: the challenges ahead. *Ecological Applications, 10*(4), 941-948.

Postel, S. L., & Wolf, A. T. (2001) Dehydrating Conflict. *Foreign Policy, 126,* 60-67.

Press Information Bureau (2013). MoU between the Ministry of Water Resources, India and the Ministry of Water Resources, China on strengthening cooperation on trans-border rivers. Retrieved from: http://pib.nic.in/newsite/PrintRelease.aspx?relid=100181. Retrieved on: 05/12/2013.

Rahman, M. M., & Varis, O. (2009). Integrated water management of the Brahmaputra basin: Perspectives and hope for regional development. *Natural Resources Forum, 33*(1), 60-75.

Rahman, M. R., & Asaduzzaman, M. (2010). Ecology of Sunderbans, Bangladesh. *Journal of Science Foundation, 8*(1&2), pp. 35-47.

Ranjan, A. (2013). *India-China MoU on Transboundary Rivers*. Retrieved from: http://www.icwa.in/pdfs/VPindiachinamou.pdf. Retrieved on 06/12/2013.

Ranjan, R. (2010, August 12). Damming the Brahmaputra: Setback to South Asian Stability? *Institute of Peace and Conflict Studies*. Retrieved from: http://www.ipcs.org/article/china/damming-the-brahmaputra-setback-to-south-asian-stability-3211.html. Retrieved on: 17/09/2013.

Ray, A. (2012). India, Bangladesh: Water Disputes and Teesta River Diplomacy. Retrieved from: http://globalvoicesonline.org/2012/06/08/india-bangladesh-water-disputes-and-teesta-river-diplomacy/. Retrieved on: 02/09/2013.

Rao, R. (2011). *Water Wars*. Retrieved from: http://himalmag.com/blogs/blog/2011/11/10/water-wars/. Retrieved on: 08/08/2013.

Rees, H. G., & Collins, D. N. (2006). Regional differences in response of flow in glacier-fed Himalayan rivers to climatic warming. *Hydrological Processes, 20*(10), 2157-2169.

Robinson, D. (1999). Northern Hemisphere snow cover during the satellite era. Paper presented at the 5th Conference on Polar Meteorology and Oceanography. *American Meteorological Society*, 255-260.

—— (1997). Hemispheric snow cover and surface albedo for model validation. *Annals of Glaciology, 25,* 241-245.

Saikia, P. J. (2013, July 17). Brahmaputra – The Beautiful River or The Battleground? *SANDRP.* Retrieved from: http://sandrp.wordpress.com/2013/07/17/brahmaputra-the-beautiful-river-or-the-battleground/. Retrieved on: 20/10/2013.

Salehin, M., Khan, M. S. A., Prakash, A., & Goodrich, C. G. (2011). *Opportunities for Trans-boundary Water Sharing in The Ganges, The Brahmaputra, and The Meghna Basins.* India Infrastructure Report. New Delhi: Oxford University Press, pp. 29-43.

SANDRP (2013). Media Hype v/s Reality: India-China Water Information Sharing MoU of Oct 2013. Retrieved from: http://sandrp.wordpress.com/2013/10/24/media-hype-vs-reality-india-china-water-information-sharing-mou-of-oct-2013/. Retrieved on: 29/11/2013

Sands, P. (1997). Bangladesh-India: Treaty on Sharing of the Ganges Waters at Farakka. *International Legal Materials, 36*(3), 519-528.

Sarfraz, H. (2013). Revisiting the 1960 Indus Waters Treaty. *Water International, 38*(2), 204-216.

Sarma, J. N. (1993). The longitudinal profile of the Brahmaputra River. Durham: Elesvier.

—— (2005). Fluvial process and morphology of the Brahmaputra River in Assam, India. *Geomorphology, 70*(3), 226-256.

Schneider, K. (2011, february 24). Coal is China's Largest industrial water consumer. Retrieved from: http://grist.org/article/2011-02-23-coal-is-chinas-largest-industrial-water-consumer/. Retrieved on: 12/12/2013.

Schneider, K., Turner, J. L., Jaffe, A., & Ivanova, N. (2011). Choke Point China: Confronting Water Scarcity and Energy Demand in the World's Largest Country. *Vermont Journal of Environmental Law, 12*(3), 714-733.

Sekiguchi, R. (2006). Water Issues in China– Stanford Programme on International and Cross cultural Education. Retrieved from: http://spice.stanford.edu/docs/113. Retrieved on: 13/11/2013

Shalizi, Z. (2006). Addressing China's growing water shortages and associated social and environmental consequences*. World Bank policy research working paper (3895).*

Shao, X., Wang, H., & Wang, Z. (2003). Interbasin transfer projects and their implications: A China case study. *International Journal of River Basin Management, 1*(1), 5-14.

Singh, P., & Bengtsson, L. (2005). Impact of warmer climate on melt and evaporation for the rainfed, snowfed and glacierfed basins in the Himalayan region. *Journal of Hydrology, 300*(1), 140-154.

Singh, S. K. (2006). Spatial Variability in erosion in the Brahmaputra Basin: Causes and Impacts. *Current Science, 90*(9), 1272-1275.

Sinha, U. K. (2012). Examining China's Hydro-Behaviour: Peaceful or Assertive? *Strategic Analysis, 36*(1), 41-56.

Siwakoti, D. G. (2011). Trans-boundary River Basins in South Asia: Options for Conflict Resolution. Retrieved from: http://www.internationalrivers.org/files/attached-files/transboundaryriverbasins.pdf. Retrieved on: 16/11/2013.

Smakhtin, V., Revenga, C., & Doll, P. (2004). A pilot global assessment of environmental water requirements and scarcity. *Water International, 29*(3), 307-317.

Stobdan, P. (2009). China should not use water as a threat multiplier: *IDSA.* Retrieved from: http://www.idsa.in/idsastrategiccomments/Chinashouldnotusewaterasathreatmultiplier_PStobdan_231009. Retrieved on: 20/12/2013.

Stricherz, V. (2012). Landslides linked to plate tectonics create the steepest mountain terrain. Retrieved from: http://www.washington.edu/news/2012/05/30/landslides-linked-to-plate-tectonics-create-the-steepest-mountain-terrain/. Retrieved on: 15/11/2013.

Subramanian, V. (1993). Sediment load of Indian rivers. *Current Science, 64*(11 & 12), 928.

Tabassum, S. (2003). Indo-Bangladesh Treaty on Farakka Barrage and International Law Application. *Pakistan Horizon, 56*(3), 47-62.

Tan, D. (2013, May 9). Water for Coal: Thirsty Miners? Retrieved from: http://chinawaterrisk.org/resources/analysis-reviews/water-for-coal-thirsty-miners-feel-the-pain/. Retrieved on: 05/12/2013.

Thukral, E. G., & Sakate, M. (1992). Baliraja: A People's Alternative. In E. G. Thukral (Eds.), *Big Dams, Displaced People* (pp. 143-154). New Delhi: Sage Publishers.

Tibet Environmental Watch (2000). Chinese Official Confirms a China Dam Break Caused India Floods. Retrieved from: http://www.tew.org/archived/dam.breach.html. Retrieved on: 13/11/2013.

Titumir, R. A., Baten, M. A., & Chowdhury , F. A. (2012). Environmental Security in Relation to Trans-boundary Water Regime: A Situation Analysis of GBM Basin. Retrieved from: http://www.indiaenvironmentportal.org.in/files/file/Environmental%20Security%20in%20Relation%20to%20Transboundary%20Water%20Regime.pdf. Retrieved on: 02/11/2013.

Toor, A. (2013, April 3). Why did 28,000 rivers in China suddenly disappear? Retrieved from: www.theverge.com/2013/4/3/4175514/china-rivers-dissappear-from-the-map-water-supply-crisis. Retrieved on: 27/11/2013

Tsering, C. (2011, November 18). Changing Discourse on the Diversion of the Brahmaputra. *Institute of Peace and conflict Studies.* Retrieved from: http://www.ipcs.org/article/india/changing-discourse-on-the-diversion-of-the-brahmaputra-3492.html. Retrieved on: 18/07/2013.

Tsering, T. (2010, May 24). Damming Tibet's Yarlung Tsangpo-Brahmaputra and Other South Asian Rivers. Tibetan Plateau blogspot. Retrieved from: http://www.tibetanplateau.blogspot.com/2010/05/damming-tibets-yarlung-tsangpo.html. Retrieved on: 20/10/2013.

Turner , J. L., Shifflett, S. C., & Batten, R. (2013). China's Upstream Advantage in the Great Himalayan Watershed. *Asia Policy, 16,* 11-18.

Vagholikar, N., & Das, P. J. (2010). Damming Northeast India: Juggernaut of Hydropower Projects Threatens Social and Environmental Security of Region. *Kalpavriksh, Aaranyak and ActionAid India*, 1-20.

Wang, Y. (2013). *China's South-North Water Diversion Project Starts To Supply Water*. Retrieved from:

http://www.forbes.com/sites/ywang/2013/12/10/chinas-south-north-water-diversion-project-starts-to-supply-water/. Retrieved on: 15/11/2013.

Warrick, R. A., Bhuiya, A. H., and Mirza, M. Q. (1996). The greenhouse effect and climate change. In R. A. Warrick and Q. K. Ahmad (Eds.), *The Implications of Climate and Sea-Level Change for Bangladesh* (pp. 35-96). The Netherlands: Kluwer Academic Publishers.

Water in a Changing World. The United Nations World Water Development Report 3 (2009). United Kingdom: Earth Scan.

Water Technology (2013). South-to-North Water Diversion Project, China. Retrieved from: http://www.water-technology.net/projects/south_north/. Retrieved on: 05/09/2013.

Watts, J. (2010, May 24). Chinese engineers propose world's biggest hydro-electric project in Tibet. *The Guardian*. Retrieved from: http://www.theguardian.com/environment/2010/may/24/chinese-hydroengineers-propose-tibet-dam. Retrieved on: 20/11/2013.

Williams, J. (2013). *The International Implications of China's Water Policies.* Retrieved from: http://www.e-ir.info/2013/02/15/chinas-water-policies-and-their-international-implications/. Retrieved on: 30/07/2013.

Wirsing, R. G. (2012). The Brahmaputra: Water hotspot in Himalayan Asia. Global Water Forum.

Wolf, A. T. (2007). Hydropolitical vulnerability and resilience: Series introduction. United Nations Environment Programme, Hydropolitical Vulnerability and Resilience along International Waters. Latin America and the Caribbean, United Nations Environment Programme-Universidad Nacional de Costa Rica-Oregon State University, Corvallis, USA, 29-60.

World Commission on Dams. (2000). *Dams and Development: A New Framework for Decision-making: the Report of the World Commission on Dams*. London: Earthscan.

World Water Assessment Programme. (2009). *Water in a changing world*: Unesco. Retrieved from: http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/wwdr/wwdr3-2009/. Retrieved on: 02/10/2013

Wouters, P. (2013). China's ‘Soft-Path’ to Transboundary Water Cooperation Examined in the Light of Two UN Global Water Conventions–Exploring the ‘Chinese Way’. Available at SSRN.

Yan, F. Daming, H. & Kinne, B. (2006). Water resources administration institution in China. *Water Policy, 8*(4), 291-301.

Zakaria. (2012). Tipaimukh Dam Dispute and Bangladesh-India Relation. Retrieved from: http://zakaria062.blogspot.in/2012/06/tipaimukh-dam-dispute-and-bangladesh.html. Retrieved on: 20/12/2013.

Zhong, L., & Mol, A. P. (2010). Water price reforms in China: policy-making and implementation. *Water Resources Management, 24*(2), 377-396.

Newspapers

People’s Daily (2002, June 07). Water Shortage Worries Researchers. Retrieved from: http://www.china.org.cn/english/2002/Jun/34067.htm. Retrieved on 12/01/2014.

The Economist (2006, May 25). The Three Gorges dam: A terrible beauty is born. Retrieved from: http://www.economist.com/node/6982326. Retrieved on: 15/07/2013.

The Guardian (2008, October 14). China plans string of dams in south Tibet. Retrieved from: http://www.theguardian.com/world/2008/oct/14/china-tibet. Retrieved on: 03/10/2013.

The Times of India a (2009, October 17). Brahmaputra dam will leave Assam dry. Retrieved from: http://timesofindia.indiatimes.com/india/Brahmaputra-dam-will-leave-Assam-dry/articleshow/5133318.cms?referral=PM. Retrieved on: 03/10/2013.

The Economic Times a (2010, April 22). China admits to Brahmaputra project. Retrieved from: http://articles.timesofindia.indiatimes.com/2010-04-22/india/28126091_1_zangmu-brahmaputra-india-and-china. Retrieved on: 13/08/2013.

The Assam Tribune a (2010, April 22). Chinese dam will not affect Brahmaputra: Krishna. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=aug0411/at014. Retrieved on: 17/08/2013.

The Assam Tribune b (2010, April 23). China confirms dam on Brahmaputra. Retrieved from:

http://www.assamtribune.com/scripts/detailsnew.asp?id=apr2310/at06. Retrieved on: 17/08/2013.

The Assam Tribune c (2010, May 14). Arunachal Cong opposes Chinese dam. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=may1410/oth05. Retrieved on: 17/08/2013.

The Hindustan Times (2010, May 26). China's Himalayan Plan: Dam on Brahmaputra. Retrieved from: http://www.hindustantimes.com/StoryPage/Print/548572.aspx. Retrieved on: 13/8/2013

The Assam Tribune d (2010, July 5). China projects won't affect Brahmaputra water flow. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=jul0510/at03. Retrieved on: 17/08/2013.

The Assam Tribune e (2010, August 12). India taking up dam issue with China. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=feb0113/at05. Retrieved on: 17/08/2013.

The Assam Tribune f (2010, Sepetembert 22). Brahmaputra diversion by China not yet. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=sep2210/at06. Retrieved on: 17/08/2013.

The Hindu a (2010, November 16). China begins damming Brahmaputra river for hydropower project. Retrieved from: http://www.thehindu.com/news/international/china-begins-damming-brahmaputra-river-for-hydropower-project/article888387.ece. Retrieved on: 12/08/2013.

The Hindu b (2010, November 16).India raises concerns over Brahmaputra dam. Retrieved from: http://www.thehindu.com/news/international/india-raises-concerns-over-brahmaputra-dam/article890265.ece. Retrieved on: 12/08/2013.

China Daily (2010, November 18). Tibet's hydropower station won't affect water flows. Retrieved from: http://www.chinadaily.com.cn/china/2010-11/18/content_11566521.htm. Retrieved on: 13/08/2013.

The Hindu c (2010, November 18). China's assurance to neighbours over Brahmaputra, Mekong dams. Retrieved from: http://www.thehindu.com/news/international/chinas-assurance-to-neighbours-over-brahmaputra-mekong-dams/article893986.ece. Retrieved on: 13/08/2013.

The Hindu d (2010, November 18). Be wary of China project, Gogoi urges Centre.. Retrieved from: http://www.thehindu.com/todays-paper/tp-national/be-wary-of-china-project-gogoi-urges-centre/article895332.ece. Retrieved on: 15/08/2013.

The Assam Tribune g (2010, November 18). Dam not to reduce water flows: Chinese firm. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=nov1810/at08. Retrieved on: 17/08/2013.

The Assam Tribune h (2010, December 2). China allays India's Brahmaputra dam fears. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=dec0310/at06. Retrieved on: 17/08/2013.

The Assam Tribune i (2010, December 6). China dam to hit India, says Canadian lensman. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=dec0610/at05. Retrieved on: 17/08/2013.

The Assam Tribune j (2011, January 2). Not aware if China building dam on Brahmaputra: Centre. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=jan0211/at034. Retrieved on: 17/08/2013.

The Hindu e (2011, June 11). Push for new dams across Brahmaputra as China faces drought.. Retrieved from: http://www.thehindu.com/news/push-for-new-dams-across-brahmaputra-as-china-faces-drought/article2093981.ece. Retrieved on: 12/08/2013.

The Assam Tribune k (2011, June 14). China dam no cause for immediate concern: India. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=jun1411/at014. Retrieved on: 17/08/2013.

The Hindu f (2011, June 15). Brahmaputra waters will not be diverted, indicates China. Retrieved from: http://www.thehindu.com/news/international/brahmaputra-waters-will-not-be-diverted-indicates-china/article2103736.ece. Retrieved on 12/08/2013.

The Times of India b (2011, June 15). No worry over dam on Brahmaputra: India. Retrieved from: http://timesofindia.indiatimes.com/india/No-worry-over-dam-on-Brahmaputra-India/articleshow/8856603.cms?referral=PM. Retrieved on: 03/10/2013.

The Assam Tribune l (2011, June 16). Call to engage China on Brahmaputra issue. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=jun1611/at08. Retrieved on: 17/08/2013

The Times of India c (2011, July 10). Gogoi plan for user right over Brahmaputra. Retrieved from: http://timesofindia.indiatimes.com/city/guwahati/Gogoi-plan-for-user-right-over-Brahmaputra/articleshow/9165872.cms?referral=PM. Retrieved on: 03/10/2013.

Want China Times (2011, July 11). Splashing out: China to spend RMB4tn on water projects. Retrieved from: http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20110711000040&cid=1105&MainCatID=11. Retrieved on: 02/12/2013.

The Assam Tribune m (2011, August 4). No threat from China dam on Brahmaputra: Manmohan. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=aug0411/at014. Retrieved on: 17/08/2013

The Hindu g (2011, August 5). We trust China's promise on dam: PM.. Retrieved from: http://www.thehindu.com/todays-paper/tp-national/we-trust-chinas-promise-on-dam-pm/article2323623.ece. Retrieved on: 13/08/2013.

The Assam Tribune n (2011, August 5). PM allays fears of Chinese designs. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=aug0511/at06. Retrieved on: 17/08/2013.

The Hindu h (2011, October 13). China rules out Brahmaputra diversion. Retrieved from: http://www.thehindu.com/news/international/china-rules-out-brahmaputra-diversion/article2532283.ece. Retrieved on: 12/08/2013.

The Economic Times b (2012, March 1). Brahmaputra dries up in Arunachal Pradesh town! Is China responsible? Retrieved from: http://articles.economictimes.indiatimes.com/2012-03-01/news/31113629_1_east-siang-district-brahmaputra-arunachal-pradesh. retrieved on: 15/08/2013.

The Economic Times c (2012, March 2). China claims Brahmaputra dam not affecting water flow to India. Retrieved from: http://articles.economictimes.indiatimes.com/2012-03-02/news/31116830_1_zangmu-brahmaputra-river-tsangpo-river. Retrieved on: 15/08/2013.

The Hindu i (2012, March 2). China denies river diversion.. Retrieved from: http://www.thehindu.com/todays-paper/tp-international/china-denies-river-diversion/article2956003.ece. Retrieved on: 18/08/2013.

The Assam Tribune o (2012, March 3). China denies dam effect on Brahmaputra. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=mar0312/at05. Retrieved on: 17/08/2013

Times of India d (2012, May 8). Ties will take a huge hit if India cannot deliver on Teesta: Bangladesh foreign minister. Retrieved from: http://articles.timesofindia.indiatimes.com/2012-05-08/india/31626128_1_dipu-moni-india-bangladesh-relations-land-boundary-agreement. Retrieved on 15/01/2014.

The Economic Times d (2012, May 14). No evidence that Brahmaputra had dried up in Arunachal: Government. Retrieved from: http://articles.economictimes.indiatimes.com/2012-05-14/news/31701201_1_zangmu-brahmaputra-river-yarlung-zangbo. Retrieved on: 15/08/2013.

The Economic Times e (2012, May 21). No report of China diverting water from Brahmaputra: Government. Retrieved from: http://articles.economictimes.indiatimes.com/2012-05-21/news/31801052_1_brahmaputra-chinese-side-mighty-river. Retrieved on: 13/08/2013.

The Hindu j (2013, January 30). China gives go-ahead for three new Brahmaputra dams.. Retrieved from: http://www.thehindu.com/news/international/china-

gives-goahead-for-three-new-brahmaputra-dams/article4358195.ece. Retrieved on: 10/08/2013.

The Hindu k (2013, January 31). Dam across Brahmaputra: Downstream states' interests shouldn't be harmed, says India.. Retrieved from: http://www.thehindu.com/news/national/dam-across-brahmaputra-downstream-states-interests-shouldnt-be-harmed-says-india/article4365319.ece. Retrieved on: 10/08/2013.

The Hindu l (2013, January 31). We will consider interests of downstream countries, says China. Retrieved from: http://www.thehindu.com/news/international/we-will-consider-interests-of-downstream-countries-says-china/article4361993.ece. Retrieved on: 10/08/2013.

The Assam Tribune p (2013, January 31). China to construct 3 more dams on Brahmaputra. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=jan3113/at08. Retrieved on: 17/08/2013.

The Assam Tribune q (2013, January 31). India takes up dam issue with China. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=feb0113/at05. Retrieved on: 17/08/2013.

The Assam Tribune r (2013, February 1). CM urges PM to raise dam issue with China. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=feb0213/at06. Retrieved on: 17/08/2013.

The Hindu m (2013, February 5). Our dams will not impact ecology in India: China. Retrieved from: http://www.thehindu.com/news/international/our-dams-will-not-impact-ecology-in-india-china/article4378746.ece. Retrieved on: 10/08/2013.

The Assam Tribune s (2013, February 10). India clears hydropower project on Brahmaputra to counter China? Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=feb1013/at042. Retrieved on: 17/08/2013.

The Assam Tribune t (2013, February 10). India for water sharing pact with China. Retrieved from:

http://www.assamtribune.com/scripts/detailsnew.asp?id=feb1113/at08. Retrieved on: 17/08/2013.

The Assam Tribune u (2013, February 14). CM raises Chinese dam issue with Rawat. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=feb1513/at06. Retrieved on: 17/08/2013.

The Assam Tribune v (2013, March 28). PM raises dams issue with China President. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=mar2913/at05. Retrieved on: 17/08/2013.

The Hindu n (2013, March 29). PM seeks joint mechanism to monitor dam work in Tibet. Retrieved from: http://www.thehindu.com/news/national/pm-seeks- Retrieved on:10/08/2013.

The Hindu Business Line (2013, April 5). Govt. allays fears over 3 Chinese dams on Brahmaputra. Retrieved from: http://www.thehindubusinessline.com/news/govt-allays-fears-over-3-chinese-dams-on-brahmaputra/article4584605.ece. Retrieved on: 11/08/2013.

The Hindu o (2013, April 6). China dams 'won't affect flow to India. Retrieved from: http://www.thehindu.com/news/national/china-dams-wont-affect-flow-to-india/article4585700.ece. Retrieved on: 10/08/2013.

The Hindu p (2013, April 10). Expert group calls for monitoring China's run-of-the-river projects. Retrieved from: http://www.thehindu.com/news/national/expert-group-calls-for-monitoring-chinas-runoftheriver-projects/article4599260.ece. Retrieved on: 10/08/2013.

The Hindu q (2013, April 17). China spikes India's proposal for joint mechanism on Brahmaputra.. Retrieved from: http://www.thehindu.com/news/national/china-spikes-indias-proposal-for-joint-mechanism-on-brahmaputra/article4627285.ece. Retrieved on: 10/08/2013.

The Economic Times f (2013, May 17). Indian experts team in China to share Brahmaputra river data ahead of Li's visit. Retrieved from: http://articles.economictimes.indiatimes.com/2013-05-

17/news/39336443_1_dagu-three-more-dams-premier-li-keqiang. Retrieved on: 11/08/2013.

The Hindu r (2013, May 17). Indian experts team on Brahmaputra in China ahead of Li's visit. Retrieved from: http://www.thehindu.com/news/indian-experts-team-on-brahmaputra-in-china-ahead-of-lis-visit/article4724665.ece.

The Economic Times g (2013, May 17). Indian experts team in China to share Brahmaputra river data ahead of Li's visit. Retrieved from: http://articles.economictimes.indiatimes.com/2013-05-17/news/39336443_1_dagu-three-more-dams-premier-li-keqiang. Retrieved on: 10/08/2013.

The Economic Times h (2013, May 19). PM holds talks with Li Keqiang, voices India's concern over incursion. Retrieved from: http://articles.economictimes.indiatimes.com/2013-05-19/news/39369966_1_recent-chinese-incursion-depsang-valley-trans-border-rivers. Retrieved on: 12/08/2013.

The Economic Times i (2013, May 20). India, China ink eight agreements on trade, water resources. Retrieved from: http://articles.timesofindia.indiatimes.com/2013-05-20/india/39391522_1_joint-economic-group-bilateral-trade-water-resources. Retrieved on: 12/08/2013.

The Assam Tribune w (2013, May 20). India, China to cooperate on river waters. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=may2113/at05. Retrieved on: 17/08/2013.

The Hindu s (2013, May 21). India, China renew flood data pact on Brahmaputra. http://www.thehindu.com/todays-paper/tp-national/india-china-renew-flood-data-pact-on-brahmaputra/article4734565.ece. Retrieved on: 12/08/2013.

People's Daily Online (2013, July 21). Paving the road to Tibet's 'secret lotus'. Retrieved from: http://chinatibet.people.com.cn/8334956.html. Retrieved on: 15/12/2013.

The Hindu t (2013,October 9). India 'pressuring' China on Brahmaputra, says Chinese scholar. Retrieved from: http://www.thehindu.com/news/international/world/india-pressuring-china-

on-brahmaputra-says-chinese-scholar/article5214193.ece. Retrieved on: 12/08/2013.

Global Times (2013, October 28). China's energy demand growth likely to slow to 1.8 pct after 2020: SGCC. Retrieved from: http://www.globaltimes.cn/content/820846.shtml. Retrieved on: 02/12/2013.

International Business Times (2013, October 29). China's Energy Demand Forecast to Slow 1.8% as Country Gets Greener. Retrieved from: http://au.ibtimes.com/articles/517733/20131029/china-energy-coal-nuclear-wind-solar.htm. Retrieved on 02/12/2013.

The Assam Tribune x (2013, December 13). China planning three more projects. Retrieved from: http://www.assamtribune.com/scripts/detailsnew.asp?id=dec1313/at05. Retrieved on: 15/12/2013.

What Experts say about the problem?

Name: ----------

Organization/Institute: ----------

Contact no./email id ----------

Country ----------

Q No.1: What are the internal risks/implications related with the china's water scarcity/crisis?

a. China's economic growth will slow down
b. Social unrest
c. Food insecurity
d. More emphasis on river linking project/more diversion of water from south to north
e. Affect international relation
f. Any other

Q No.2: What are the international risks/implications related with the China's Water scarcity/crisis?

a. China will use more coal and emit more carbon (aggravate global warming)
b. It will spend more on defence to secure oil supply route
c. It will regulate the flow of the international rivers according to its own needs
d. Any other

Q No.3: How can China's water scarcity/crisis affect the South Asian region in particular?

a. Will further strain the already fragile/tense relationship among the nations
b. Aggravate the food security problem in the region

Q No. 4: Do you think that China's water Scarcity/crisis is the world's water scarcity/crisis?

a. Yes
b. No

If yes, how

……..

Q No. 5: How increase in the demand of energy is aggravating the water scarcity/crisis in China?

a. Diversion of water is causing water scarcity

b. Thermal power plants are consuming more water right from coal mining to power generation
c. Thermal power plants or other industries are polluting water resources
d. More coal fired thermal power plants are coming up in the water scarce north China
e. Any other

Q No. 6: China has signed few MoU's for sharing hydrological data with India. Are those sufficient to keep these two nations at peace under the purview of changing climate of Tibet?

a. Yes.
b. No

If not, why
……

Q No.7: What will be implications of the steps taken by China to deal with their water scarcity (dam construction) for India?

a. Strain their relationship
b. Will cause internal conflict in India
c. May cause dam related hazards
d. Want to slowdown the economic growth of India
e. Any other

Q No. 8: How china's dam diplomacy will affect India and Bangladesh relationship?

a. They will cooperate each other to counter China
b. Their diplomatic relationship will get deteriorated
c. They will develop the cooperation on trans-boundary river water management
d. Any other

Q No. 9: Why India is planning to build many (approx.. 168) dams in Arunachal Pradesh?

a. …….
b. ……..

Q No.10: Why China is sponsoring major hydro power plants in neighbouring countries of India like Nepal and Pakistan?

a. As confidence building measure
b. Trying to help these countries to meet their energy demand
c. To weaken India diplomatically
d. To project themselves as responsible and respected international actors

e. Any other

Q No. 11: Are there chances of water diversion on Brahmaputra by China?

a. Yes
b. No
c. To some extent
d. Not possible due to rough terrain and harsh climatic conditions
e. Any other

Q No. 12: In future, will China divert water of Brahmaputra under its South –North Water Diversion project?

a. Yes…..
b. No…….
c. Difficult to say……..

Q No. 13: What will be the implications of water diversion on the downstream countries, if China will divert the waters of Brahmaputra to its north?

Q No. 14: Do you think that great bend area is going to be the dangerous place on earth both from social and environmental security point of view?

Q No. 15: Is India trying to compete with China in north-east in terms of dam construction plan?

a. Yes
b. No

If yes, why
……

Q No. 16: Do you think that china's infrastructure development in Tibet (like construction of roads, railways, airports etc.) can be linked to the proposed dam construction in the great bend area?

a. Yes
b. No

If yes, how
……

Q No. 17: Do you think that China can use water as a tool to pressurise India to extract concessions on the boundary disputes?

a. Yes
b. No

Q No. 18: Is there any possibility that China will sign a treaty on Brahmaputra with India?

a. Yes
b. No

If yes, what kind of treaty
…….

Q No. 19: How much does dispute over use of the Brahmaputra actually matter for India?

a. A clear and present danger to India
b. One of many friction points in the bilateral relationships with China
c. Irritating but tolerable fact for India
d. Will push India and China to war
e. Any other

Q No. 20: What initiatives have been taken by Indian government to maintain harmonious relationship with China?

Q No. 21: Shall India convince China and Bangladesh for making agreement on Brahmaputra River?

a. Yes
b. Not required now

Q No. 22: Does India take China's hydro-hegemony seriously?

a. Yes.

   If yes, then why
……..

b. No.

   If no, then why not

Q No. 23: Is there any need to take dam building process seriously by the people in the region at all or not?

   a. Yes

   If yes, then why

   b. No

If no, why not

Q No. 24: Why state governments are focusing on hydroelectric projects (single purpose) and giving tenders to private hydropower companies?

a. So that People of the region will be provided electricity
b. Power generated in the region will be transmitted to other areas where demand is increasing and revenue will be generated for these states
c. India wants to gain the prior use right on Brahmaputra
d. Any other

Q No. 25: Why there is a shift from multipurpose projects (in other parts of India) to single purpose projects in northeast India?

Q No. 26: Government is claiming that the hydropower projects in northeast India are Run-of-the-River projects. Are these projects really Run-of-the-River projects?