UAPP611: Regional Watershed Management

Farakka Barrage Action Initiative and Response (FAIR)

(Source: Water Resources Information System of India)

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Mission Statement: FAIR's mission is to restore the social and environmental relationship (between human and environment and between India and Bangladesh) through the improved watershed management in the region of the Farakka Barrage by the year 2026.

Background History:

Bangladesh is geographically surrounded by India; most of rivers in Bangladesh flow from India (Fig. 1). Thus, water availability of Bangladesh is largely affected by upstream water use by India. Some experts argue that the flow of 48 out of 54 transboundary rivers in Bangladesh is already heavily modified by the Indian authorities (Peace Research Institute Oslo [PRIO], 2013). The Ganges River, the longest river in India as well as one of the largest water sources for Bangladesh, also flows from India to Bangladesh. The Ganges basin lies in four countries: China, Nepal, India, and Bangladesh. Of the basis of basin area, India has 79% while Nepal, Bangladesh, and China have 14%, 4%, and 3% respectively (Mia et al., 2009).

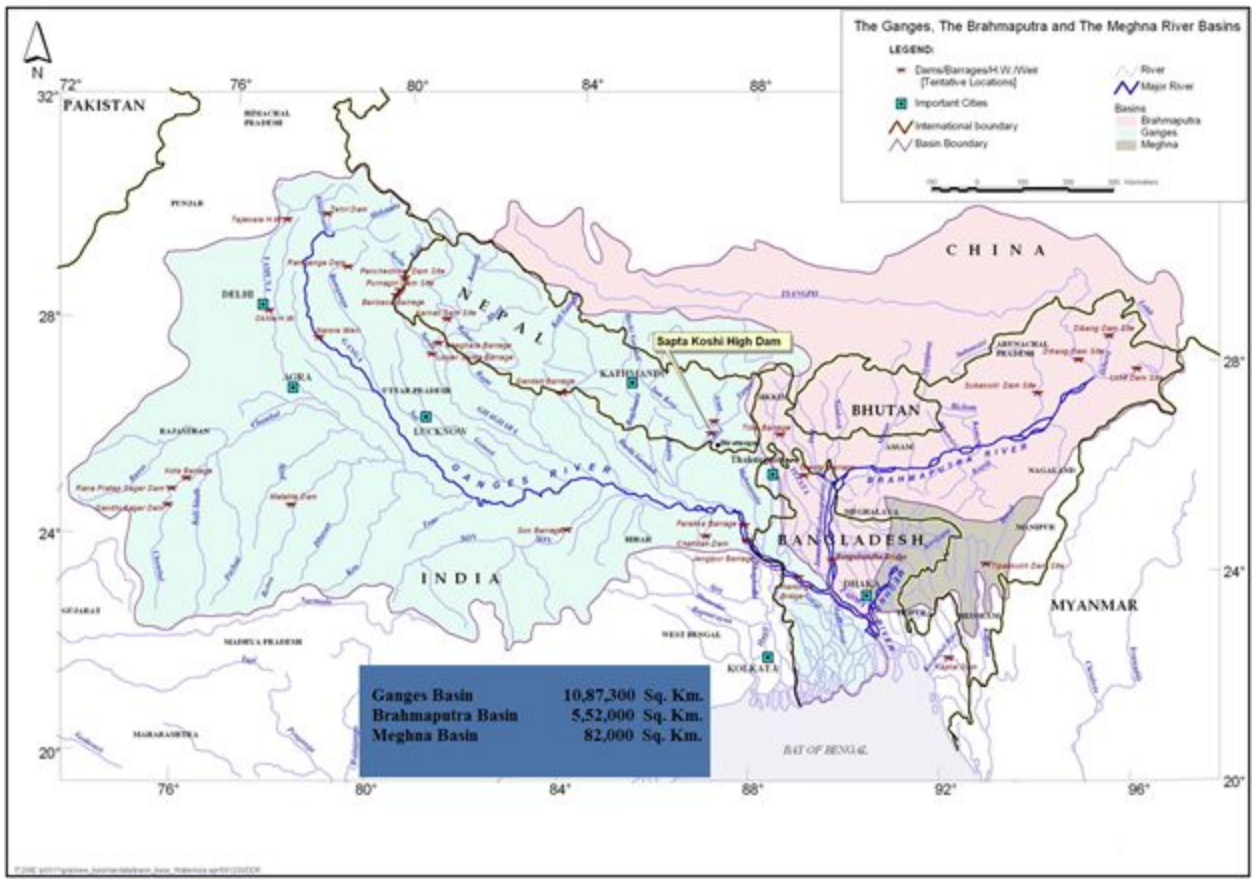

Figure 1. The Ganges Basin crosses transnational boundaries involving four countries: China, India, Nepal, and Bangladesh (JRCB, n.d.).

Farakka Barrage, a 2,245 meter-long barrage across the Ganges River, was constructed by India to divert water of the Ganges River to the Hooghly River for the maintenance of the Calcutta port and the navigability of Hooghly River ("Farakka Barrage Project Farakka," 2017). The construction commenced in 1961 and the project was commissioned in 1975. It consequently resulted in the conflict between India and Bangladesh since Bangladesh's environment and agriculture are largely affected by it.

Initial planning for the barrage dates back to the 1950s. At that time, Bangladesh was called East Pakistan and still part of Pakistan. Pakistan had expressed its concerns to India, but no agreement on sharing the waters of the Ganges River was made. In 1972, after Bangladesh became independent, India and Bangladesh signed a Joint Declaration. According to the Declaration, a Joint River Commission (JRC) was established in the same year to conduct joint surveys on common rivers. An agreement on water sharing was signed in 1975, but India withdrew water on its own decision throughout 1976-1977 (Kawser & Samad, 2016). Bangladesh finally brought this issue into the international ground including the 31st session of United Nations General Assembly, while India was against internationalizing the issue. However, consequently, the two countries had an urgent meeting which led to water sharing agreements. In 1977, the two nations signed a treaty on Sharing of the Ganges Waters at Farakka and on Augmenting its Flows. This treaty guaranteed at least a minimum flow level of water to Bangladesh for a five-year period (Roy, 1997). The treaty expired in 1982. This was followed by memorandum of understanding (MoU) in 1982 and 1985 (Kawser & Samad, 2016).

Figure 2. Diversion of water of the Ganges River to the Hooghly River (Google maps, n.d.).

After expiration of the 1985 MoU, India started again to withdraw water at will. In 1993, Bangladesh put the issue before the United Nations General Assembly and the Commonwealth Heads of Governments Meeting (Swain, 1996). With the change of the government in Bangladesh, negotiation between the two countries made progress: a thirty-year water sharing treaty was signed in 1996 (Kawser & Samad, 2016).

Ganges River Treaty

In 1996, India and Bangladesh signed the Ganges Water Sharing Treaty, this treaty is intended to last 30 years. This treaty is to specifically address water flow during the dry season (January-May). The treaty stipulates that Bangladesh will receive at least a minimum of water flow or at least 50% of the water flow (Ganges Treaty, 1996).

The Ganges Treaty, formally known as, Treaty Between the Government of the People's Republic of Bangladesh and the Government of the Republic of India on Sharing of the Ganga / Ganges Waters at Farakka, is a bilateral treaty that is strictly between the states of India and Bangladesh. The treaty was established to guarantee water flow south of the Farakka Barrage, into Bangladesh. India's commitment to this water sharing is one made on a promise of goodwill as suggested in the treaty's preamble, "The Government of the People's Republic of Bangladesh and the Republic of India [are] determined to promote and strengthen their relations of friendship and good neighbourliness (Ganges Treaty, 1996)".

According to Article II of the Ganges Treaty, the schedule of water flow is based the average availability during the 40-year period between 1949 and 1988. This dated data may be problematic in determining fair water sharing in the present. In the age of anthropogenic climate change, this region has experienced increased climate variability. This includes more intense storms during the rainy season and exacerbated drought in the dry season.

Article IV establishes a Joint Committee to monitor daily flows at the Farakka Barrage. The committee should be made of equal numbers of representatives from both India and Bangladesh. Article V gives the committee power to decide its own function. The Joint Committee is supposed to meet when the Ganges River flow reaches a crisis point, currently considered 50,000 cusecs – but for urban and agricultural needs in Bangladesh a crisis point is reached well before 50,000 cusecs (Lovelle, 2016).

Current Problems:

Problem One: Political Dispute

From the beginning of the Farakka Barrage project, a series of negotiations and agreements on sharing the waters of the Ganges river was largely affected by politics. During the Mujib government of Bangladesh, which was friendly to India, India showed a gesture of goodwill resulting in an agreement in 1975 (Kawser & Samad, 2016). However, after the fall of Mujib in 1975, India started to withdraw water unilaterally (PRIO, 2013). Bangladesh also tried to internationalize this issue several times. Bangladesh raised this issue at the Islamic Foreign Ministers Conference in Istanbul and at the 31st session of United Nations General Assembly in 1976, and put it again at the United Nations General Assembly and the Commonwealth Heads of Governments Meeting in 1993 (Kawser & Samad, 2016). Despite these efforts by Bangladesh, not much progress was made. Rather, the change of the government in Bangladesh triggered the change of situation, which led to a thirty-year water share treaty in 1996, the Ganges Treaty (Kawser & Samad, 2016). Thus, water-sharing issue has been incessantly affected by political dynamics between the two countries. Since water is an essential element for human beings and nature, measures should be taken to secure mutual benefit from the sharing of water without any political influence.

The 1996 Ganges Water Sharing Treaty favors the hydro-hegemonic state. The treaty is primitive in that it only secures water sharing in a volumetric sense. The treaty refers to the "do no harm" principle, which espouses a focus on water needs rather than one of water rights. Despite a legally binding agreement on water allocation, there is a de facto lack of dispute resolution. Since 1996, there have been several instances where Bangladesh has not received at least minimum flows of water to meet urban and agricultural needs and yet there are few option for recourse established in the Ganges Treaty.

Current treaty expires in 2026, and a new treaty to persistently monitor and share waters of the Ganges should be established. Multilateral treaty would be less vulnerable to political situations of the two countries. A new treaty should also deal with various aspect of water sharing. The existing treaty mostly focuses on water discharge rate, while there are far more relevant issues such as environmental and agricultural impacts. Comprehensive watershed management measure is needed.

Financing plays a critical role in developing appropriate programs for the treaty. Each country should financially contribute to joint watershed management by the treaty. In addition to the two countries' contribution, co-finance from Global Environment Facility (GEF) is also available. GEF supports management of transboundary water resources through the International Waters focal area. In many cases, GEF funds five-year project to assist the different governments with understanding the water situation for working together, and then, another five-year project to undertake local projects, build stronger institutions and undertake sector reforms (Global Environment Facility, 2015).

Goal One: Establish a robust and legally binding instrument such that it minimises any political, environmental and agricultural impact from the barrage.

Action Plans:

1.1. Establish a new multilateral treaty to replace the Ganges River Sharing Treaty by the year 2026

The Ganges River Sharing Treaty is to set to expire in 2026. Prior to this, a new treaty must be written and ratified to prevent a lapse in sharing agreement. The current treaty utilizes a bilateral agreement - between Bangladesh and India. The new treaty should include all states in the Ganges River Basin: Nepal, China, India, and Bangladesh. The new treaty should shift to a demand based paradigm to ensure better cooperation and order between nation states, even in the dry season (Khan, 2002; Sachan et al., 2015)

1.2. Establish a permanent implementing entity to prepare, implement and monitor the new treaty by 2020

There is a need of an entity that can prepare, implement and monitor the new treaty. Since bilateral entity is vulnerable to political influence as shown in the history, a multilateral entity including other countries in the Ganges basin and international organizations needs to be established. This entity will compose a working group by 2020 to set principles of water-sharing and provisions of the new treaty. When the treaty enters into force in 2026, this entity will function as implementing and monitoring body as well as dispute resolution body.

1.3. Establish a financial mechanism to support the new treaty

Costs for the treaty and entity should be shared by India and Bangladesh, and Nepal and China if possible. A cost-sharing structure shall be developed by the above entity by 2025. To receive financial support from the GEF, a project proposal should be developed. The proposal will be developed by 2023, and submitted to the GEF by 2024. Maximum period of co-financing from the GEF is 10 years.

Problem Two: Environmental and Agricultural Impact of the Farakka Barrage

Environmental Impact

The study performed in the year 2000 on Farakka barrage discusses the dam's impact on three rivers: the Ganges of Padma, the Meghna, and the Jamuna. Since the establishment of the barrage in 1975, there has been unilateral diversion of water upstream. This has led to the conversion of Padma from a mighty river to a narrow stream. Similarly, "drastic reduction of the Ganges flow downstream has resulted permanent change in the breeding and raising ground of many of its aquatic animals" (Zaman, 2014). The study shows that as a result of shrinkage of Padma, gangatic dolphin, pabda fish, and Hilsha fish have become rare (Animesh et al., 2014; Chaudhury et al., 2012; Zaman, 2014). Further study on Kushtia district, location for the largest surface irrigation project at the Ganga-Kapotakka (G-K) intake channel and the proposed anti Farakka barrage site, shows the impact of the barrage on vegetation and fauna (Zaman, 2014).

Prior to the construction of Farakka Barrage several studies were done to determine the hydraulic effects of the dam. Studies were carried out to determine the minimum upland discharge for a navigable channel, and water flow to bring a balance on flood and ebb tide velocities. Similarly, a geo-technical assessment was also done to determine the best site for the barrage. However, no Environmental Impact Assessment was done (Banerjee, 1999).

The construction of Farakka Barrage has directly affected 79 rivers and canals, 75 thousand ponds, lakes, and hoars downstream. These natural water resources remain dry throughout the year. The scarcity of water in these natural resources has directly impacted agriculture, fisheries, forestry, and navigation. The continual withdrawal of water upstream, at Farakka Barrage, the flow of river downstream has been in jeopardy since years. After the construction of Farakka Barrage out of 230 rivers, 80 rivers of Bangladesh have been waterless. Similarly, post Farakka Barrage, the groundwater in many downstream areas have been adversely affected due to intrusion of Arsenic (Mia et al., 2009).

Studies have shown that post Farakka Barrage flow of the Ganges river has been negatively impacted. This has led to poor condition of some of the riverine and estuarine fisheries. Likewise, studies have shown that post Farakka Barrage colossal loss of floral composition has been observed. The result of the study shows that this loss of flora and fauna resulted due to insufficient flow of water, and loss of habitat. Various studies on Farakka Barrage shows that the Barrage is fully responsible for impact on river flow, and for the loss of flora and fauna. In addition to this, Farakka Barrage is also responsible for the impacts on local climate (Mia et al., 2009). It will not be an exaggeration to say that "the unilateral diversion of the Ganges by India at Farakka Barrage has caused a series of adverse environmental and ecological problems in

Bangladesh" (Mia et al., 2009). The diversion of river flow has continually posed threat to the freshwater biodiversity, and ecosystem processes as well. An example of this is the gangatic dolphin which has now become endangered (Zaman, 2014).

Further study on downstream ecology shows that diversion of the Ganges through Farakka Barrage has led to severe destruction of biodiversity. There have been considerable damages to forest species, aquatic animals, bird species, and fish species. A study on the Kushtia region shows that the diversion of Padma's water flow has resulted in ecological change which has ultimately caused negative impacts on surrounding biodiversity (Zaman, 2014). The shrinkage of Padma has affected both bird population and aquatic animals. While birds such as Bank moyna, Gallinule, Parakeet, Grey leg goose are not visible anymore, birds like White neck stork, King fisher, Large egret, Ruddy sheld, Lesser whistling teal, Ashy swallow shrike, and Little ring plover are visible less frequently (Zaman, 2014). In addition to this, the Farakka barrage has led to "the destruction of breeding and raising ground of 109 fish species and other aquatic animals in the lower Ganges basin" (Adel, 2001; Zaman, 2014).

Along with poor consequences of the dam downstream, some of the areas upstream too have been a victim of the dam construction. Due to Farakka Barrage the water level of Ganga rose by about 8 meters. As a result of this some of the districts upstream, such as West Bengal and Malda, have seen flooding on the left bank. Sedimentation upstream has been noted at approximately 640E 10^6 metric tonnes per year with an increased flood frequency and magnitude. Severe bank erosion and displacement can also be noticed upstream. Farakka Barrage has also led to estuarine saline intrusion. The obstruction caused by Farakka Barrage has lead to an accumulation of approximately 64 crore tonnes of silt every year in the riverbed. This has not only affected agriculture but it has also affected riverine and estuarine fisheries (Banarjee, 1999). The negative impact of increased salinity and silt content on forestry can be seen on mangrove forest (Ahmed et al., 1994; Khan, 1994; Zaman, 2014). Along with issues upstream, the groundwater table is falling. According to a research study conducted by Central Inland Fisheries, statistical records show that since the construction of the barrage, the population of hilsa has been declining. Along with this, the barrage has also caused an obstruction for the natural migration of valuable fishes resulting in their extinction over time (Banerjee, 1999).

Further studies on the barrage shows that the Ganges basin that was considered to be one of the most fertile areas in the world is now barren (Khan, 1994; Zaman, 2014). This has led to changes in floral composition along with emergence of new plant diseases (Zaman, 2014).

Not enough resources has been devoted to maintain water quality and sanitation. It is predicted that by 2050 along with Bangladesh, India too will suffer from water scarcity. This problem is heightened due to polluted surface water and over extraction of groundwater. The current

decentralized water management strategy of India has not been effective. With India's continued population growth and ever expanding economy it is vital to have a strategy in place that will save current natural resources. While India lies upstream of Bangladesh, it is a lower riparian of China. The Chinese controlled Tibetan Plateau: the Brahmaputra and the Ganges, affects the decisions India makes for water within its region. This ultimately affects Bangladesh which lies further downstream. Bangladesh relies heavily on the flow of three rivers: the Padma, the Jamuna, and the Meghna (Lovelle, 2016). "Flood, water scarcity, and poor water quality are the three most severe challenges to water security that Bangladesh faces" (Lovelle, 2016). Studies have shown that Bangladesh's water supply has decreased drastically after the construction of Farakka. In fact Bangladesh's water supply worsened after the Ganges Water Sharing Treaty (Ganges Treaty, 1996). For both India and Bangladesh, it is known that water quality is a major threat to water security.

One of the major environmental disadvantages post construction of Farakka is the deposit of silt in the Ganges river. To make the matters worse both India and Bangladesh do not have a national silt management policy. Construction of Farakka Barrage has led to flood inundation and sedimentation in lower Gangetic basin. Siltation at the Ganges has led to a reduction in the carrying capacity of the river channels which ultimately leads to floods.

Currently there is no explicit guidelines for de-siltation or silt management, however, there are guidelines for sand mining by the Ministry of Environment, Forests, and Climate Change (MoEF&CC) (Central Water and Power Research Station [CWPRS], 2017). Similarly, Geological Survey of India (GSI) also has guidelines on the "Impacts and Methodology of Systematic and Scientific Mining in the river bed material" (CWPRS, 2017).

Agricultural Impact

Bangladesh is a low-lying deltaic country in the confluence of the major rivers like the Ganges, Brahmaputra and Meghna (GBM) and their respective tributaries. More than 310 rivers and tributaries have made this country a land of rivers with 80% of total areas as flood plain (ADRC 2008, Khan and Rahman 2007, Zaman 1999). Ganges Basin covers 37% of total Bangladesh (Gain & Giupponi, 2014). The country's economy is mostly agriculture dependent and it is the major source of income and occupation (Mirza & Hossain, 2004). Major crops produced are rice, wheat, jute and sugar crops along with the non-food crops like cotton, betel vine, orchard, etc. The Ganges basin in general are mostly used for agricultural purposes. Figure 3 shows the land use land cover pattern in the ganges basin which shows the majority of the area is used for cultivation purpose.

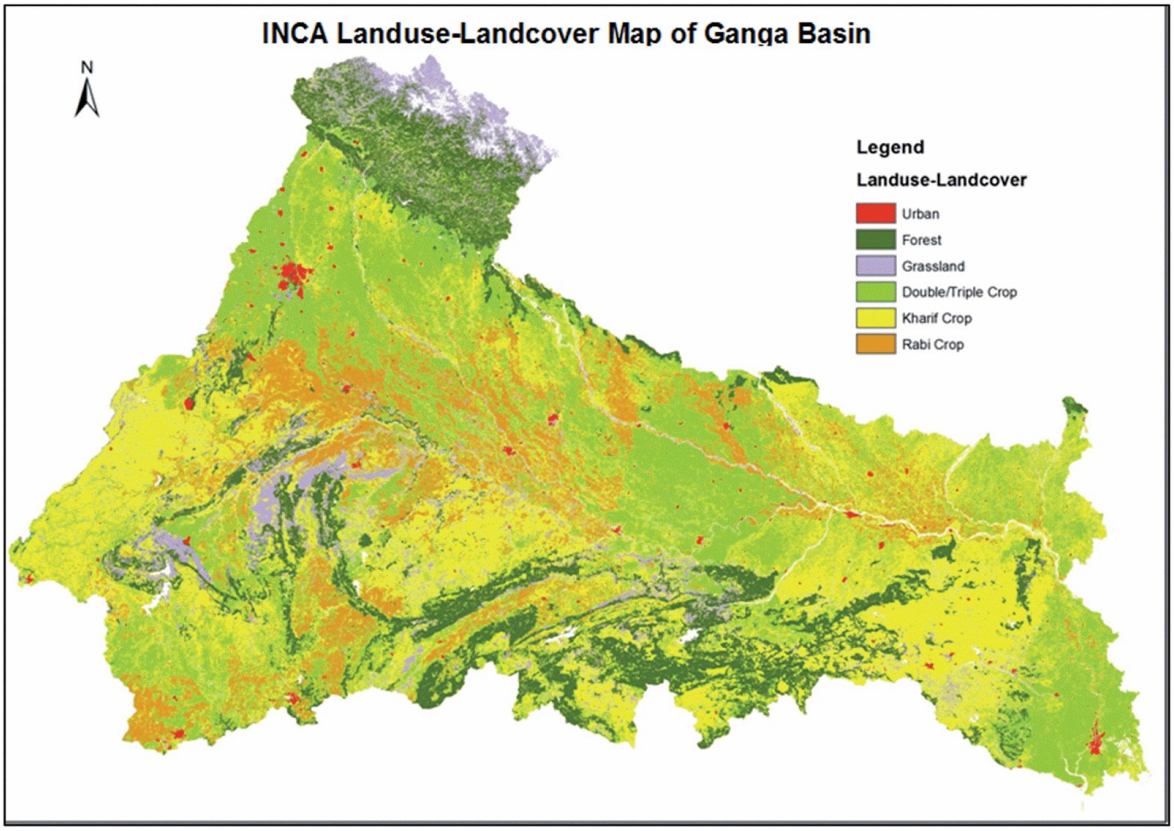

Figure 3: Landuse-Landcover of Ganges river basin (Jin et al., 2015).

The water supply and distribution in Ganges River adversely impacts the agriculture in the south-western part of Bangladesh. Farakka barrage had "immediate, large-scale and deleterious effects on the industry, food production, transportation and communication systems, and ecology of Bangladesh" in more than two decades of disputes (Adel, 2001; Begum, 1987; Crow et al., 1995 in Thomas, 2017, p.44). Also mentioned by Mirza and Hossain, 2004 (p.177), "Agricultural activities are largely dependent on the water supply from the Ganges River and its distributaries….the commissioning of the Farakka Barrage.…put the agriculture sector in Bangladesh under a severe strain, and has an adverse chain effect on the macro-economy and sustainable development of the country." Agriculture contributed about one-half of the country's GDP in 1972-1973 that has declined to one-third because of less crop production (Mirza & Hossain, 2004). Farakka Barrage directly affected 65% of crops production and 34% crops were damaged due to scarcity of water, lowering the groundwater level, less access to rainwater, etc. (Mia et al., 2009). Production loss valued US$ 56.9 million for 1992-1993 (Mirza & Hossain, 2004).

The irrigation water for cultivation comes from surface water and groundwater including G-K Canals, Deep Tube Wells (DTWs), Shallow Tube Wells (STWs), Low Lift Pumps (LLPs), as well as, canal and indigenous methods. One of major transboundary river, the Padma (called the

Ganga in India) has experienced a decline in flow, though more recently. According to the Bangladesh Water Development Board, as mentioned in Islam, 2016, the average minimum flow of the Padma River has been 22,300 cusecs over the last 12 years. But in May 2011 there was a drastic drop, down to 3,100 cusec (Islam, 2016). Shortage of surface water for irrigation caused 3.2% reduction in rice cultivation in year 1992-93 (Mirza & Hossain, 2004). "In 1999-2000, the country produced 23.07 million tons of rice in about 26.46 million acres of land of which about 11.15 million acres land was under navigation. If the irrigation process totally stop due to non-availability of ground water, the rice production will almost come to an end" (Ahmed, 2006 in Mia et al., 2009, p.91).

Unilateral water withdrawals in India caused reduced crop production, groundwater and soil salinization, diminished fisheries, impeded navigation, disruption to forestry, agriculture, and increasing salinity intrusion from the coast. Consequently, having significant effect on the social-ecological system of Bangladesh (Thomas, 2017; Gain & Giupponi, 2014; Mia et al., 2009). Gain and Giupponi, 2014 found that the river flow was natural before the construction of the dam from the rainfall trend analysis. Also in the post-Farakka period both floods and droughts are seen to be more frequently occurring because of decreased discharge in the dry season while increased discharge in the monsoon period (Gain & Giupponi, 2014; Asafuddowla, 1993 in Mia et al., 2009).

Though the country floods during the monsoon period, the northwest and southwest regions (location of Ganges basin) of the country faces drought because of scarcity of water in the dry season (Mirza & Hossain, 2004). The basin area also has the lowest mean annual rainfall in the country. There are also records of no rainfall for several months together in some areas. (Mirza & Hossain, 2004). Besides, the groundwater Arsenic concentration became very high in many places of these regions in post Farakka period because of depletion in the water table. Therefore, the produced food also became arsenic poisoned. There are several other direct and indirect impacts on agriculture that needs to be addressed to improve the prevailing situation.

Goal Two: Establish a robust plan such that there is an equitable allocation of flow of the Ganges and its tributaries which in turn will reduce water burden and water pollution.

Action Plans:

2.1. Reduce over extraction of groundwater by reducing over dependence on the Ganges and the Farakka.

To manage water quality, reduce over extraction of groundwater, and reduce conflict over GSW, both India and Bangladesh need to eliminate over dependence on the Ganges and the Farakka

(Lovelle, 2016). This can be done by negotiating an "equitable allocation of the flow of the Ganges river and its tributaries between the riparian states," "develop a rational plan for integrated watershed development, including supplementing Ganges flow" (Wolf & Newton, 2015).

2.2. Explore better water management techniques including dredging rivers.

This can be achieved by exploring alternative water resources and concentrating on utilizing the current water resources soundly. An alternative to efficiently using current water resources would be by dredging rivers and watersheds, and by employing better water management techniques (Lovelle, 2016).

2.3. Explore alternative water treatment techniques that can reduce water dependence on the Ganges and the Farakka.

Similarly, wastewater treatment plants capable of treating wastewater that can be reused for agricultural and/or household purposes can drastically reduce water dependence on natural water resources.

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Goal Three: Formulate a silt management plan to mitigate siltation and to manage the Ganges basin.

Action Plans:

3.1. Keeping in mind the current "sand mining" guidelines adopted by MoEF&CC, and GSI, formulate a silt management plan that can both mitigate siltation and "give silt the way".

Due to heavy siltation at the Ganges, it is vital to formulate a silt management policy that can take measures at both micro and macro level (Bhatnagar, 2016). De-siltation is an approach that can be used to manage excessive siltation. However, erosion, sediment transport, and siltation are all complex phenomena that requires broader de-siltation principles. The guidelines for sand

mining that are currently in place should be given due consideration while formulating a de-siltation guideline.

3.2. Before formulating a silt management plan perform ample study on the region and suggest recommendations for erosion control.

Before finalizing a siltation management guideline it is important to study the morphology of the Ganges river and identify vulnerable reaches. Following this, appropriate structural measures for flood and erosion control can be recommended. Similarly, the guidelines need to recommend catchment area treatment, forestation, and sediment retention measures. While de-siltation can improve the hydraulic performance of river, it can also adversely impact river flow. Hence, along with de-siltation, river bank protection/ anti-erosion works to reduce silt inflow into the river is equally important. It is important to understand that sediment transport to river is a natural phenomena, hence, sediment equilibrium of river should be maintained. A report by CWPRS has mentioned that, "instead of keeping the silt away, strategy to give the silt way should be adopted" (CWPRS, 2017).

Goal Four: Find alternative solutions to adapt with the existing situation for agricultural and environmental improvements in short term basis (5-10 years)

Action Plans:

4.1. Alter cropping based on land fertility, water supply from dam and rainfall condition

Scientist have invented genetically modified crops to sustain less water and saline water condition to improve cultivation in the arid land. These High Yielding Variety (HYV) crops are becoming more popular to face the adverse situation. Also traditional cultivation method should be applied to ensure sustainability of the projects. The farmers are now shifting from production of rice crop to non-food crops that needs less water like wheat, jute and rabi rice and which survive adverse climate. Such alternating cultivation system needs to be encouraged based on land fertility, water supply from dam and rainfall condition.

4.2. Community involvement at the grass root level for best management practices

A bottom-up approach to adaptation involving all relevant stakeholders which includes training of the community people in promoting conscious use of water for irrigation. During crisis period, they must take adequate decision in choosing the right crop for cultivation and altering it with other less water demanding crops . Mass education program should be organized by the agricultural department at Government level to promote farmers in the methods and benefits of

sustainable, organic farming. Many national and international NGOs are already working in the field. Their involvement can be increased.

Goal Five: Along with reducing water burden, establish a conservation protocol to protect the existing flora and fauna.

Action Plans:

5.1. Keeping previous action plan in mind, reduce water burden by employing various water treatment, water sharing, and water management techniques.

Reduction in water burden will ultimately reduce water scarcity and water pollution. This will help preserve land fertility and prevent onset of drought. Unpolluted surface water then helps conserve the natural habitat of various biodiversity including flora and fauna.

5.2. Formulate short term and long term solution such that it addresses the agenda of the Rio Summit which focused on global environmental issues.

All basin states: India, Bangladesh, should take river development schemes that will use natural water resource in a sustainable way (Zaman, 2014). The Ganges acts as a water source for both plants and animals. With the construction of the barrage flow in the Ganges has been affected which has adversely impacted biodiversity in the lower riparian region. Few short term conservation techniques that can be adopted are: enforcement of wildlife protection act, control of poaching, and awareness amongst natives. In the long run, sustainable measures to control catchment degradation, preservation of floodplain vegetation, and uninterrupted quality river flow must be adopted.

Established Watershed and Environmental Protection Organizations and Agencies:

Joint River Commission (JRC, 1972) - The Indo-Bangladesh Joint Rivers Commission was formed in 1972 to study the river flow and develop a cooperative plan for development. The Joint Rivers Commission does not have the independent power to formulate and implement solutions.

Joint Committee - The Joint Committee is established by the Ganges Treaty of 1996 in Article IV. An equal number of representatives from both India and Bangladesh make up the committee. The Ganges Treaty does not define the role the committee must serve. Article V of the Ganges Treaty gives the committee the power to define its own function.

Water Ministries of Nation States in the Ganges River Basin - Regulating bodies over water issues should be involved in this management plan, this includes: China - Ministry of Water Resources of the People's Republic of China, Nepal - Ministry of Water Supply and Sanitation, India - Ministry of Water Resources, and Bangladesh - Ministry of Water Resources.

GEF - The Global Environment Facility (GEF) was established in 1992, and works as a catalyst for action on the environment. The GEF has been a financial mechanism for 5 major international environmental conventions including the United Nations Convention on Biological Diversity (UNCBD), the United Nations Convention to Combat Desertification (UNCCD), and the United Nations Framework Convention on Climate Change (UNFCCC). International Waters focal area, among its 6 focal areas, supports management of transboundary water resources

GSI- Geological Survey of India began in the early part of the nineteenth century. The main function of GSI is to create and update the national geoscientific information and the assessment of mineral resource. GSI achieves its objectives through ground surveys, air-borne and marine surveys, mineral prospecting and investigations, multi-disciplinary geoscientific, geo-technical, geo-environmental and natural hazardous studies, glaciology, and seismotectonic study.

MoEF&CC- The Ministry of Environment, Forest and Climate Change is responsible for the planning, promotion, coordination and for overseeing the implementation of India's environmental and forestry policies and programmes. "The Ministry also serves as the nodal agency for the United Nations Environment Programme (UNEP), South Asia Co-operative Environment Programme (SACEP), International Center for Integrated Mountain Development (ICIMOD) and for the follow-up of the United Nations Conference on Environment and Development (UNCED)" (MoEF&CC official website).

Summary:

Issues	*Objectives*	*Partnerships*	*Milestones*
- Expiration of the existing treaty in 2026 - Vulnerability of water-sharing agreements to political circumstances	- Establish a new multilateral treaty - Establish a permanent implementing entity - Establish a financial mechanism	- Countries in the Ganges basin (India and Bangladesh, possibly Nepal and China) - International organizations (e.g. GEF)	- Establish an entity by 2020 - Establish a financial mechanism by 2025 (apply for co-financing by 2024) - Establish and ratify a new treaty by 2026

- Depleting water quality, and water burden due to unequal water sharing	- Reduce over dependence on the Ganges and the Farakka for water needs - Establish water treatment plants; reuse treated water - Equitable allocation of flow of the Ganges	- South Asia Network on Dams, Rivers, and People - Countries: Bangladesh, India, and China	- By 2050 India will suffer the dire consequences of water scarcity - Establish water treatment design by 2020 - Operate the treatment plant by 2040
- Sedimentation, siltation, and erosion at the Ganges river basin	- Establish de-siltation guidelines - Give due consideration to sand mining guidelines currently in place	- GIS - MoEF&CC - Countries: Bangladesh, India	- By 2025 study the current sand mining guidelines - By 2025 study the Ganges basin - By 2030 formulate plan for erosion and flood control - By 2040 draft a de-siltation guideline
- Loss of biodiversity, flora, and fauna	- Reduce water burden to manage water pollution, and surface water quality. - Preserve floodplain vegetation, and riparian vegetation.	- Countries: Bangladesh, India	- By 2025 circulate pamphlets, organize community events to generate awareness amongst native population.' - By 2050 manage and take steps to improve natural river water quality.

Conclusion:

There has long been a conflict between India and Bangladesh on water sharing since the construction of the Farakka Barrage on the Ganges River in 1975. There are three types of problems that need to be addressed: political dispute, environmental impact, and agricultural impact.

Water is an essential element for human beings and nature, so water-sharing issue should not be subject to political influence. For this, a new legally binding instrument is needed. A new multilateral treaty should be established to substitute the existing treaty which expires 2026. All states within the Ganges River Basin should be involved in the new treaty: China, Nepal, India, and Bangladesh. The impacts of the Farakka Barrage are predominantly between India and Bangladesh, but the water flow in the Ganges is also determined by upstream users and flow in the headwaters located in China and Nepal. Along with the treaty, a permanent implementing entity should also be established to prepare, implement, and monitor the treaty. These treaty and entity would be more effective if supported by a robust financial mechanism.

To resolve water burden issue it is vital to efficiently use available natural water resources and further explore water treatment. Treated water can then be reused for both household and agricultural purposes. Similarly, post Farakka, siltation and flooding is a major problem. While the sand mining guidelines are already in place these have done little to combat siltation problem surrounding the Ganges. An effective way to resolve this issue would be to understand the morphology of the area and then establish a robust plan to mitigate sedimentation as well as formulate an erosion control plan.

In order to improve the agricultural production in the down stream of Ganges basin the water flow must be increased especially in the dry period. It is possible through proposed actions and goals along with ensuring collaboration and negotiation among transboundary countries with shared watershed. As treaty and contractual agreements are lengthy-time consuming process, by the mean time, alternative solution to adopt with the prevailing adverse situation can be implemented. Thus the economy of the country will make up the loss in agricultural sector. Also it can try to have profits and support the locality and national economy in the long run.

Sources:

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