

Water Exploitation-Induced Climate Change

Paper # 616

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Topic Description: Upstream water piracy made the Aral basin's summer warmer vis-à-vis winter colder than before due to the loss of the heat storing water media. The global warming CO₂ is beside the point. India's own treatment to the Ganges can lead to surface water crisis. On the Indian eastern side, the lower Ganges basin has been turned into another Aral Sea basin due to the diversion of the Ganges's course through India and the constructions of dams and barrages upon other transboundary rivers in the form of a ring of dams and barrages upstream of the Indo-Bangladesh border. The heat storing water medium has been replaced by huge sandy heat emitting riverbeds. In the wake of heating, lightning occurrences have increased that takes a heavy toll of lives and properties. India's current government threatened the western neighbor Pakistan of cutting off water supply to her voiding a six-decade old WB-mediated Indus Water Treaty by construction of dams and barrages. India's own irrigation progression shows a correlation for lightning-related fatalities. China's and India's competing plans of building of dams is going to turn the lower Brahmaputra basin into another Aral Sea basin. The same is going to happen in the lower Mekong basin. Climatologists' inconsideration of the upstream water piracy issue lets the upstream riparian countries leverage boundless exploitation of international water resources depriving the downstream countries of their due share. In the research of climate change, climatologists' wholistic study of CO₂ emission and surface water exploitation can save the latter's depletion.

Keywords: Water piracy, Aral Sea, Ganges, Teesta, Brahmaputra, distributary, shoals, lightnings, Bangladesh, and Farakka Barrage

1. Introduction

Regional warming vis-à-vis cooling due to the surface water exploitation predominates the influence of global warming. The former USSR diverted the water from the Amu Darya (35th longest, 2620 km) and the Sir Darya (25th longest, 3078 km) Rivers (Fig. 1), the main feeding streams of the world's 4th largest inland water source the Aral Sea (45.3963° N, 59.6134° E) (Fig. 2 <http://www.columbia.edu/~tmt2120/environmental%20impacts.htm>; Figs. 3 and 4 (<https://openoregon.pressbooks.pub/envirobiology/chapter/7-5-case-study-the-aral-sea-going-going-gone/>) to excel in cotton production. Water bodies absorb heat during summertime for release in wintertime thereby stopping the temperature drop. Being deprived of the heat storage medium, this Central Asian region's (Fig. 5) summer became warmer, and winter became colder than before. Global warming was not reported to be responsible for the generation of the extreme weather like summertime temperature 60°C(140°F). During 1960 -2000, the basin summertime's average monthly air temperature increase vis-à-vis wintertime decrease was 2°C- 6°C per month (Zavialov, 2005). Also, summers were getting hotter and becoming short-lived duration whereas winters were getting colder and becoming long-lived along with decreased precipitations.

Ragab- Prudhomme (2002) reported of the projected temperature increase in the range of 1.75 to 2.25°C on average by 2050 that would rise more in the summer (2 to 2.75°C) and less in the winter (1.5 to 2°C). Their reported annual precipitation increase was by 5 to 20% in average by 2050. The water level in the lake has dropped 23 m, the lake area has shrunk 74%, the lake volume has decreased 90%, and the lake salinity has grown from 10 to more than 100g/l. Along with the climate change there has been negative ecological changes, decimation of native fish species, onset of dust/salt storms, and degradation of deltaic biotic communities. These effects have been disruptive of the basin populations' lifestyle (Micklin, 2007).



Fig. 1. Map showing the location of the Aral Sea and the watersheds of the Amu Darya and Syr Darya which flow into the lake (McKinney, 2003) Fig. 2. Dying rivers feeding the Aral Sea (Micklin, 2007).

This sort of water diversion is taking place in other river basins of the Asian continent making warmer summers and colder winters. In South Asia, the Ganges is the world's 34th longest (2704 km) river with the 8th largest annual discharge of 3.17E8 cubic meters. India built the Farakka Barrage upon the Ganges to divert its discharge through the Hooghly River that had been dwindled by building dams and barrages upon its primary and secondary tributaries. Also, India has built a ring of dams and barrages around Bangladesh (23.6850° N latitude and at 90.3563° E) and performs the upstream water piracy. Further, the Indian government has threatened the western neighbor of Pakistan of cutting off the water supply to the country voiding the decades' old World Bank-mediated the Indus Water Treaty. The Indus is the world's 19th longest river with a length of 3,610 km, has the world's 14th annual discharge of 2.7E8 cubic meters. The sources of river discharges in Pakistan lie in India. Furthermore, China's dam building on the world's 9th largest and the 15th longest River Brahmaputra, and the Indian dam building in the Brahmaputra basin will dwindle the river. The Brahmaputra has the world's 4th largest annual discharge of 1.23E10 cubic meters.

In Southeast Asia and East Asia, the continued building of dams in the basin of the world's 12th longest Mekong River that has the 7th annual discharge of 4.05E8 cubic meters by China and the downstream countries will weaken the river.

The greatest implication of this article is the accountability of the greed-driven anthropogenic actions-caused depleting inland water bodies through storing, distribution via multi-channeling,

irrigation, industrial and domestic use, for the occurrences of global heating vis-a-vis cooling and not CO₂ and other greenhouse gases accumulation in space. Immediate international actions are needed to end the episode.



Fig. 3. The dried bed of the Aral Sea (User Staecker, 29 April 2003). Fig. 4. A comparison of the Aral Sea in 1989 (left) and 2014 (right). (NASA. Collage by Producercunningham, 2014).

2. Materials and Methods

The author paid visits to the affected region to be an eyewitness of the environmental changes occurring in the lower Ganges basin. Photographs of dry surface water resources were taken. River discharge, climate, navigability, and other data were obtained from Bangladesh government offices, published literatures, and electronic and print news media. The environmental reactions rose gradually for continued deprivation of water in the lower courses of the Ganges River. The region's central climate office did not find any change in climate for not considering shorter time intervals of climate data in their analysis although people's feeling of the summer heat and the winter cold along with the climate center- recorded temperature figures were reported in the news media. About a decade's of temperature data preceding and following the onset of the water piracy was selected for analysis. The annual summertime highest and the wintertime coldest temperatures vs years were plotted to find the onset of the heating and cooling. The annual hottest and the coldest temperatures were found for pre (prior to 1975)- and post-piracy to study the correlation with the Ganges discharges. K-S statistics (Hollander and Wolfe, 1999) were applied to establish the nonidentical nature of the pre-piracy and the ongoing piracy period Ganges discharges. The correlation of the pre- and ongoing piracy period heating degree days (HDD) and cooling degree days (CDD) with the Ganges discharges for the same periods was studied.

3. Aral Sea Basin-Like Scene Creation

3. 1. The Ganges in India

The Article covers Central Asia (Kazakhstan, Uzbekistan,), South Asia (Pakistan, India, Bangladesh), East Asia (China), and Southeast Asia (Cambodia, Laos, Myanmar, Peninsular

Malaysia, Thailand, Vietnam) that includes (Fig. 5). In the Introduction, Central Asia part has been covered.

Fig. 6 shows the course of the Ganges from the birthplace to its forced fall (because India artificially changed its course) in the Bay of Bengal. Fig. 7 shows the drying of the Ganges bed. At places, groundwater supply the river water.

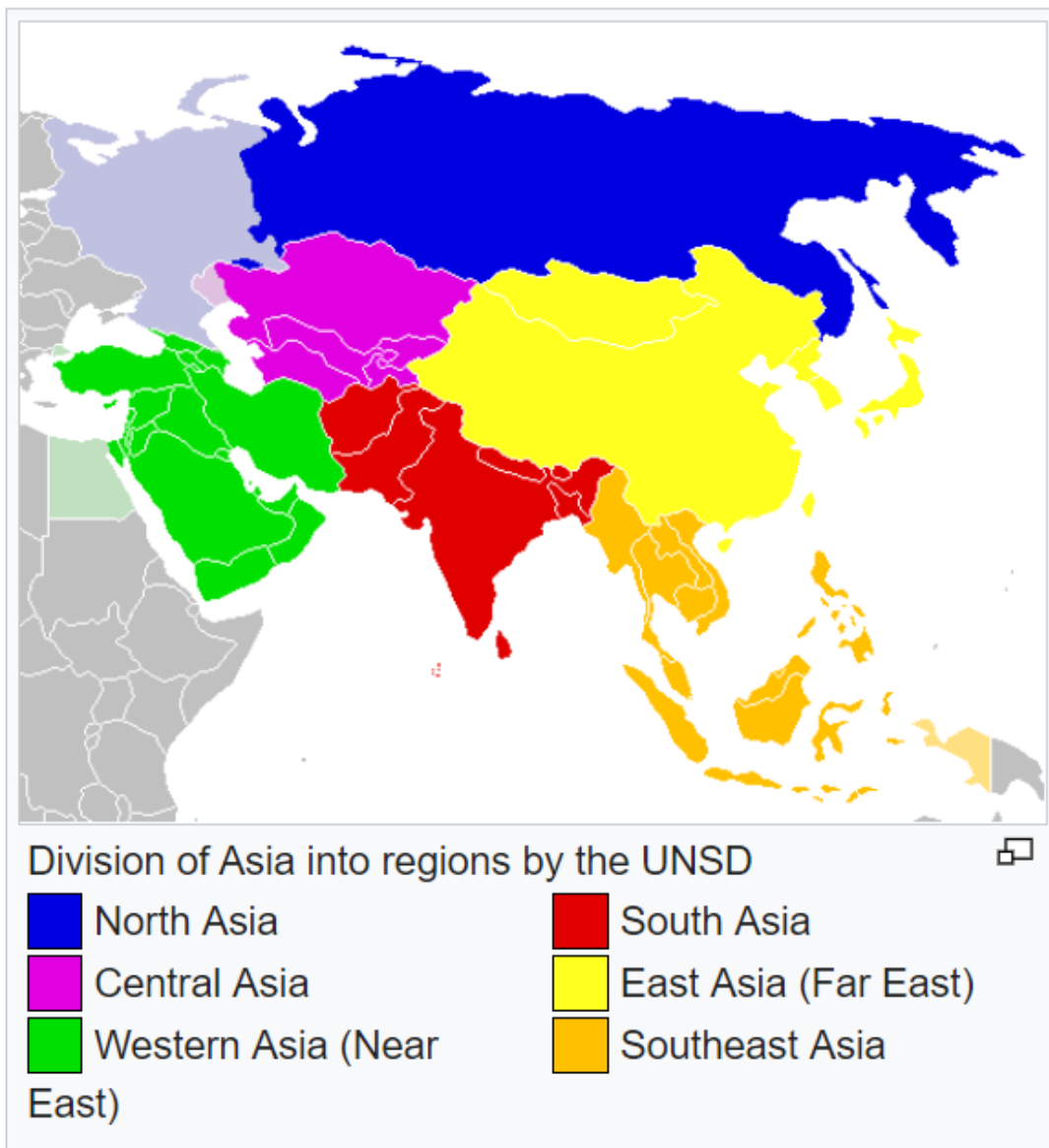


Fig. 5. Atlas of Asia (Anthony, 2006)

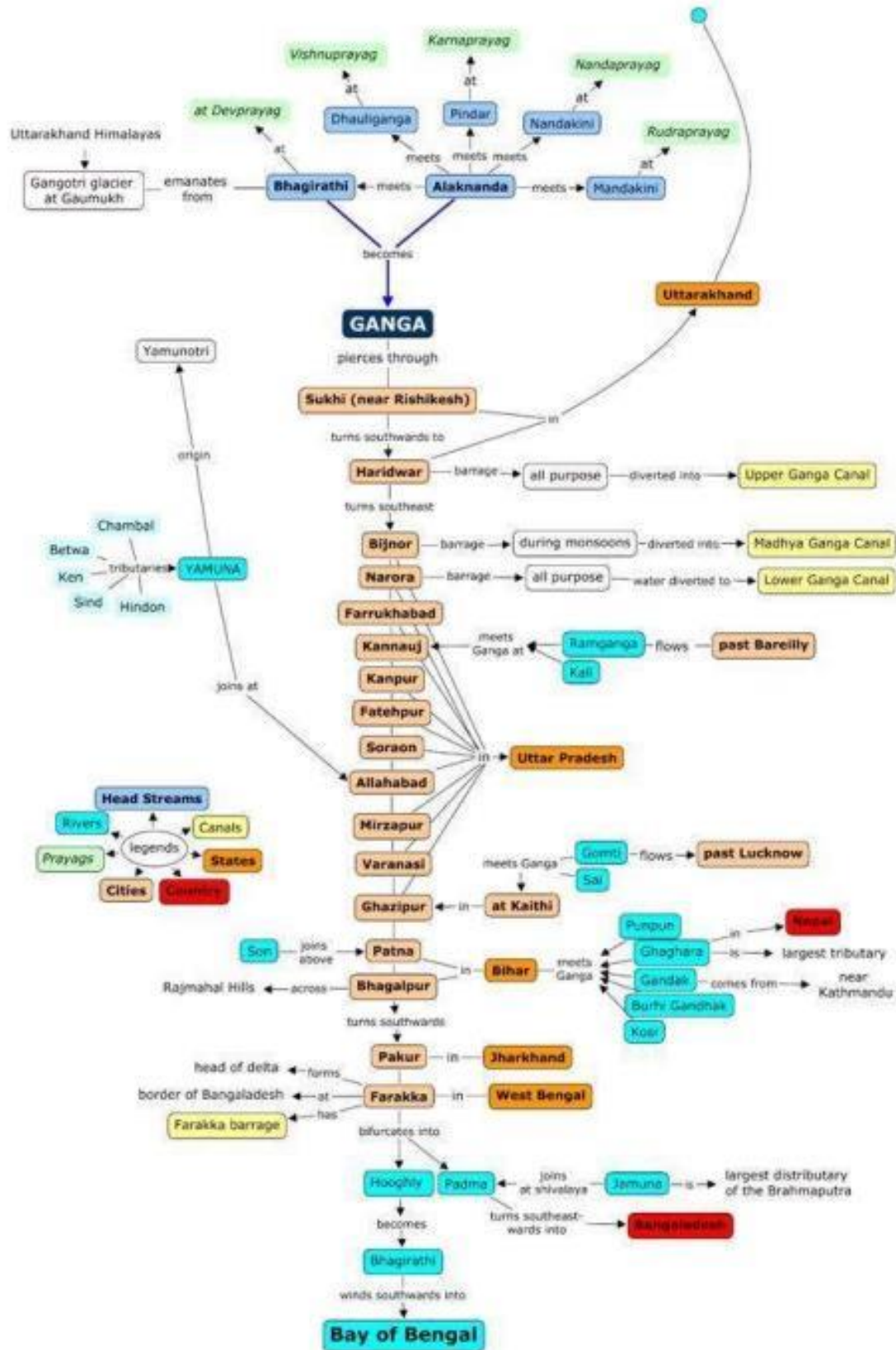


Fig. 6. The course of the Ganges (<https://nmcg.nic.in/courseofganga.aspx>).



Fig. 7. As India's Ganges runs out of water, a water crisis looms (*Summer drying of the Ganga. Image by Abhijit Mukherjee.*)

Figs. 8 shows the Ganges (covering India and Bangladesh), the Brahmaputra (covering China, India, and Bangladesh), the Indus (covering India and Pakistan), and the Mekong basins.

In Fig. 8, the Nadia District rivers (Fig. 9a) and the Damodar basin (Fig. 9b) fall in the yellow colored West Bengal to the west of Bangladesh. The Bhagirathi (Hooghly) river was fed by many mighty tributaries (Fig. 9b). Both the Figs. 9a and 9b show the Hooghly basin. India started damming the primary and secondary tributaries of the Hooghly River from the fifties. The river became almost dead. India then built the Farakka Barrage (Figs. 10a and 10b) on the Ganges in 1975 on the plea of turning the Calcutta Port, located about 300 km downstream, navigable. She dug the Feeder Canal (Fig11) to let the Ganges discharge down it. Then she publicized that the Ganges changed its course through Hooghly to fall in the Bay of Bengal. There have been water sharing treaties (Table 1) between India and Bangladesh from time to time, and in between treaties (Adel, 2013a, 2013b, 2013c), India pirated an inordinate amount of Bangladesh ecosystem's water(Adel, 2015) (Figs. 12 and 13). Almost all the dry season

Ganges water is taken by India (Hillary, 1979). The Gangetic ecosystem cannot survive the India's rationing of water to it.

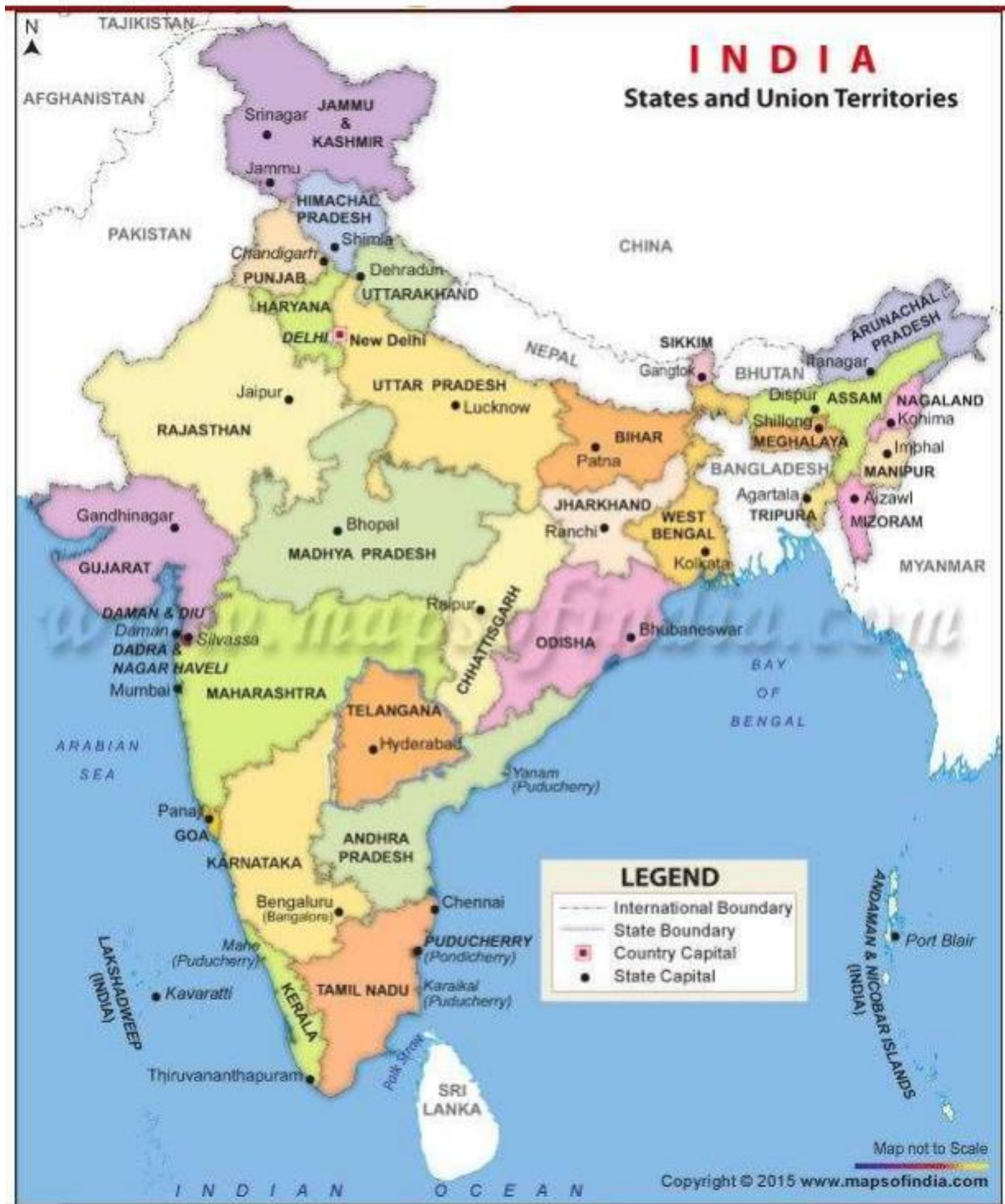


Fig. 8. . The political map of India (<http://www.mapsofindia.com/maps/india/india-political-map.htm>).

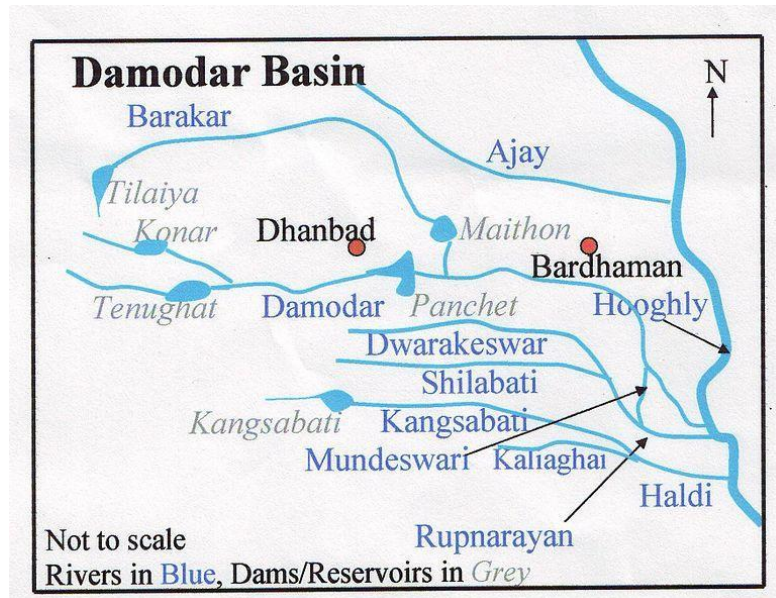


Fig. 9a. Nadia District Rivers (Niyogi, 2002) Fig. 9b. Damodar basin (Niyogi, 22 June 2008)

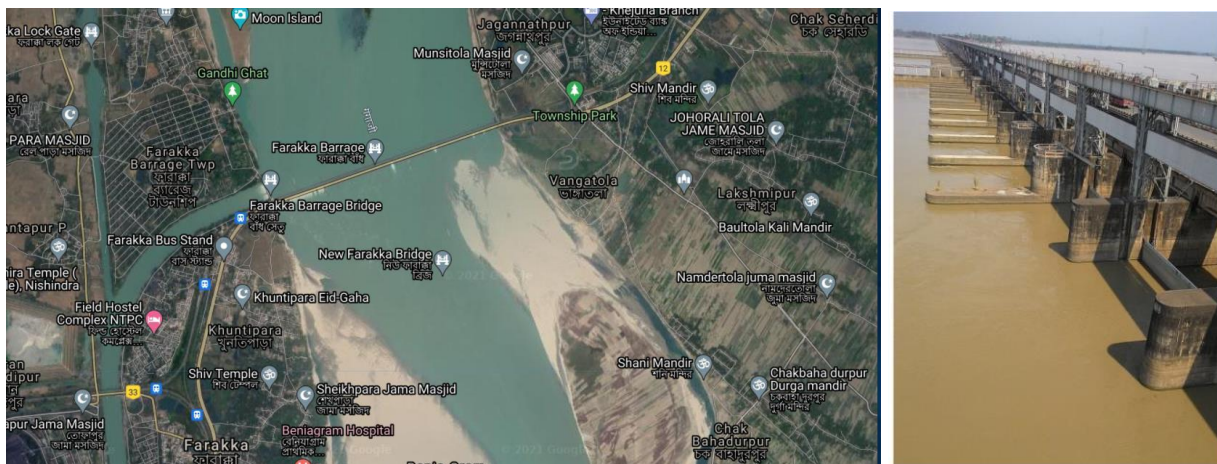


Fig. 10a. The Farakka Barrage upon the Ganges. The Feeder Canal is shown to the left of the Ganges River

(https://www.google.com/maps/d/u/0/viewer?ie=UTF8&t=h&oe=UTF8&msa=0&mid=1S5JxMrYPrASaDwjGZcr3h_zhW0&ll=24.846989124921432%2C87.9194521599745&z=14); Fig. 10b. Farakka Barrage (courtesy of SANDRP – South Asia Network on Dams, Rivers and People).

Table :1 Upstream’s Increased Allocation (cumecs) in the Coercive Water Sharing Agreements

Period	Provisional (4/21-5/31/75)	5-Year (1977-82)	30-Year (1997-2027)
April 21-30	311	566	735.6
May 01-10	340	608.5	990.5
May 11- 20	424.5	679.2	1,092
May 21- 30	452.8	757	1,132



Fig. 11. The Feeder Canal (Photo credit: Prasad, reproduced with permission). Pirated water from the Gangetic Bangladesh’s ecosystem provides navigability and adds aesthetic beauty.

3. 2. The Padma (Ganges) in Bangladesh

In course of time, apart from pirating the Ganges water, India surrounded Bangladesh by the Great Ring of Dams & Barrages (Fig. 14) covering more than 30 of the 58 common rivers. Consequently, the lower Ganges basin (Fig. 15) has been turned into another Aral Sea basin-like spot. A huge shoal has formed on the Ganges (Padma) bed further downstream from the ring of dams and barrages in Bangladesh as shown in Fig. 16 (Donald Katz <http://donnybangla.blogspot.com>). Fig. 17. Shows the cracked bed of the Ganges under the Hardinge Bridge.

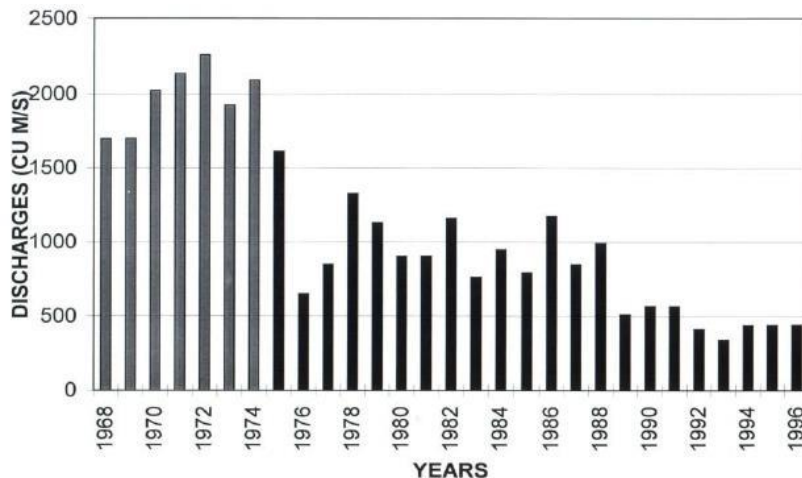


Fig. 12. The dwindling flow in the Ganges in Bangladesh has lost more than 70% of her virgin ecosystem's sustaining water flow (Hebblethwaite, 1997).

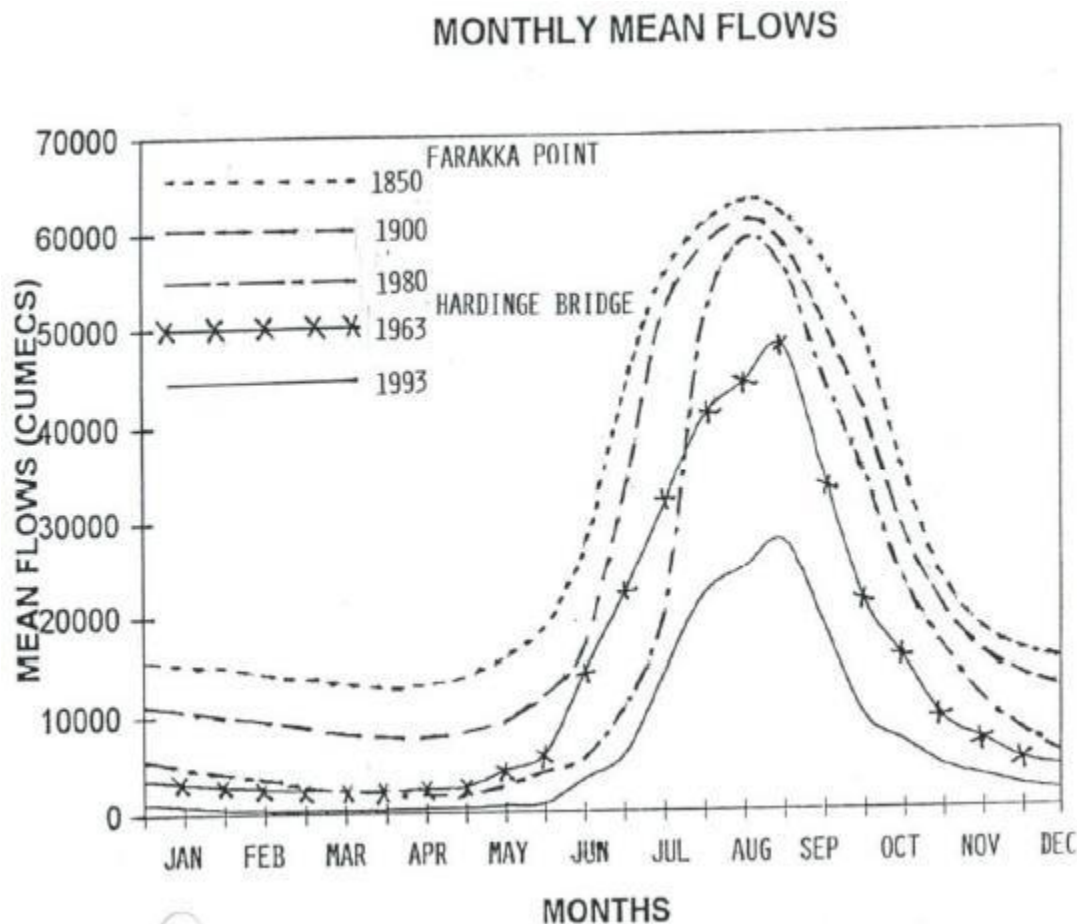


Fig. 13. Monthly average discharge in the Ganges. The top three curves refer to Farakka and the bottom two at the Hardinge Bridge point in Bangladesh (Adel, 2001).

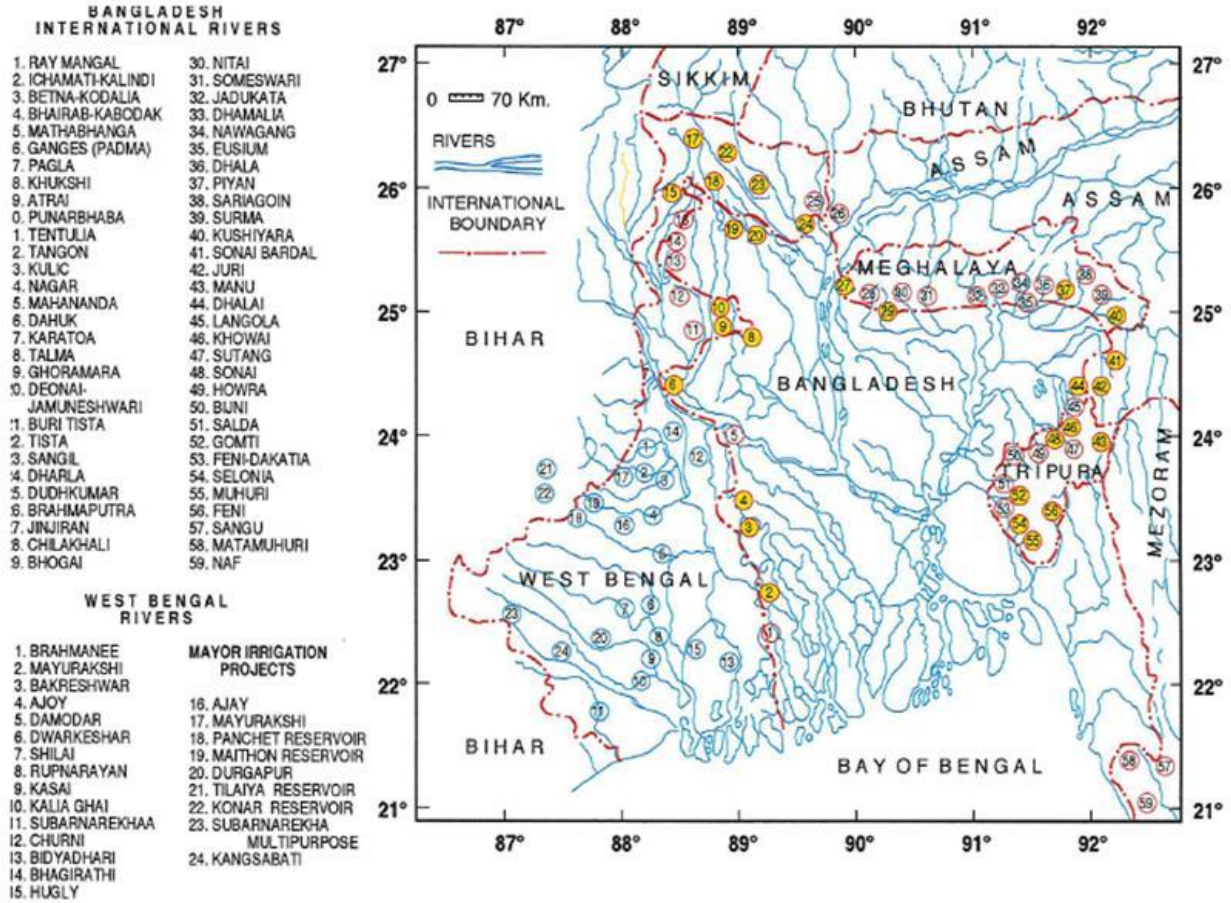


Fig. 14. Bangladesh encircled by Indian Great Ring of Dams and Barrages marked in yellow colors, a unique technique to subjugate a downstream riparian nation.

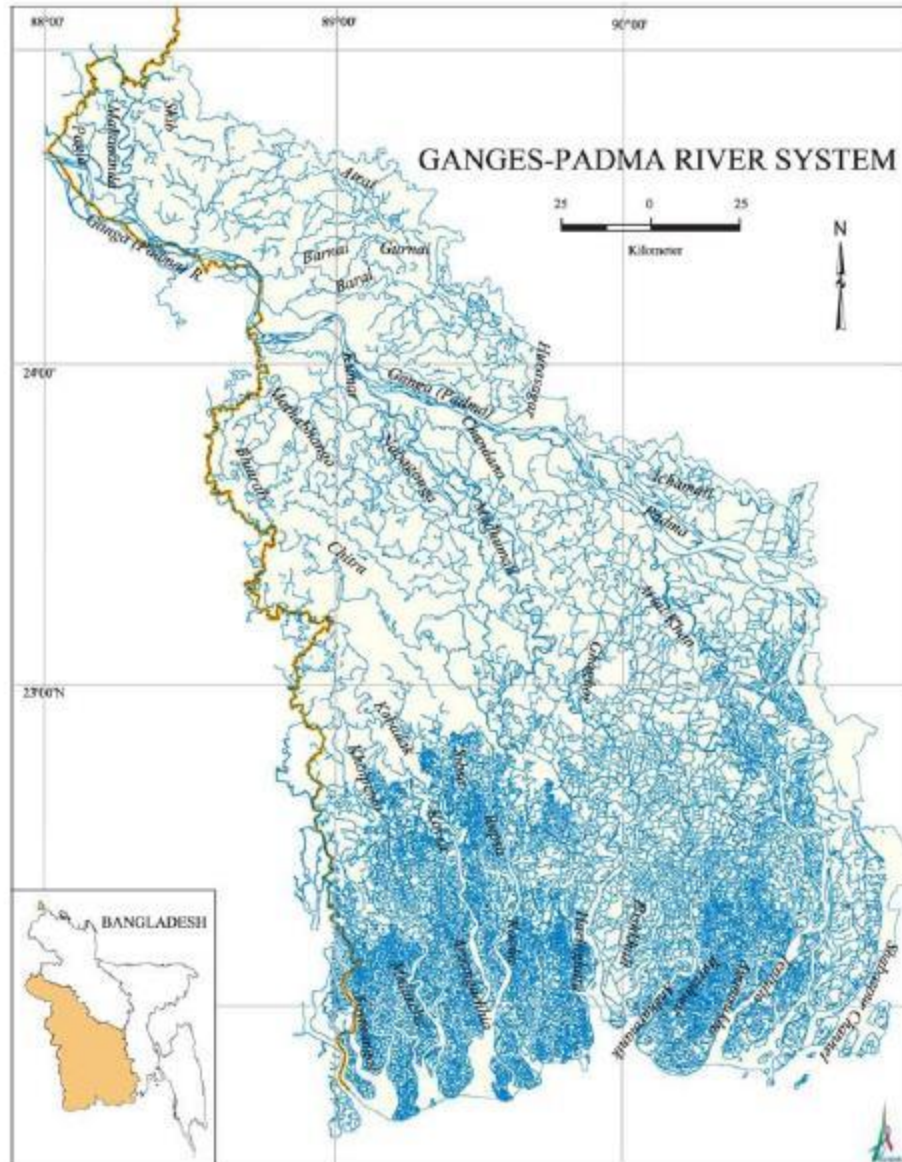


Fig. 15. The Ganges basin in Bangladesh (Courtesy of http://www.banglapedia.org/HT/R_0265.htm)



Fig. 16a River Ganga (Padma) dried up & reduced to a 6ft wide shallow stream in Rajshahi, Bangladesh; Fig. 16b. Cracked bed of the Ganges in Rajshahi (courtesy of Donald Katz, <http://donnybangla.blogspot.com>)



Fig. 17. The 1.8- km long Hardinge Bridge on the dry River Padma (Ganges) at Paksey, named after India's British Viceroy Lord Hardinge (1910-1916) (Courtesy of Shakoor Majid).

3. 3. The Distributaries' Conditions

3.3.1. The Baral Distributary

The Ganges's first distributary in Bangladesh is the Baral River (Figs. 18a and 18b). The Baral is approximately 147 km long, 120 m wide, 6 m deep, and had a drainage area of 230 square km. Fig. 19b, 19c, 20a, and 20b shows the current conditions of Baral.

The Baral's distributary Musa Khan's (Figs. 18b, 20c, 21a, 21b, and 21c) discharge about 1,000 m³/s during the flood season has been totally stopped by the formation of a shoal that levels off the riverbed with its banks. The 10-15 km long Musa Khan would feed its floodplains during July through November using 50 canals. Those floodplains do not get a single drop water from the Musa Khan.

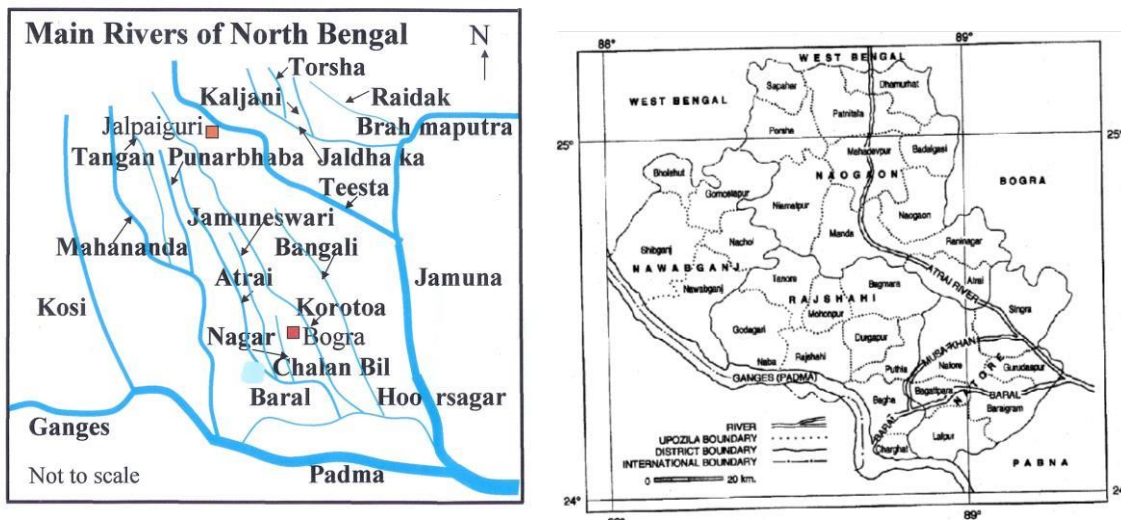


Fig. 18a. Main Rivers of North Bengal (Niyogi, 1997); Fig. 18b. The Baral and the Musa Khan basins.



Fig. 19a. The Baral River of decades ago (Shmunmun, 2011); Fig. 19b. A huge shoal in front of Baral's mouth; Fig. 19c. The pasture on the Baral's bed.



Fig. 20a. Google maps (Shadman Polok, May 2021); Fig. 20bb. Dry Baral under the bridge; Fig. 20c. Musa Khan’s hydrograph



Fig. 21a. The Baral’s offshoot Musa Khan (leftmost); Fig. 21b. The levelling off of the Musa Khan’s mouth; Fig. 21c. The Musa Khan at its mid course.

3.3.2. The Gahrai Distributary

The Garhai-Madhumati River is the supplier of the lifeblood of northwest Bangladesh. It has sixteen distributaries. In 1988 summer, its mouth was clogged and no water could flow in it. In the upper reaches, the river is known as the Madhumati and in the lower reacher, the Garhai. Fig. 20a shows the river with shoals on its bed. The gradual decreasing Ganges’s discharge-dependent flow in the Gahrai is shown in Fig. 20b. Its summertime scene is shown in Fig. 20a. Fig. 23 shows the branching off of the Garhai from the Ganges.

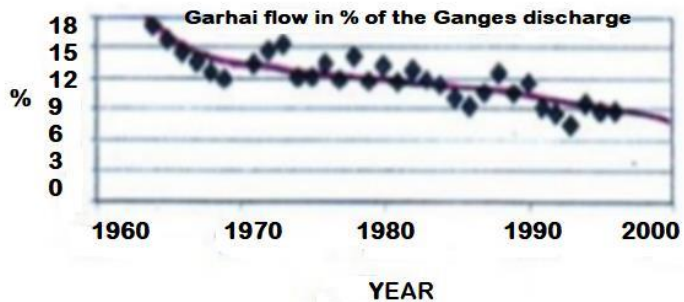


Fig. 22a. The summertime condition of the Garai, the main distributary of the Ganges that used to feed about 16 secondary distributaries. (Courtesy of *The Daily Star*, 12:02 am Tuesday, October 21, 2014, http://news.bbc.co.uk/2/hi/south_asia/7192200.stm); Fig. 22b. Decreasing trend in the Garai's discharge;

The Garhai branches of the Ganges at Kustia (Fig. 23)

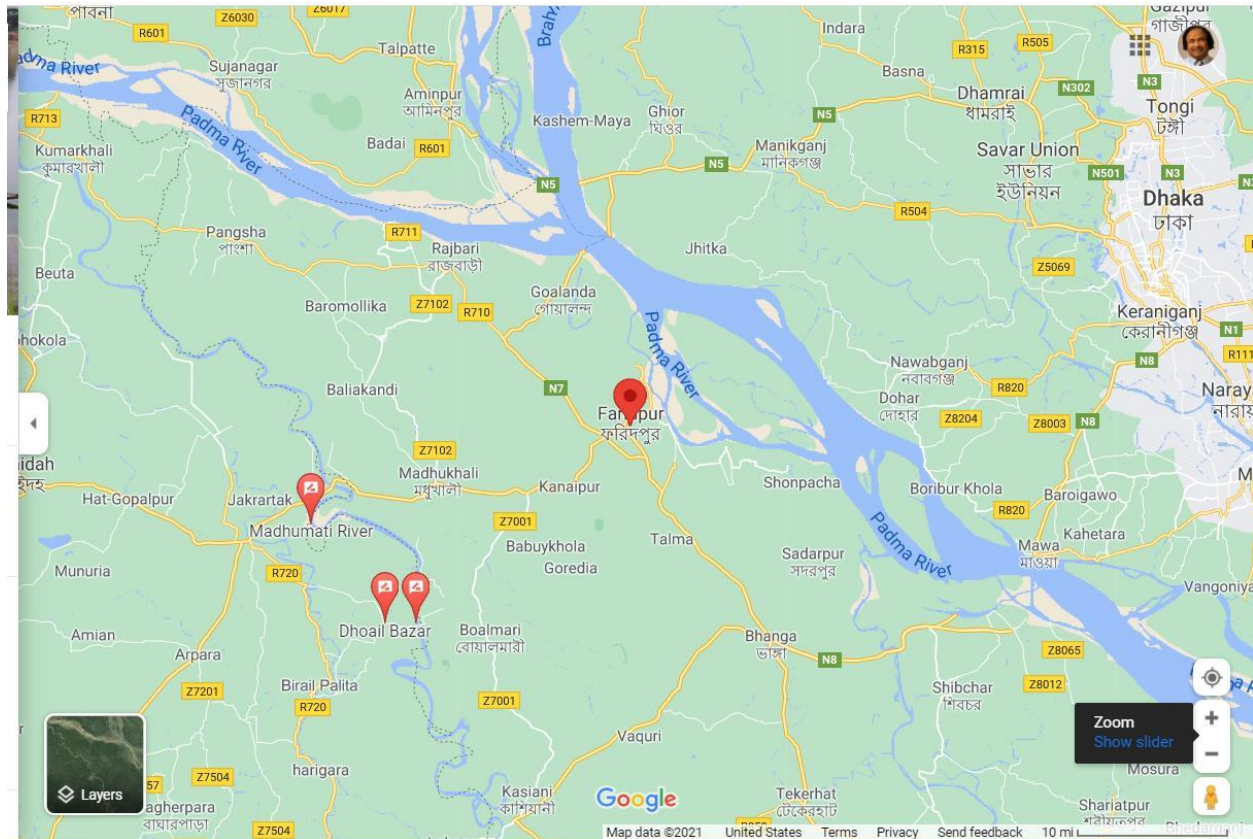


Fig. 23. The branching off of the Garhai River from the Ganges (<https://www.google.com/maps/place/Faridpur,+Bangladesh/@23.6013295,89.5610021,10z/data=!4m1!1m5!8m4!1e2!2s117288901601604184841!3m1!1e1!3m4!1s0x39fe2534aaa4fc7f:0x4daf43ffdb19a28e18m2!3d23.601745!4d89.8334885>).

3. 4. The Teesta Basin

Fig. 18a above shows that 315-km long Teesta rises in the eastern Himalayas, flows through West Bengal and Sikkim states of India to meet the Brahmaputra in Bangladesh. It drains 12,370 square km. Whereas the Teesta River needs 4,000 cusecs for its existence, its lowest discharges have been 4494, 4732, 529, 8, and 42.45 to 11.57 m³/s in 1980, 1990, 2000, 2005, and 2014, respectively (<http://archive.thedailystar.net/2006/11/03/d611031803114.htm>). The Teesta's bed has formed 58 shoals (Fig. 24a). It brings down a lot of silt from the upstream (Fig. 24b). Its

silted bed causes people's sufferings by flooding (Figs. 24c and 24d). Its sandy dry bed is shown in Fig. 25a. The Indian Teesta Dam is shown in Fig. 25b.



Fig. 24a. 58 shoals on the Teesta bed (courtesy of the *Daily Janakantha*, January 9, 2020). Fig. 24b silts clogged the Teesta Barrage gates (Courtesy of the *Daily Janakantha*, Staff reporter, July 18, 2020). Figs. 24c, and 24d present a thumbnail view of the devastating flood situation (https://www.somewhereinblog.net/blog/mostofa_kamal/30206906).



Fig. 25a. Silted and dry bed of the Teesta (<http://www.thedailystar.net/due-share-must-for-good-indo-bangla-relation-21336> Pankaj Karmakar, 24 April 2014);

Fig. 25b. The Teesta Head Regulator (http://india-wris.nrsc.gov.in/wrpinfo/index.php?title=Teesta_Barrage,_St.I,_St.I_Ph.I_JI02921).

In the pre-piracy period, flood and rainwater-filled numerous shallow and deep floodplains and other surface water resources would work to recharge the groundwater annually. In the ongoing piracy period, people use groundwater in all sorts of water-related works – drinking, cooking, cleaning, bathing, gardening, aquaculture, agriculture, irrigation, etc. etc. - while there is little recharging of groundwater annually from rainwater and more than 40% of the withdrawn water evaporates. Irrigation sector is the major user of groundwater. The countrywide irrigation systems use 26,704 deep tubewells, 4,69,226 shallow tubewells Fig. 26), 56,829 low lift pumps, 1,42,132 manual pumps, and more than 5,65,000 indigenous water lifting devices with an efficiency of only 30%

(https://www.google.com/search?sxsrf=ALeKk03q6d8Y4SloIxOmQaJ2N-fF3eEf3A:1626373742979&source=univ&tbm=isch&q=irrigation+in+Bangladesh&sa=X&ved=2ahUKEwiR_OKp2uXxAhVGc60KHSMcCJkQ4216BAgLEAQ&biw=1152&bih=601)

). Shallow water tables do not exist anymore. People had to reset up their tubewells to withdraw groundwater from a depth of 80 meters or more deep. In the pre-piracy days, the shallow

groundwater tables would fluctuate around a depth of 8 meters in the dry season and less the 5 meters in the wet season. During the on-going piracy era, a huge number of tubewells has been abandoned for withdrawing no water or arsenic contaminated water (Fig. 27). Arsenic contaminated groundwater (Adel, 2013d) drinking accounts for a 20% fatality.

Consequently, the groundwater table that takes thousands of years to build up is on the verge of depletion (Fig. 28) (Dey et al., 2013).



Fig. 26. Irrigation by shallow tubewells from a depth of about 30 m (<https://en.banglapedia.org/index.php/Irrigation>)



Fig. 27. Hand tubewells fail to extract groundwater because of its sinking down. Or they yield arsenic-contaminated water

3.5. Floodplains

Canals from rivers would feed the floodplains which would work as the recharging wells for the groundwater. Insufficient rainfalls fail to recharge the groundwater. Groundwater extraction overcomes recharging. Water cannot accumulate in canals and floodplains where the author used to swim in his boyhood days.

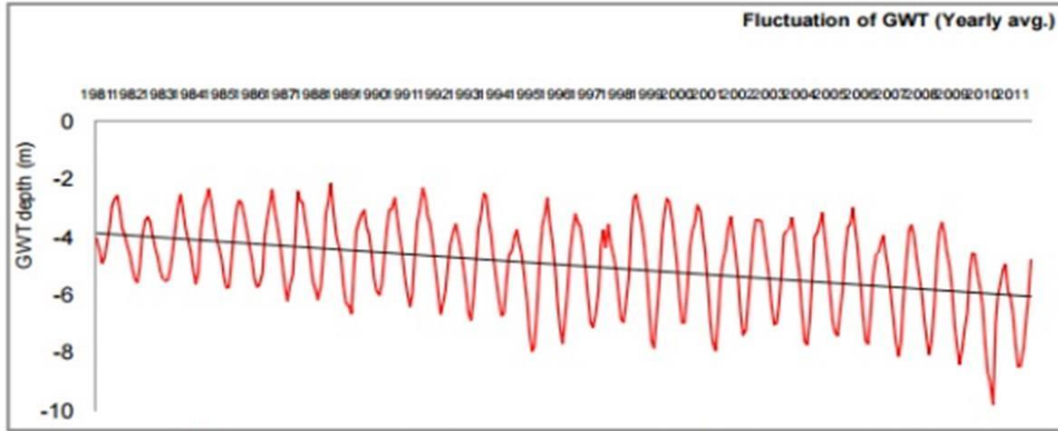
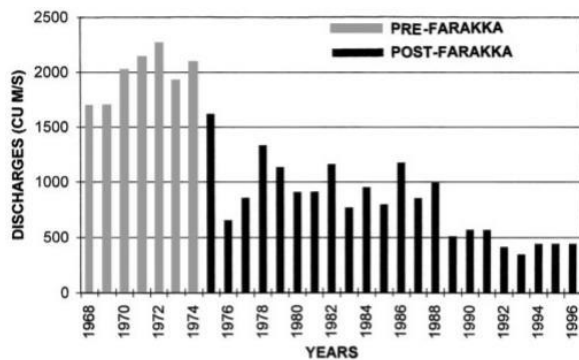


Fig. 28. A 30-year (1981-211) declining trend of groundwater in northwest Bangladesh (Courtesy of Dey et al, 2013)

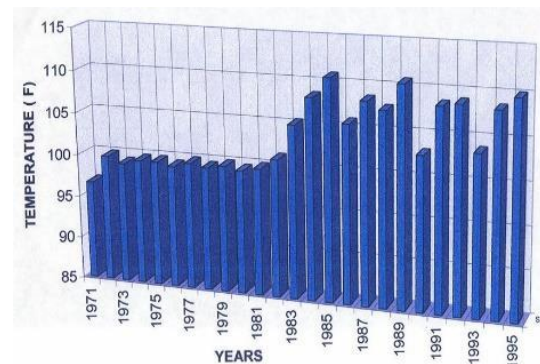
4. Climatic Impact

4.1. Heating and Cooling

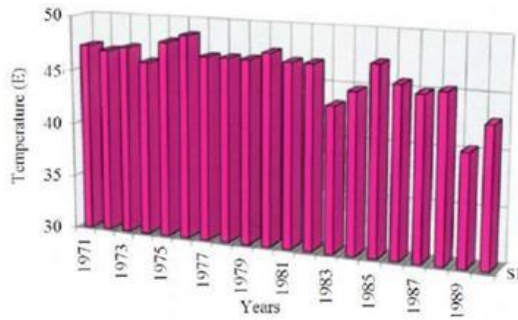
Temperature, humidity, and rainfall data pertaining to the onset of heating vis-à-vis cooling have been analyzed. The results are shown in Figs. 29 -33. Figs. 29b and 29c show the plot of annual maximum and minimum temperatures. Fig. 29d shows the HDD and CDD plots.. The highlights are that (i) the summer highest temperature was $> 42.78^{\circ}\text{C}$, (ii) the winter lowest temperature was $\sim 2.78^{\circ}\text{C}$, (iii) the Heating Degree Days appeared 1.33 times more than the pre-piracy value, (iv) the cooling Degree Days appeared 1.44 time more than the pre-piracy value, (v) the summertime average temperature was 1°C more than the pre-piracy value, (vi) the wintertime average temperature was 0.5°C less than the pre-piracy value, (vii) the summer temperature mode 32°C was 1°C higher and appeared 414 times more than the pre-piracy value, and (viii) the winter temperature mode 25°C was 1°C less and appeared 17 times less than the pre-piracy value. The correlation coefficients of the annual highs, annual lows, the HDDs, and the CDDs with the Ganges discharge (Fig. 29a same as Fig. 12) were -0.60, 0.55, 0.47, and 0.49, respectively.



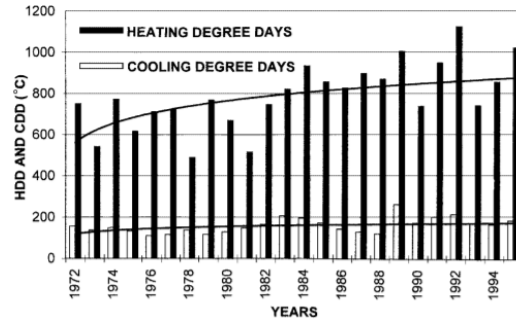
(a)



(b)



(c)



(d)

Fig. 29a. The Ganges's discharge in Bangladesh (Hebblethwaite, 1997). Fig. 29b. Summertime highest temperature in the Ganges basin; Fig. 29c Wintertime coldest temperature in the Ganges basin; Fig. 29d HDDs and CDDs.

Table 2 below highlights the differences between the pre-piracy and piracy era important environmental quantities.

Table 2: Comparison of Pre-piracy and Post-piracy Quantities

Quantities	Pre-piracy	Post-piracy
Summer highest temperature	-----	> 42.78°C
Winter lowest temperature	-----	~2.78°C
Heating Degree Days	-----	1.33 times more than Pre-piracy (Pp)
Cooling Degree Days	-----	1.44 time more than Pp value
Summertime average temperature	-----	1°C more than Pp value
Wintertime average temperature	-----	0.5°C less than the Pp value
Summer temperature mode	-----	32°C, 1 °C higher than Pp value, and 414 times more than Pp value
Winter temperature mode	-----	25°C, 1°C less the Pp value, and 17 times less than Pp value
Average of maximum RH	-----	increased by more than 2%
Average of minimum RH	-----	dropped by more than 2%
Mode of maximum RH	-----	95%, 1322 times more than Pp value
Mode of Minimum RH	-----	70%, 84 times more than Pp value
Frequency of ≥ 100 mm rainfall	-----	dropped by 50%
Monthly average rainfall	-----	dropped by 30%
Annual highs, lows, HDD, CDD	-----	correlated with Ganges discharge with correlation coefficients of -0.60, 0.55, 0.47, and 0.49, respectively
Ganges basin fldpln. water	44,043 sq km	11,011 sq km
Ganges basin heat content	1.73E19 Cals	4.32E18 Cals
Summer heat excess/winter heat loss	-----	10 times the pp value (Adel et al., 2014)
Lightnings	-----	Lightning frequencies has increased exceedingly

Ganges's 794 million tons sediment

Inland deposition

45% on the Indian Hooghly coast
just 5% on the Bangladesh coast.
Ganges deposits about 8% on Indian
floodplains and 41% on Bangladesh
rivers

4.2. Humidities

The humidity variations (Figs. 30 and 31) are due to the massive groundwater withdrawals more than 40% of which evaporates. In the ongoing piracy period, the average of maximum RH increased by more than 2%, the average of minimum RH dropped by more than 2%, the mode of maximum RH 95% appeared 1322 times more than the pre-piracy value, and the mode of minimum RH 70% appeared 84 times more than the pre-piracy value.

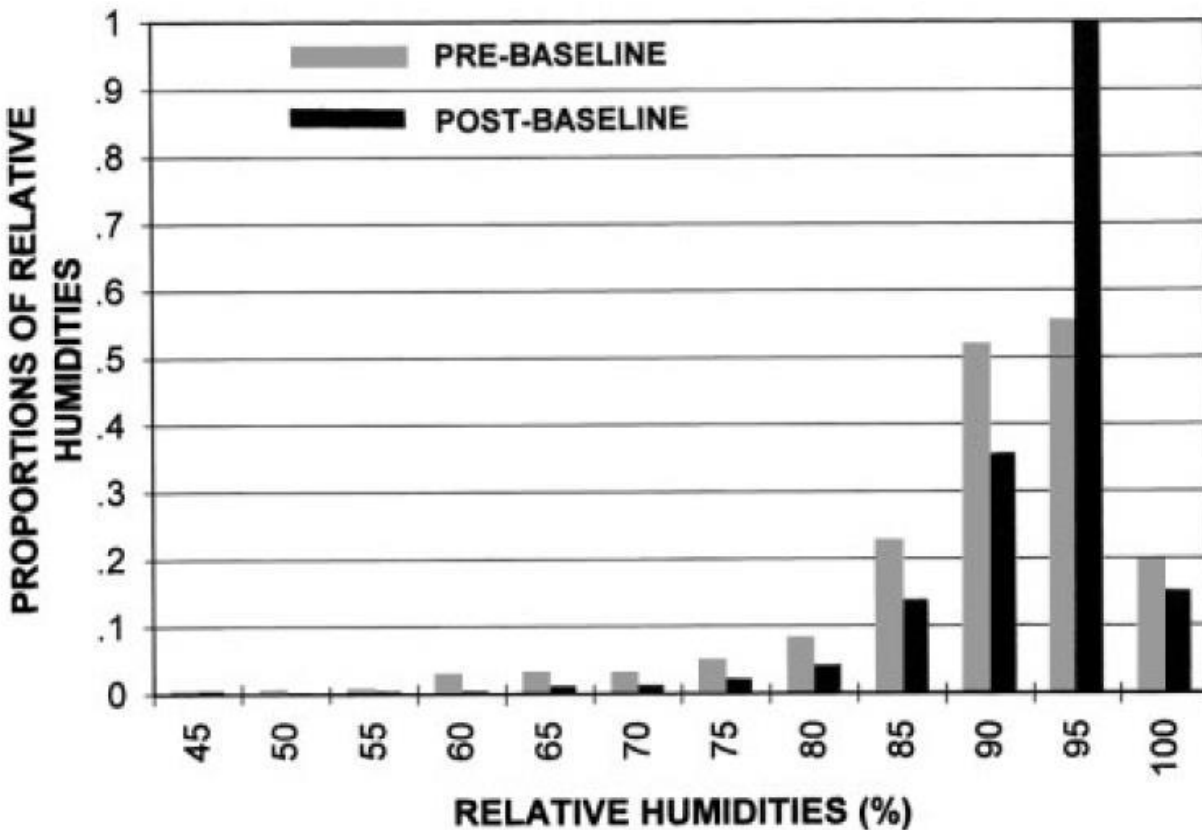


Fig. 30. Illustration of the proportions of the maximum relative humidity for pre- and post-baseline periods (Adel, 2002).

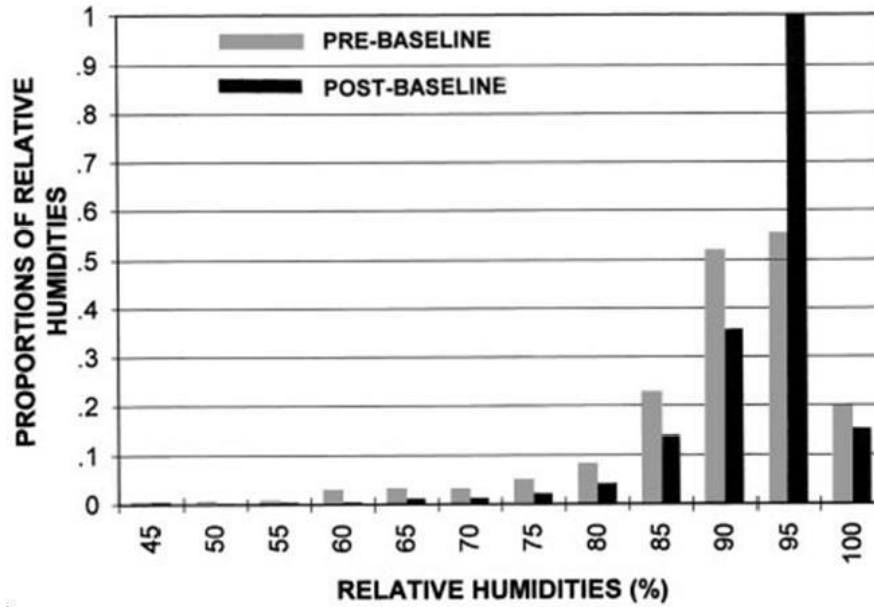


Fig.31. Illustration of the proportions of the minimum relative humidity for pre- and post-baseline periods (Adel, 2002) through false promises, bullying, and tricks.

4.3. Precipitations

Precipitation (Figs. 32 and 33) has decreased. Frequency of ≥ 100 mm rainfall has dropped by 50%, and the monthly average rainfall has dropped by 30%.

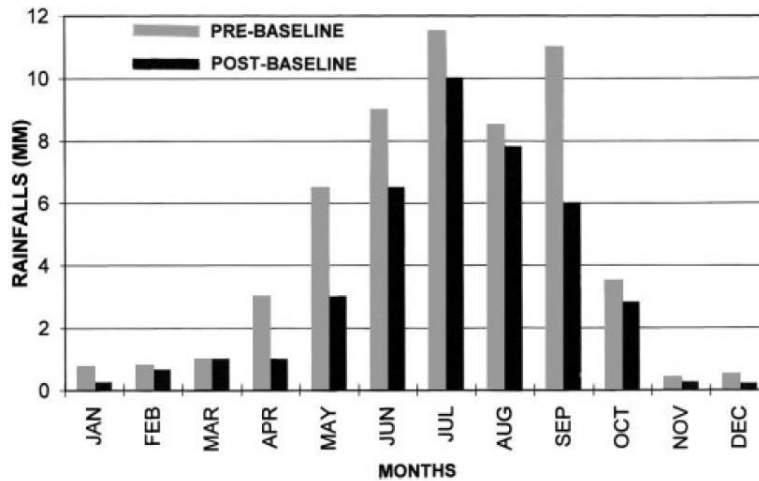


Fig. 32. Comparison of monthly rainfalls (Adel, 2002).

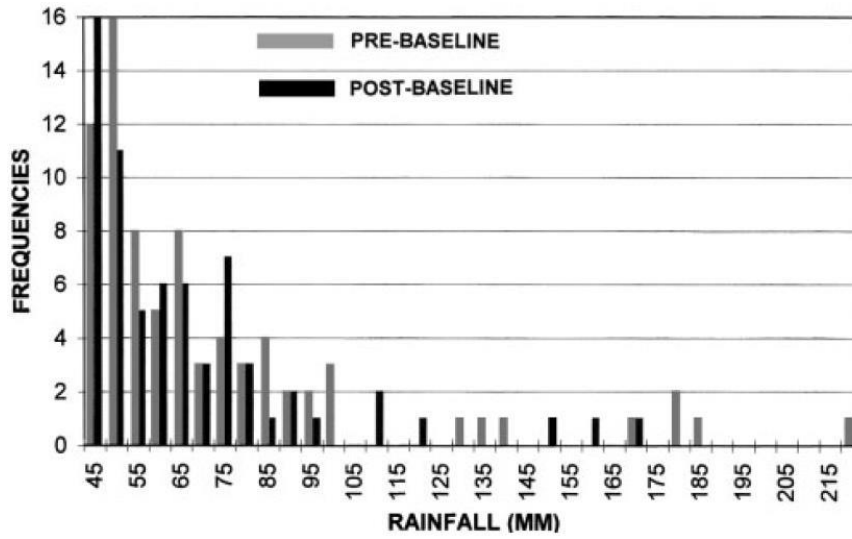


Fig. 33. Decreased rainfall frequencies (Adel, 2002)

Tremendous heat burns the crops. Fig. 34 shows burned boro rice field.



Fig. 34. Rice field burning (Zaman, 2021)

4.4. Increased Lightnings

Figs. 35 and 36 shows exceedingly increase of cloud to ground lightnings. 2018 has been the worst year (Fig. 35) and May has been the worst month of any year (Fig. 36). There has not been any kind of indoor or outdoor engagements in which lightnings do not strike any victims (Adel, 2021). Some lightnings victims are pictured in Fig. 37.

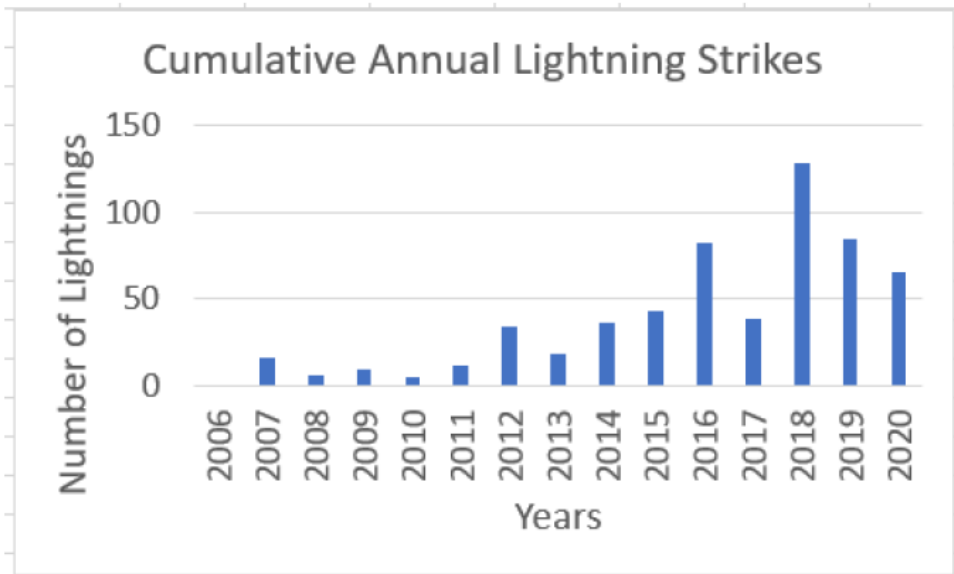


Fig. 35. Annual number of lightnings.

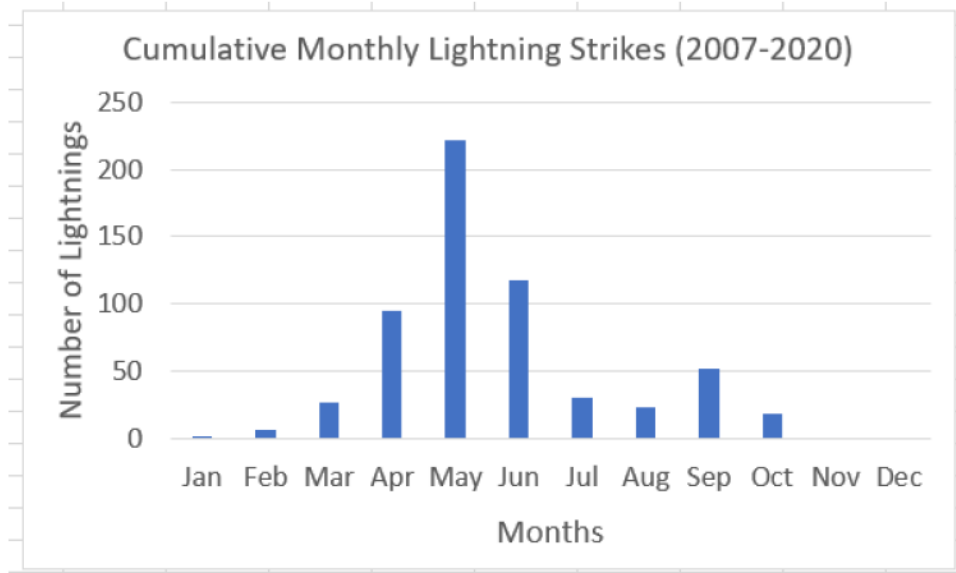


Fig. 36. Maximum lightnings occur in May



Fig. 37a Four farmers died of lightning strikes while working in a rice field in Magura (Magura representative, 2018); Fig. 37b. Ten buffalos died of lightning strikes in Sirajganj((Sirajganj representative, 2018) (<https://bangla.bdnews24.com/samagrabangladesh/article1491890.bdnews>)

5. Potential Aral Sea Basin-like Scenes

5.1. Brahmaputra Basin

China completed 510 MW Zangmu Dam on the upper reaches of the Brahmaputra, a few kilometers from Bhutan—India border. Its active capacity is 86,600,000 cubic meters. Three more dams are under construction – Dagu (640 MW), Jaicha (320 MW), and Jeixu. The largest dam on the Brahmaputra the Zam hydropower station was completed in 2015.

(<https://timesofindia.indiatimes.com/india/china-plans-dam-on-brahmaputra-how-it-may-impact-india-bangladesh/articleshow/79528597.cms>). China is now planning to implement hydropower exploitation in the downstream of the Brahmaputra Fig. 38). The project could serve to maintain water resources and domestic security.

To offset the impact of the dam on the Chinese side, India has announced to build a 10 gigawatt hydropower project the Dibang Dam in Arunachal Pradesh. If constructed, it will be India's largest dam and the world's tallest concrete gravity dam, standing 288 metres tall.

The Indian government sees her northeastern region as the country's future powerhouse (Figs 39 and 40). The Central Electricity Authority (CTA) in 2001 identified 168 large hydroelectric projects with a potential of 63,328 MW in the Brahmaputra basin

(<https://thediplomat.com/2020/12/india-to-expedite-dam-construction-after-china-announces-project-in-tibet/>).



Fig. 38. The Great curving of the Brahmaputra, the site for China's world's biggest hydropower project (<https://sandrp.files.wordpress.com/2013/07/yarlung-tsangpo-grand-canyon-e28093-tibet.jpg>)

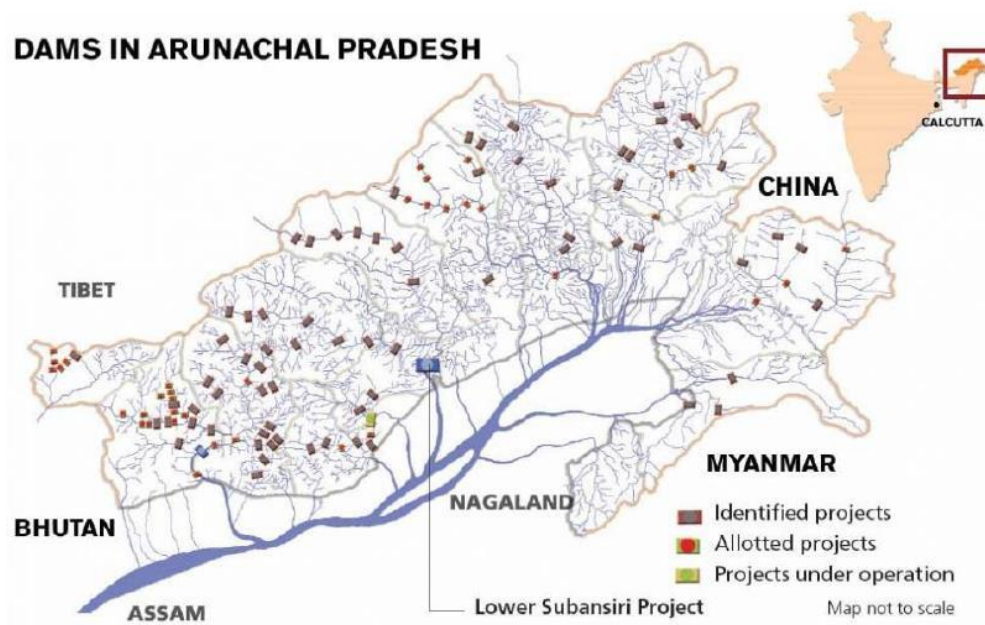
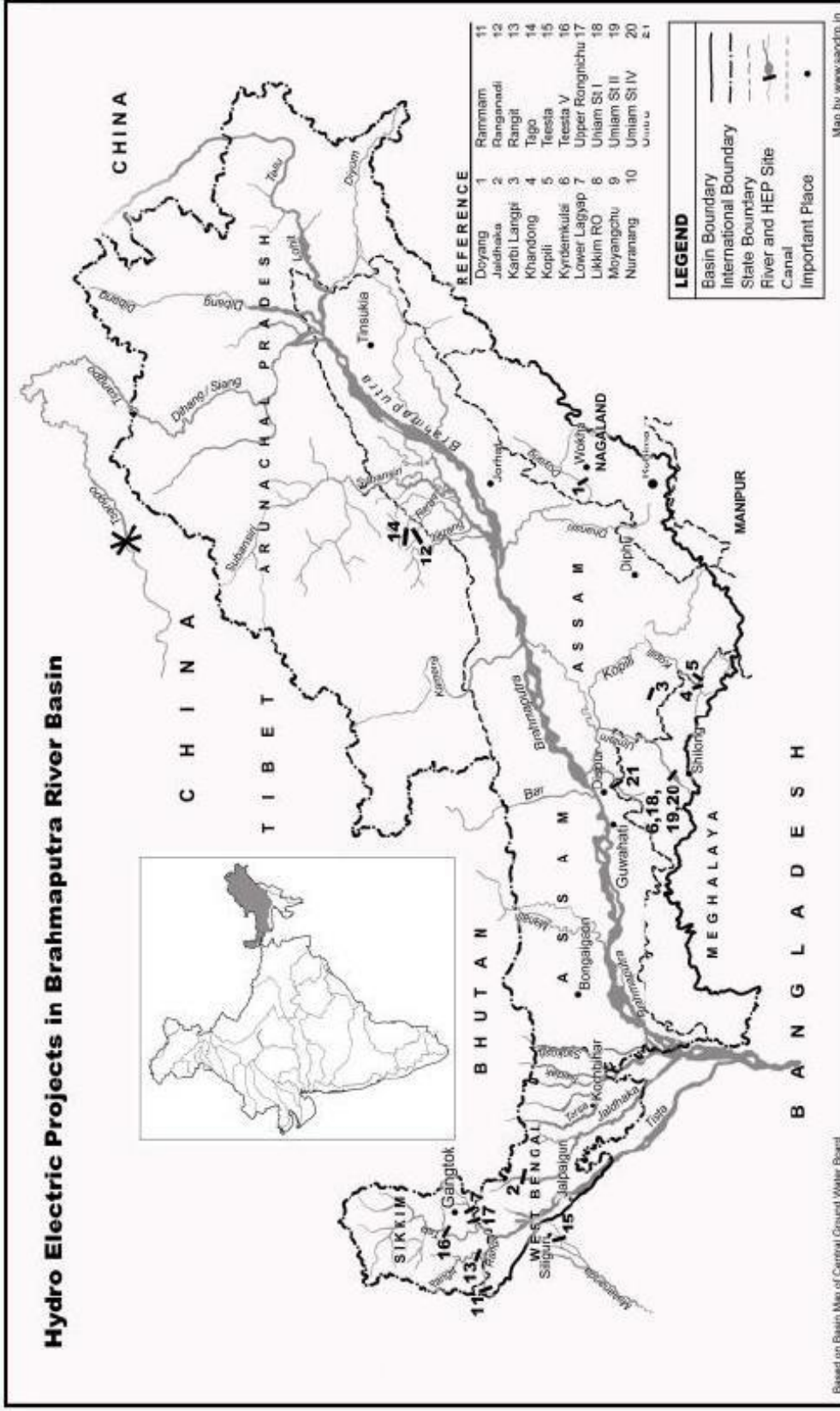


Fig. 39. Identified, allotted and operational projects in Arunachal Pradesh (<http://www.internationalrivers.org/campaigns/northeast-india>)

Hydro Electric Projects in Brahmaputra River Basin



Based on Basin Map of Central Ground Water Board
Map by www.sandrp.in

Fig. 40. Hydropower projects in the Brahmaputra basin

http://sandrp.in/basin_maps/Hydropower_Projects_in_Brahmaputra_Basin.pdf

The lowe Brahmaputra basin is shown in Fig. 41. Following constructions of the hydels the decrease in the river discharges would favor siltation in riverbeds decreasing its capacity to accommodate flood water that would cause irreparable damages to lives and properties. Also, the silted distributaries would have their mouths clogged inviting land grabbers to blot out the existence of the river mouths. Floodplains would be deprived of their water. In the absence of surface water bodies, summers would turn warmer and winters colder. Further, the surface water scarcity would cause groundwater sinking, drinking water scarcity, and widened and increased contamination of groundwater with arsenic.

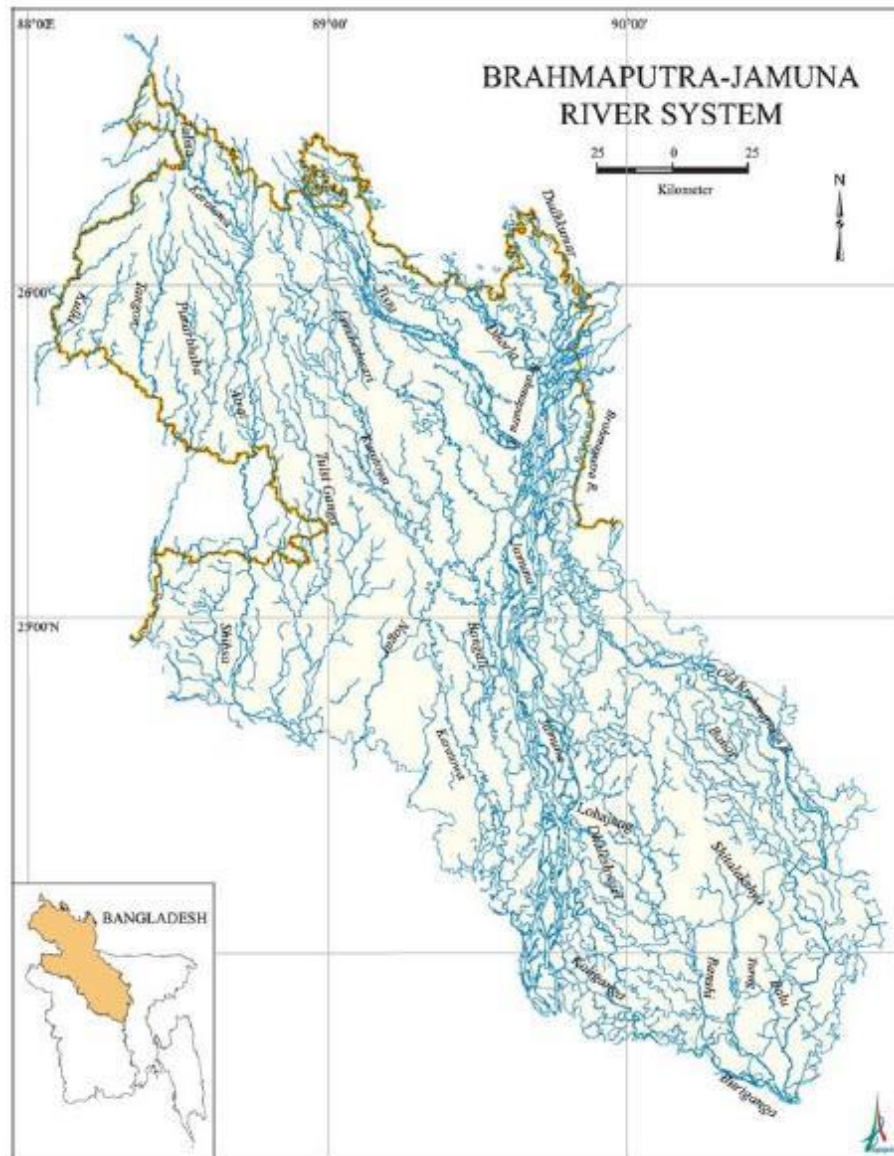


Fig. 41. Brahmaputra-Jamuna subbasin (Courtesy of http://www.banglapedia.org/HT/R_0265.htm)

Further, the lowest recorded flow of the Brahmaputra being only 3,117 cumecs, the piracy of unknown quantity of water would leave little water for the 13-km wide river (Fig. 42). The consequences would be more disastrous than the Ganges basin (Sufian, 1993; Sattar, 1996).



Fig. 42. The Brahmaputra in Bangladesh (KM Reazul Hoque, 20 November 2014)
<http://www.thedailystar.net/sharp-decrease-of-jamuna-water-hampers-navigation-51204>

5.2. Western Neighbor of India: The Indus Basin

India threatened her western neighbor Pakistan of cutting off water supply voiding the six-decade old water Indus treaty (Fig. 43). Following the 1960 World Bank-mediated Indus Water Treaty (IWT), Pakistan gets water from the Indus, the Jhelum, and the Chenab Rivers. And India gets water from the Ravi, the Beas, and the Sutlej Rivers (Fig. 44). About 39% of the Indus River system lies in India and 47% in Pakistan. (FAO, 2011). Pakistan is the world's one of the most water-stressed countries. Pakistan's water demand is projected to be 225 cubic kilometers in 2050 which was 163 cubic km in 2015. The Indus supports about 90% food and 65% employment of Pakistan through farming and animal husbandry. Pakistan fears of India's upstream Indus water piracy through dams. She already tried multiple times to prevent India's dam building on the Jhelum's tributary the Neelam River and on the Chenab River because of contravening the IWT. India gets the upper hand of upstream water piracy by building dams and barrages (Fig. 45 for which there are no restrictions in the IWT nor there is restriction on the quantity of her water piracy (<https://climate-diplomacy.org/case-studies/water-conflict-and-cooperation-between-india-and-pakistan>; Dutta, 2019; Thakkar, 2019).



Fig. 43. Prime Minister Narendra Modi speaking at Charkhi Dadri in Haryana, where he said India can no longer allow Pakistan to use water from its share allocated under the Indus Waters Treaty. (Photo: PTI)



Fig. 44. The main tributaries of the Indus divided between India and Pakistan

(<https://sandrp.in/2017/03/21/india-pakistan-resume-talks-on-indus-treaty-stakes-are-high/>)

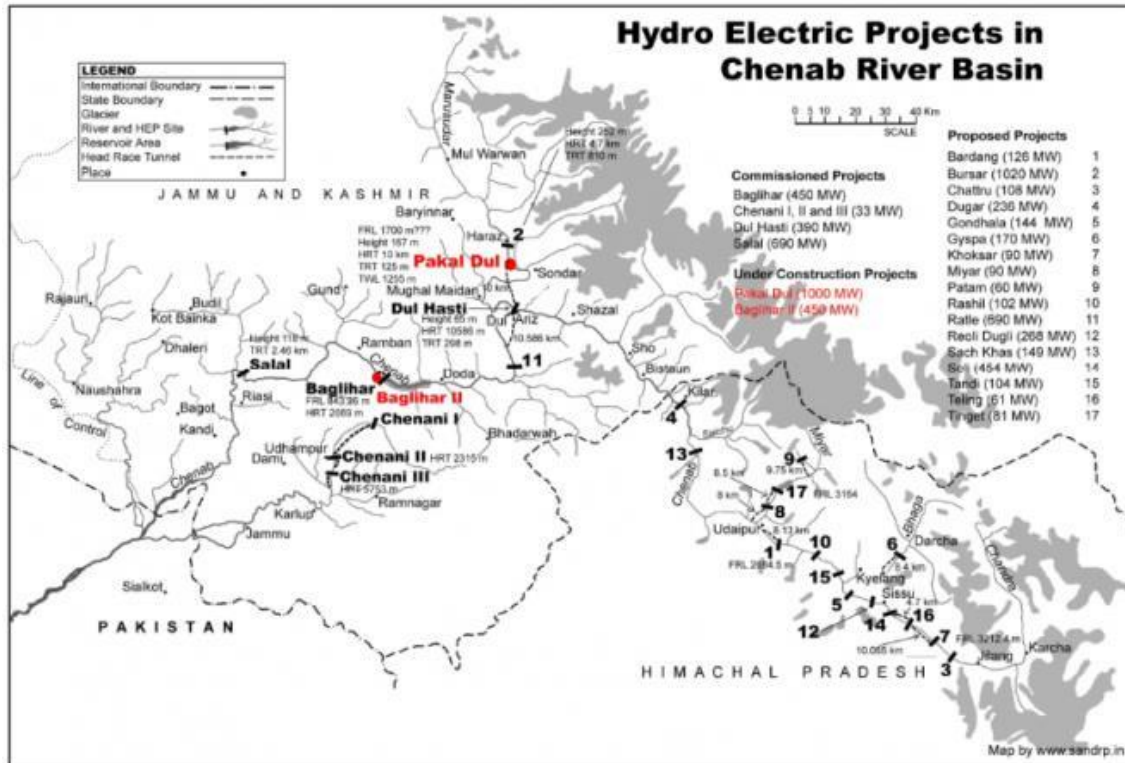


Fig. 45. Hydroelectric projects in the Pakistan’s shared Chenub River Basin that will affect the Indus discharge (<https://sandrp.in/2017/03/21/india-pakistan-resume-talks-on-indus-treaty-stakes-are-high/>)

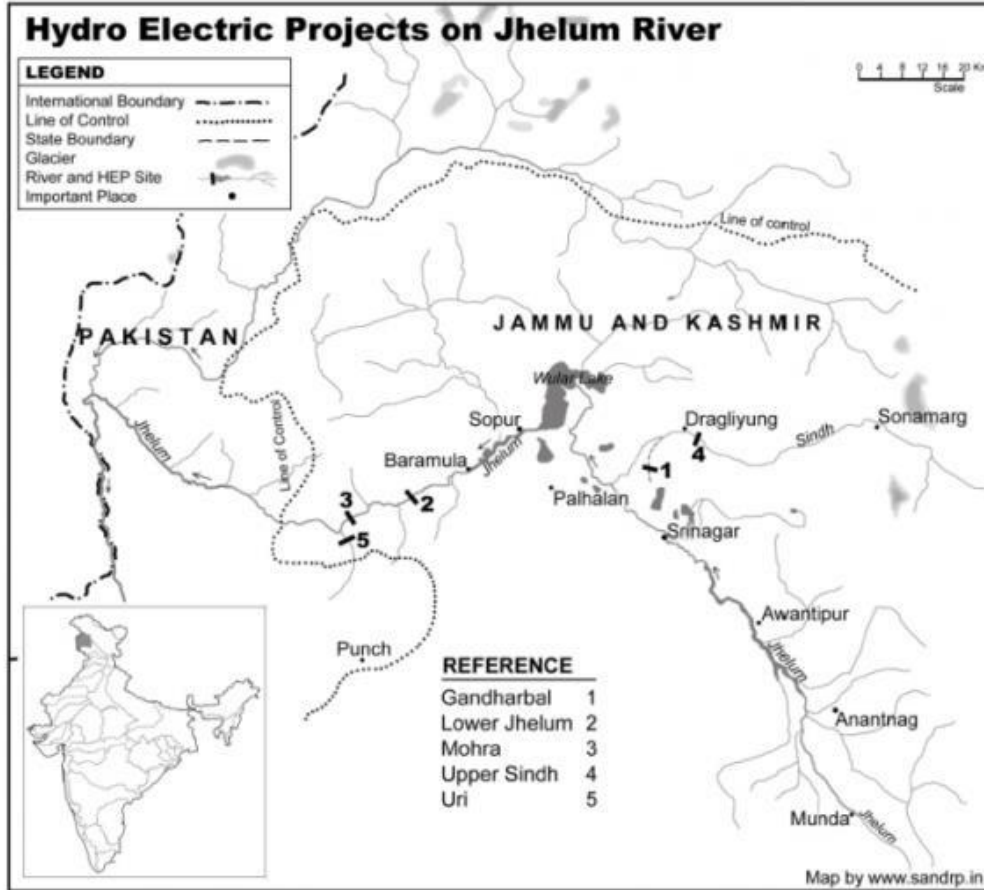


Fig. 46. Hydroelectric projects on the Jhelum River (<https://sandrp.in/2017/03/21/india-pakistan-resume-talks-on-indus-treaty-stakes-are-high/>)

5.3. Climatic Effects – Lightnings

India's progression of irrigation and lightning strikes correlates as evidenced from Figs. 47 and 48. It seems playing with water is like playing with fire.

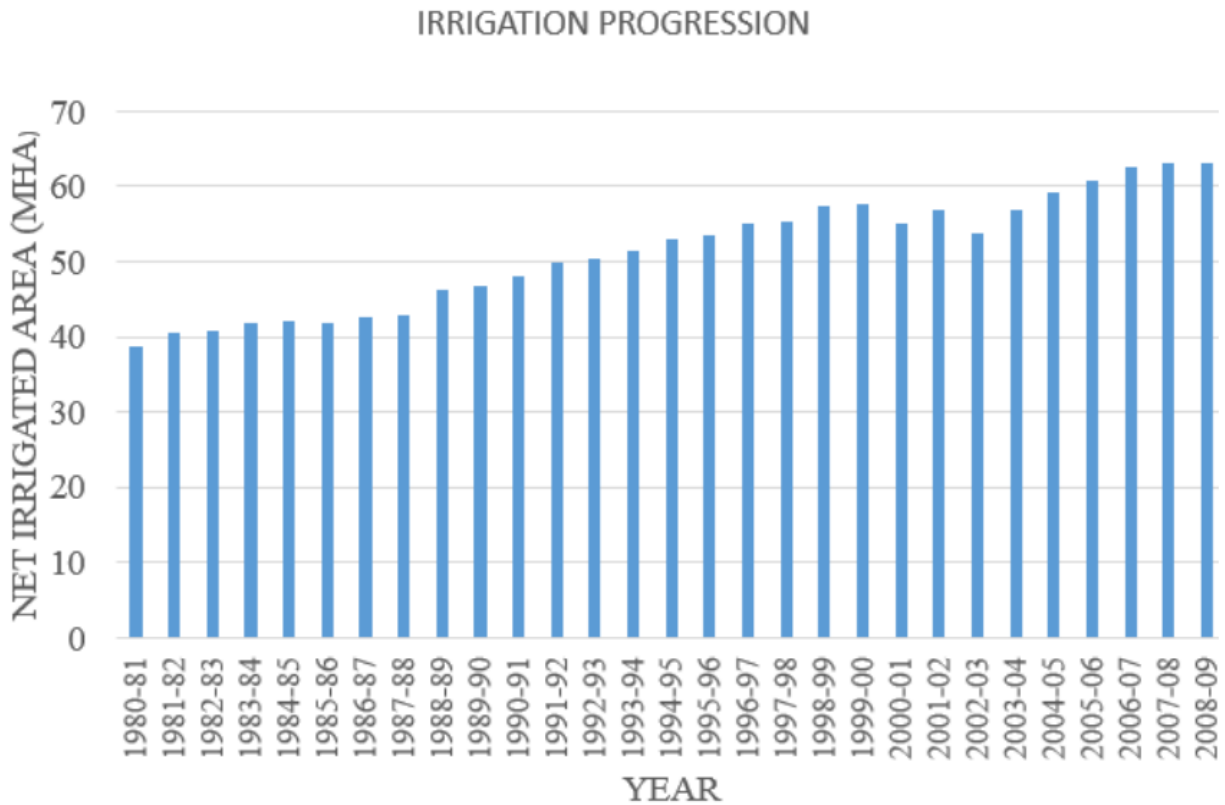


Fig. 47. Progression in irrigation (<http://www.indianstatistics.org/irrigation.html>).

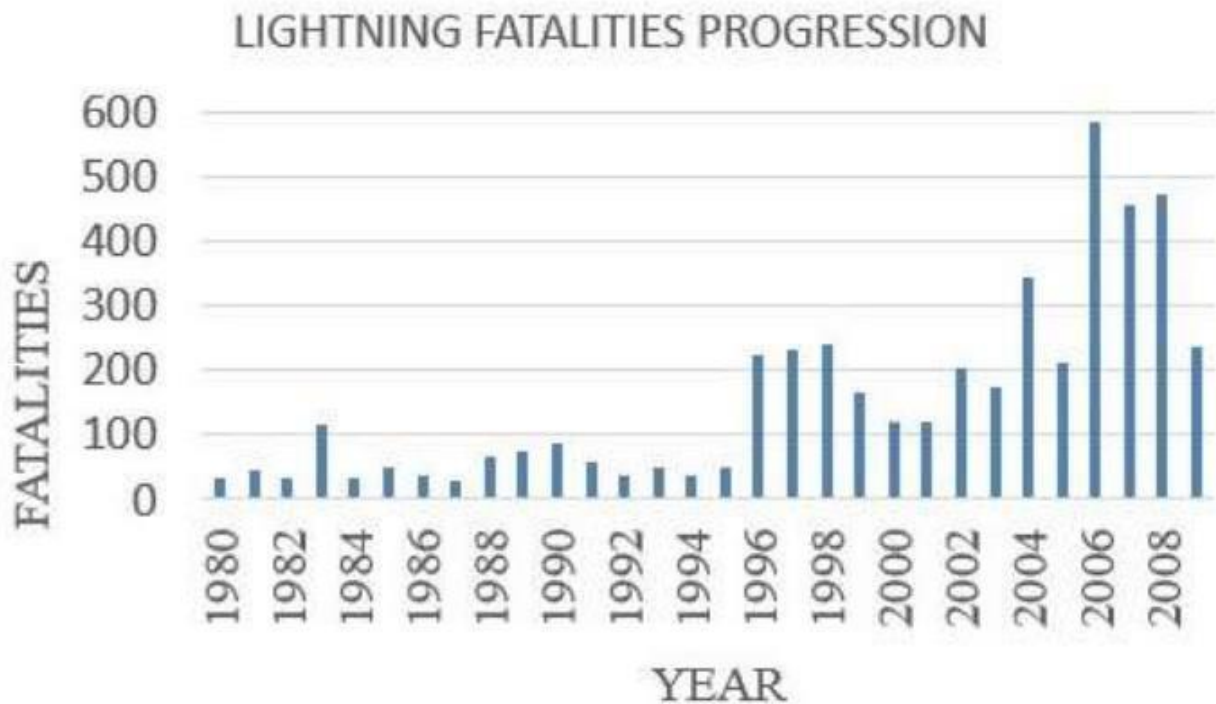
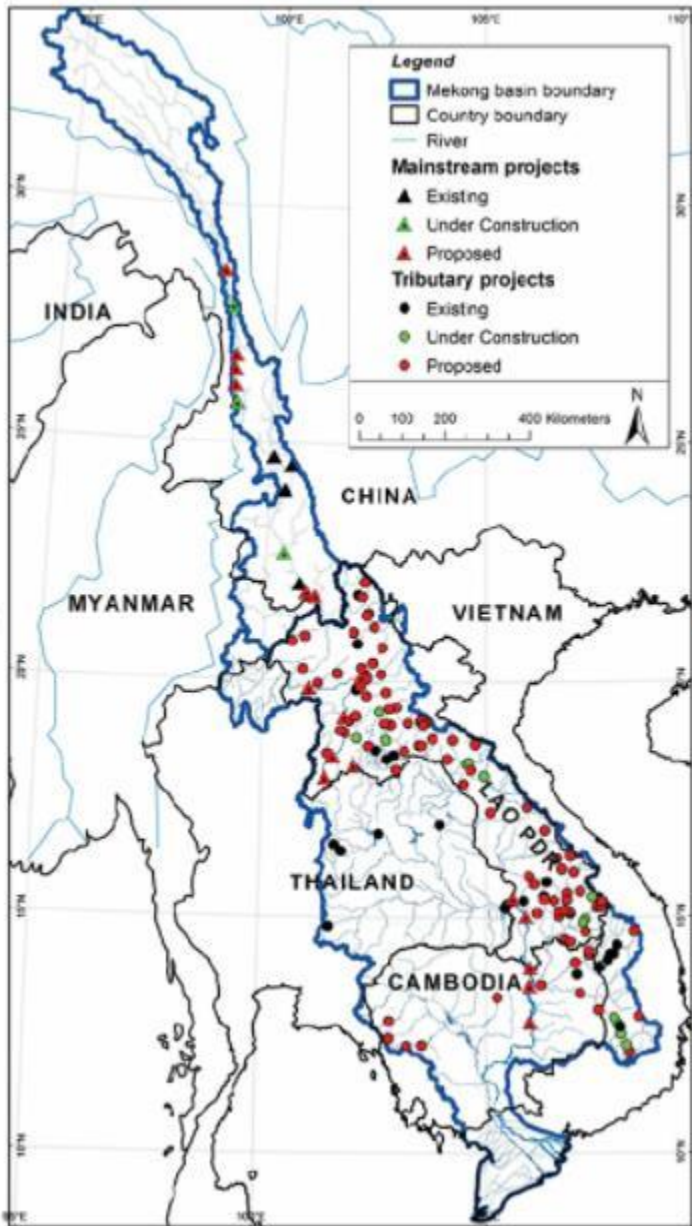


Fig.48. Increase in lightning fatalities (Singh and Singh, 2015).

5.4. Mekong Basin

Fig. 43 shows the operational, under-construction, and planned hydels in the Mekong basin. A US government-funded study already showed that a series of new dams built by China on the Mekong River had worsened the drought situation in the downstream countries. This is the same scenarios of precipitation as in the Ganges basin discussed above. But China disputed the findings.



<u>Country</u>	<u>Planned</u>	<u>Proposed</u>
Cambodia	12	0
China	11	2
Laos	43	20
Myanmar	7	0
Thailand	7	0
Vietnam	1	1
Totals	74	23

Fig. 49. A map of the Mekong River Basin with all existing and future dam projects Source (https://www.researchgate.net/figure/A-map-of-the-Mekong-River-Basin-with-all-existing-and-future-dam-projects-Source_fig1_259430849); Planned and proposed hydropower dams in the Mekong River Basin (https://en.wikipedia.org/wiki/Hydropower_in_the_Mekong_River_Basin; "WLE, 2016. Dataset on the Dams of the Irrawaddy, Mekong, Red and Salween River Basins. Vientiane, Lao PDR: CGIAR Research Program on Water, Land and Ecosystems - Greater Mekong". CGIAR Research Program on Water, Land and Ecosystems (Greater Mekong). Retrieved 2018-04-04.)

6. Discussions

Out of all materials in our environment, water has the highest specific heat of 4,186 J/kg.°C. Regarding the summertime warming up and wintertime cooling down, water bodies can absorb and store heat in summer for release in winter. In the absence of the water bodies this action cannot take place. Clear water absorbs 90% of the incident radiation and reflects just 10%. Wet soil, at most, reflects 20% of the incident radiation. Rice plants reflect more than 40% and absorb about 60% of the incident radiation. Green crops reflect 30% of the incident radiation. Other environmental materials like air, wet soil, dry soil, brick, concrete, wood, glass, and sand are 1,005, 1,480, 800, 840, 880, 1,300-2,400, 670-753, and 830 J/kg.°C, respectively. (https://www.engineeringtoolbox.com/air-specific-heat-capacity-d_705.html; https://www.engineeringtoolbox.com/specific-heat-capacity-d_391.html). The release of CO₂ (of specific heat at constant pressure 846 J/Kg.°C (https://www.engineeringtoolbox.com/carbon-dioxide-d_974.html)) is beside the point in this scenario

The huge pool of water that would be contained in place of the shoal of width 1.6 to 8 km in the Ganges and in other dried rivers could store a significant amount of heat letting not the rise of summer heat and dropping of winter cold. Summertime this huge sandy shoal has an emissivity of (the ratio of the radiant energy emitted by a surface to that emitted by a blackbody at the same temperature) 90% (<https://www.thermoworks.com/emissivity-table>) and the average reflectivity of sand can be taken as 40% in the wavelength range of 500-800 μm (Drakopoulos et al., 2014). The negative correlation coefficient shows moderate correlation between water shortage and the warming. So does the positive correlation coefficient between the water shortage and the cooling down.

As to the humidity variations, it is the evaporation from the extracted groundwater that adds to the piracy period humidity. Irrigated lands have shallow water levels. The solar radiation heats up a smaller volume of water raising its temperature at the surface faster. At the surface, the specific humidity becomes low and favors further evaporation.

Regarding the drop in precipitation, it can be said that water begets water. There are more rainfalls on oceans than on lands. The moisture-laden air coming over the land from sea does not meet the adequate moisture to fulfill any critical condition to cause the rainfalls.

For increased lightning frequencies, Thompson reported of a 12% increase in lightning for each degree Celsius rise of temperature (David et al., 2014; Thompson, 2014). The summertime maximum temperature plot (Fig. 29b) shows, at least 4 degree Celsius rise. This indicates about 50% increase in lightnings. According to Bangladesh's Met Office, prior to 1981, the country

saw lightning strikes on average nine days each May. Since that time, the country has seen strikes an average of 12 days each May (<https://in.reuters.com/article/bangladesh-lightning-disaster-idINKCNOZ81U4>). Additional lightning reasons are embedded in the facts that in most cases victims fell in an aerial environment of increased electrical conductivity in the range 10^{-14} to 10^{-9} S/m due to a past, ongoing, or sudden shower when the aerial electric field becomes about 20 times larger than the natural one of 100 V/m to which added about 100 times more victims' moist body conductivity, crops' leaves/thorns conductivity in the range of ~ 0.3 to 0.9 S/m, and the curvature-dependent induced electric field in victim' working tools and/or ornaments of conductivity $\sim 10^{-7}$ to 10^{-8} S/m (Adel, 2021).

China and the downstream countries in the Mekong basin have been exploiting this river discharge. People will feel little by little the climate change – increased heating vis-à-vis cooling (Adel et al., 2014).

The best management of the international water resources is to use it by the upstream country as much as she needs and let remaining part flow downstream. The accumulation of excess water or rationing or blocking the downward flow is just piracy of water. It results in climate change both in the upstream (Adel, 2018) and in the downstream.

The issue was raised in the American Meteorological Society's Climate Studies Diversity Project Workshop in Silver Springs, MD

(https://drive.google.com/drive/u/1/folders/1xTdAnDqlyn_dcMdDqID2TdC12UQv3-Sf).

Niepold (2018) from NOAA Climate Program Office admitted the truth of the matter but due to many factors was unable to address all the aspects. The Nobel Laureate. Alley (2018) from Penn State University, did not support it. He stressed that energy availability could solve the problem. He did not know that India is running mad for energy productions, water acquisitions and reservations, and food productions. She provides free electricity and water to the farmers. Her food production got so much that huge surplus of grains rot in the storage facilities in northwest Punjab. On the face of hungry millions, India wasted both resources and energy. She wasted the water used in the production of food grains. Also, she wasted the energy required to move the water in irrigation. This is because massive energy is required in moving water in farming with the help of electric pumps. That makes the mine sector fall short of energy in lifting coal causing fuel shortages in running coal-fired power plants. A great discussion was held on “Choke Point: India initiative, an exploration into the water-energy-food confrontations in the world's second most populous country” on 2 April 2014 by the Circle of Blue and the Wilson Center (China Environment Forum Choke Point: India –A Wilson Center-Circle of Blue Joint Initiative, April 02, 2014//9; 00 am – 11:00 am). The Circle of Blue's initiative is very much informative and worth of taking lessons for India (<https://www.wilsoncenter.org/event/choke-point-india-wilson-center-circle-blue-joint-initiative>; Adel, 2015). We focus on curbing CO₂ production that is believed to cause warming. Before the CO₂ curbing race is over, inland surface water resources will be depleted. The problem can be solved easily if the upstream nations listen to what the Father of India said – “The world has enough resources to meet everybody's need but to no one's greed.” Nations should focus on wind energy, solar energy, etc. instead of hydroelectricity.

Worldwide there are 60, 53, 71, 39, and 38 international rivers covering 62%, 39%, 54%, 35%, and 60% areas in Africa, Asia, Europe, North America, and South America, respectively. The percentages of international basin sharing by the number of countries are 90-100% by 39, 80-90% by 11, 70-80% by 14, 60-70 by 11, 50-60% by 17, 40-50 by 10, 30-40 by 10, 20-30% by 13, 10-20 by 9, and 0-10% by 1, respectively Adel, 2015). Thus, the internationality of sweet water streams cannot be ignored for our mutual coexistence. If all other riparian countries follow the footsteps of India and China, a global havoc will be created. Covid-19 has targeted the global

human population, but the upstream water piracy will affect all living beings – humans, animals, and the ecosystems.

7. Conclusion

A pen picture of the Aral Sea basin-like scene along with warming vis-à-vis cooling has been presented. It should be an eye-opening for all of us to understand the importance of water in climate change. Water resources once gone is not recoverable due to its irreversibility. Its absence has a domino effect. As we live together, we should feel for each other. Motivation by self-interest mars others' interests, and even put the self in jeopardy. Let there be a policy of current use of water and not storing for future. Let the water be released for the downstream after the need but not the greed of the upstream has served. Let it not be used to corner a downstream neighbor. Let us not waste resources. Let us focus on other forms of energy. Climatologists should be as vocal on exploitation of water resources as they are on CO₂ emission to maintain a livable environment for the inhabitants of this planet. If they can be vocal on CO₂ emission by the industrialized nations, there should not have any reason not to raise voice against the indiscriminate water exploitation, the elixir of this living planet. CO₂ emission causes the global warming, but the H₂O exploitation causes the dual effects of warming as well as cooling. A balanced amount of H₂O can protect the environment from extreme heating and cooling. AMS should include topics on transboundary water resources in its every conference to emphasize the due importance.

Acknowledgement. Thanks to AMS for including this topic after years of making the request. Also, thanks to those individuals that have supplied facts and figures for this article.

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