Teesta River Comprehensive Management Project: A Preliminary Assessment

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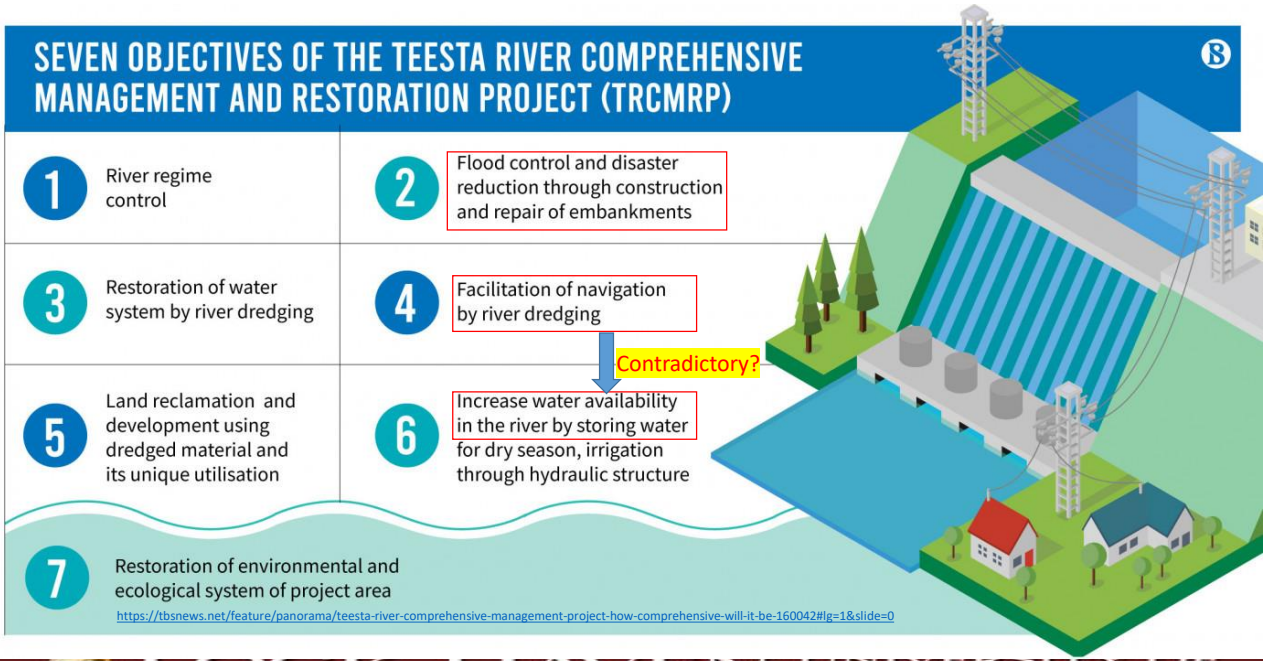
Preliminary Development Project Proposal (PDPP)

- As a part of a MoU with PowerChina signed on September 28, 2016, the BWDB under the Ministry of Water Resources prepared the PDPP for the Teesta River Comprehensive Management and Restoration Project in May of 2019
- The main objectives of the project are:
  - river training to control Teesta River regime
  - Capital dredging and maintenance dredging
  - Build new embankments & repair existing ones
  - Land reclamation by dredged materials
  - Management of dry season flow by building storage
- A feasibility study is done by PowerChina and approved by the DG of BWDB



Basic Information on the project

- Teesta is a braided river originating at TsoLamo in Sikkim, India
- Total length of the Teesta River is 414 km, of which 113 km in Bangladesh
- The proposed embankment is 102 km, from Teesta Barrage to the confluence at Chilmari

- Three segments: Upper = 39km; Middle=24 km; Lower=39 km
- Will be dredged with a width of 700 m (upstream of Kaunia) to 1,000 m with a depth of 10 m from Kaunia to the confluence with the Brahmaputra River at Chilmari

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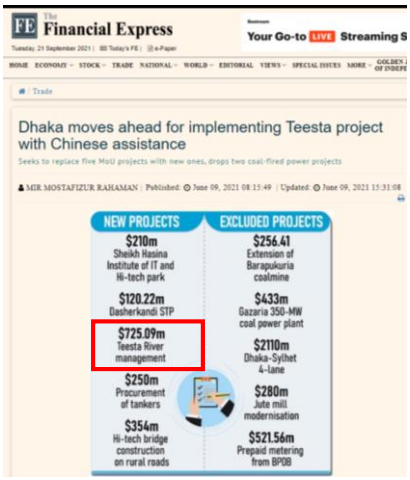
Basic Information on the project (cont'd)

- 46 km new levee & 27 groynes on left bank (East Bank)
- 78 km new levee & 23 groynes on right bank (West Bank)
- 170 km^2 land will be reclaimed on both sides ($1.5 billion value+$1.35 from others)
- Agricultural zone, Urban complex, Photovoltaic park & Industrial park
- One Freight terminal, 2 passenger terminals & 11 simple terminals
- Initial loan of $853 millions (Tk. 8,500 cr.) from China with their tech. assistance
- Recent reporting mentions $725 million loan from China (next slide)

Teesta Project is a go…



- On June 9, 2021, the FE reports about the latest decision on the Teesta Project quoting the Finance Ministry

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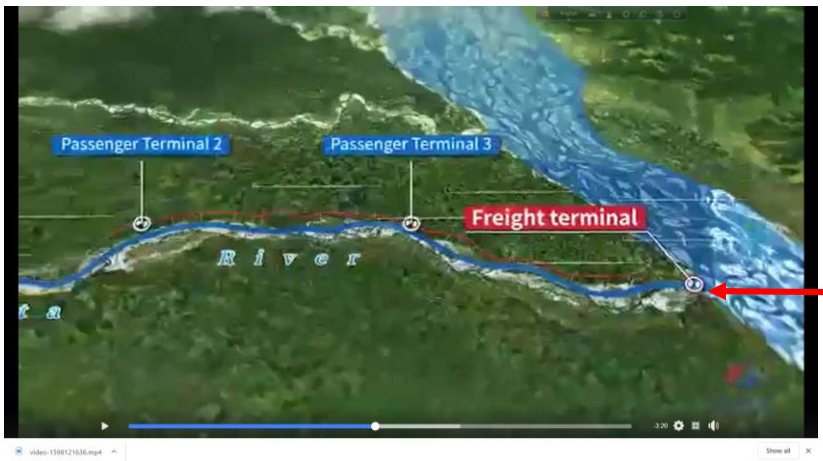
Upper Reach: Dalia-Mohipur

Mid-Lower Reach

Three terminals



Not clear if there will be a reservoir

Eleven simple terminal and roads

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Land Reclamation Projects on Right Bank

New Infrastructures

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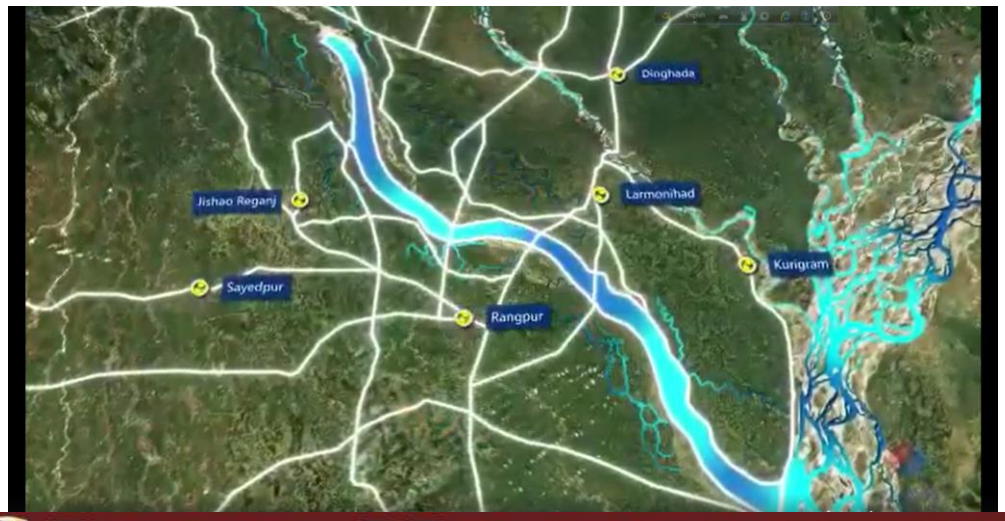
Road Network in Surrounding Area



Managed Waterways and Infrastructures

Courtesy of PowerChina

All good, so what's the problem?

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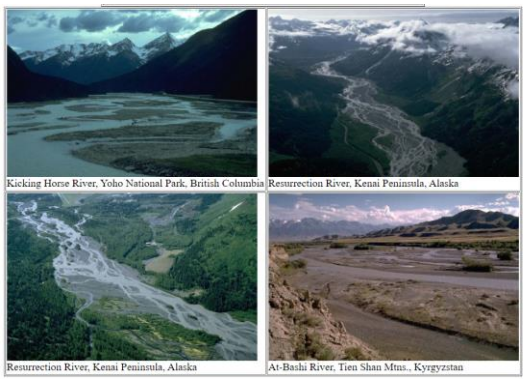
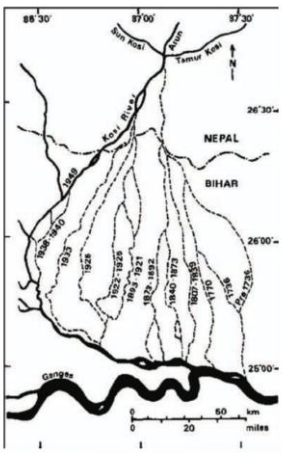
What is a Braided River?



- Braided Rivers exhibit numerous channels that split off and rejoin each other to give a braided appearance
- They typically carry fairly coarse-grained sediment down a fairly steep gradient
- Additionally, the water discharge tends to be highly variable
- Consequently, braided rivers usually exist near mountainous regions, especially those with glaciers

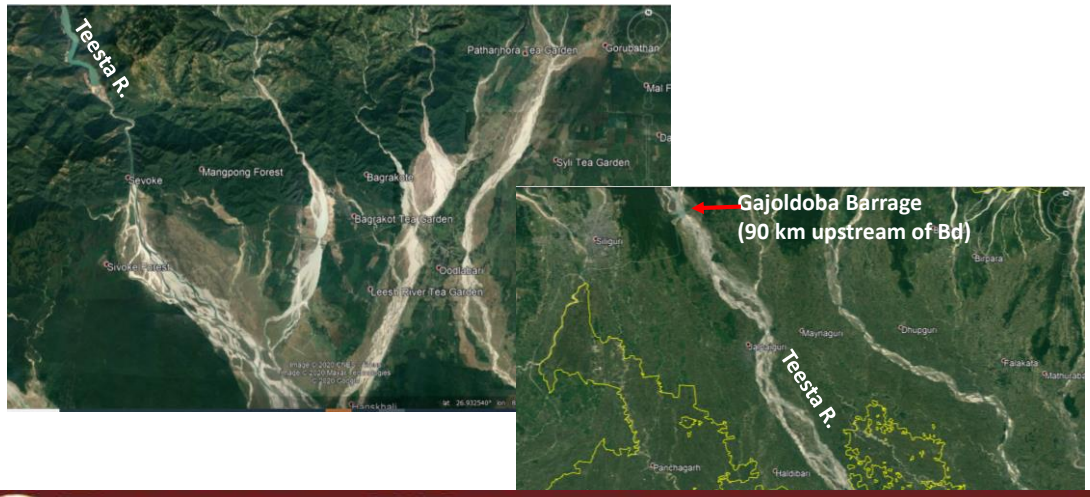
Shifting of the Kosi River during 1736-1949



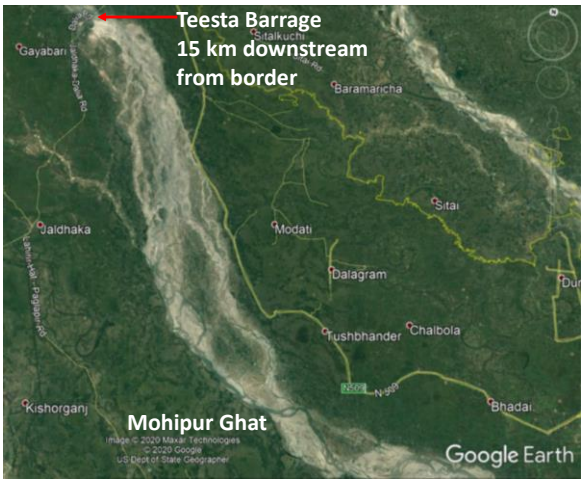
- Braided rivers tend to shift their course relatively quickly on a human time scale
- The Kosi River shifted its course more than 100 km during the last 200 years or so
- Teesta shifted its course in the recent past, and likely to do so again if natural or human disturbances perturb the natural equilibrium

https://www.researchgate.net/publication/256503722_The_Koshi_Deluge_of_2008_and_the_aftermath/figures?lo=1

Teesta River – A typical braided stream



Teesta Barrage between Doani-Dalia and Mohipur



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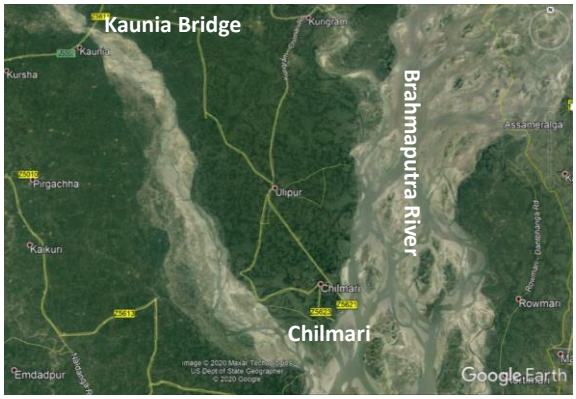
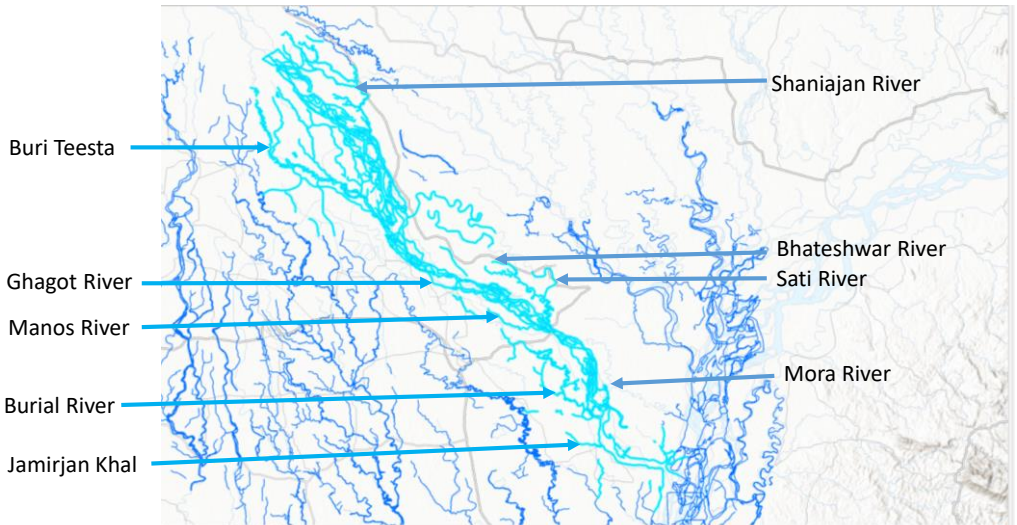
Teesta River between Kaunia and Chilmari



Teesta River and Tributaries within Bangladesh



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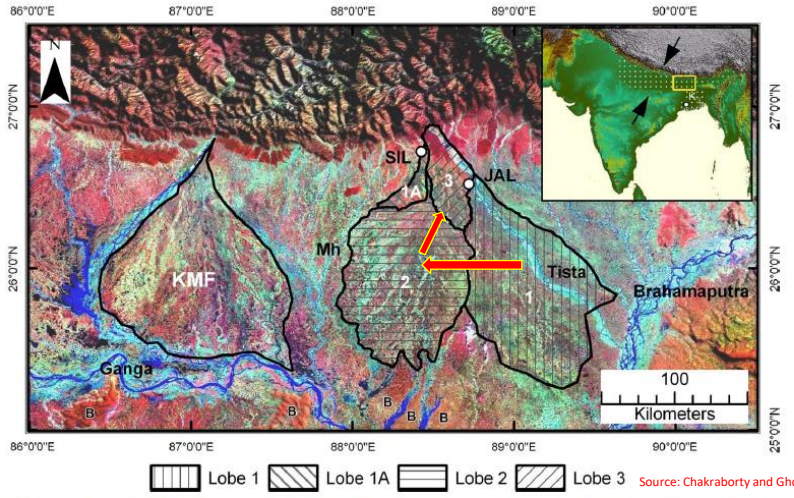
Historic Changes of the Teesta Fan



Source: Chakraborty and Ghosh, 2010

Fig. 1. A generalised map showing the Tista and Kosi megafans and the associated major drainages in the sub-Himalayan alluvial plain. Inset is a GTOPO30 view of the Himalayan orogenic belt and the flanking Ganga–Brahmaputra foreland basin (stippled). The rectangle marks the study area. 'K' in the inset marks the city of Kolkata. Note the lobes of the Tista megafan marked as 1, 1a, 2, and 3. SIL = Siliguri; JAL = Jalpaiguri; KMF = Kosi megafan; Mh = Mahananda River ; B = marks the basement spurs at the southern margin of the megafan.

What is the future of Teesta River?

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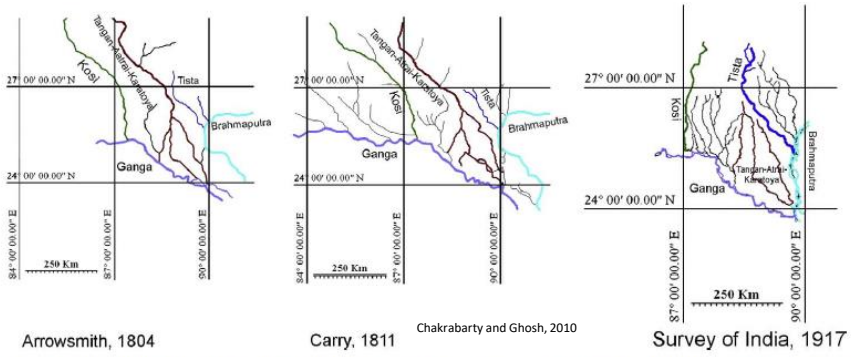
Evolution of the Teesta River



Chakrabarty and Ghosh, 2010

Fig. 7. Major drainages traced from three old maps. Arrowsmith, 1804: Tangan–Atrai–Karatoya directly connected to the Himalayan catchments and draining into Ganges. Note plains-fed nature of Tista River occurring as a small tributary of Brahmaputra; Carry (1811): Tangan–Atrai–Karatoya trio hinterland-fed. Note hinterland-fed Kosi and plains-fed Tista Rivers; Survey of India (1917): hinterland-fed Tista and plains-fed Tangan–Atrai–Karatoya. Source: Chakraborty and Ghosh, 2010

The Tangon-Korotoa-Atrai-Punorbhoba used to be bigger river systems than the Teesta River during the early 19th centuries. Rejuvenation of these river systems to their historic form through dredging is a possibility that warrants consideration.

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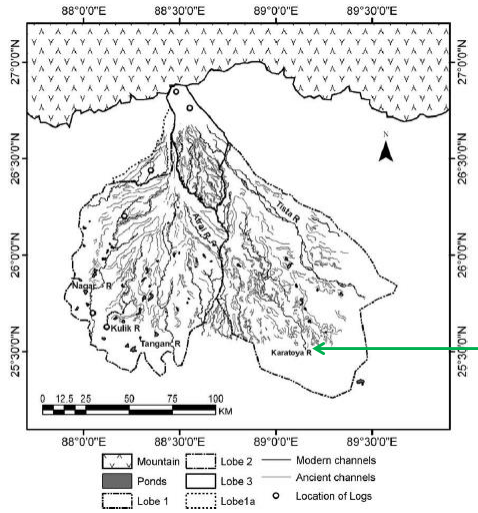
The nature of abandoned channels and the evolution of Teesta



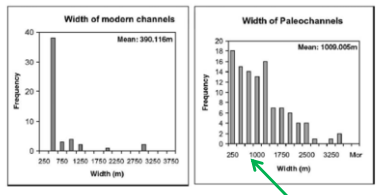


Fig. 5. Histogram showing the widths of the modern plains-fed channels and paleochannels seen in the satellite images (see Fig. 2).

Source: Chakraborty and Ghosh, 2010

The abandoned channels in the Karotoa-Atrai-Tangon-Kulik-Nagor River watersheds are larger than the current Teesta River. It is important to rejuvenate some of these and to use them for irrigation.

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Why is it not a good idea?

- The Teesta River will lose its natural characters and connection with its tributaries (shown earlier), as well as to the ecosystems and char dwellers
- The river becomes a "drainage conduit" and the flood plains lost to land grabbers (i.e. returning to "Cordon" or Structural approach to rivers)
- It is in contradiction of the HC verdict about rivers as "Living and Legal Entity."
- Bangladesh will legitimize Indian diversion of water at upstream locations
- Not a solution to disappearing flow during lean season; rather antagonizes India by involving China in transboundary river management
- The engineered "channel" of the Teesta River is likely to get filled up with bedload in rainy seasons in an attempt by the river to reach a new equilibrium and angle of repose

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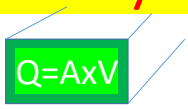
Calculated Flow Velocity of the Teesta River



- Q = V*A => V = Q/A
  - Q = discharge in cumec; V= River velocity m/s; A= cross-sectional area of river
- Average peak discharge, Q= 4,000 cumec (m^3/sec)
- Natural cross-sectional area, A = 5000 m wide X 5 m deep = 25,000 m^2
- Velocity (for natural river), V = 0.16 m/sec (or 16 cm/sec)

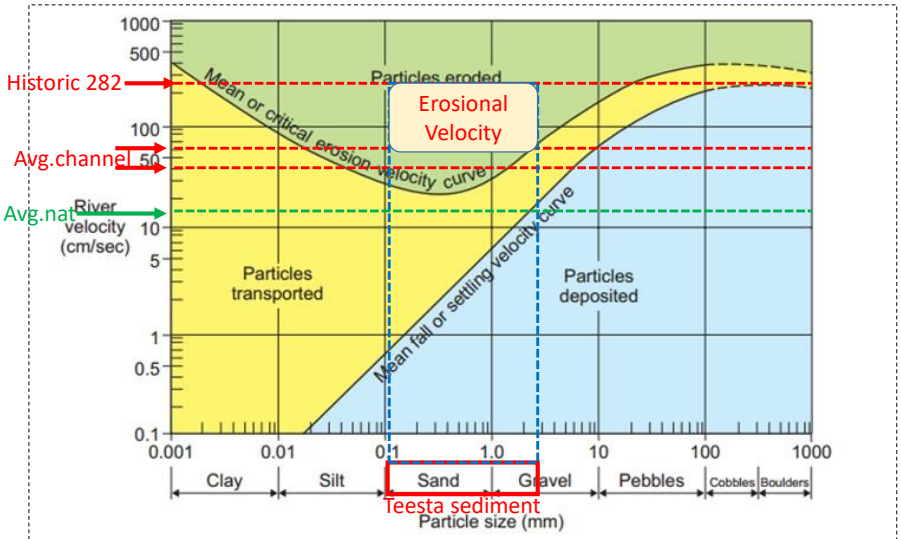
- Channelized Cross-sectional area=A = 700 m wide X 10 m deep river cross section = 7,000 m^2 to 10,000 m^2 (downstream)
- Velocity = V = Q/A = 0.57 m/s (or 40-57 cm/sec)

Source: Rudra, 2014

Velocity for the Historic High flow condition

- Historic high discharge (Rudra, 1968) => Q = 19,800 cumec
- Velocity (for historic high flow through channelized river with 10,000 to 7,000 m^2 area):
- V = 1.98 - 2.82 m/sec (or 198 cm/sec to 282 cm/sec)

Sediment Erosion and Transportation Velocity



- Natural average flow velocity is not erosional for the river
- Average and historic peak velocity in the Teesta River will be conducive to riverbank erosion in a narrow river

Angle of Repose for different sediment types

Teesta Riverbank is composed of natural sandy gravel

Soil Type	Dry	Moist	Wet
Top Soil; Loose	35 - 40		45
Loam; Loose	40 - 45		20 - 25
Peat; Loose	15	45	
Clay/Silt; Solid		40 - 50	
Clay/Silt; Firm		17-19	
Clay/Silt; Loose		20 - 25	
Puddle Clay			15-19
Silt		19	
Sandy Clay		15	
Sand; Compact		35 - 40	
Sand; Loose	30 - 35		25
Sandy Gravel; Compact		40 - 45	
Sandy Gravel; Loose		35 - 45	
Sandy Gravel; Natural		25 - 30	
Gravel; Medium Coarse	25 - 30		25 - 30
Shingle; Loose		40	
Shale; Hard		19 - 22	
Broken Rock	35		45

- The slope of a dredged, narrow, sandy riverbank is likely to be steeper (close to, say, 45-60 degrees)
- Angle of repose (slope) of natural sandy gravel is 25-30 degrees
- Therefore, Riverbank will erode in the steeply-slopped dredged channelized river to attain an angle of repose

What are the likely problems?

- Riverbank erosion will be unstoppable and the newly built infrastructures will be threatened by erosion and flooding due steeper bank slope and higher flow velocity

- Flooding is likely to intensify due to narrowing of the river and levees
- Flooding is likely to intensify on right floodplain at upper reach and on left flood plain at mid-lower reaches due to levees
- Sedimentation will fill up the channelized river, if a reservoir is built

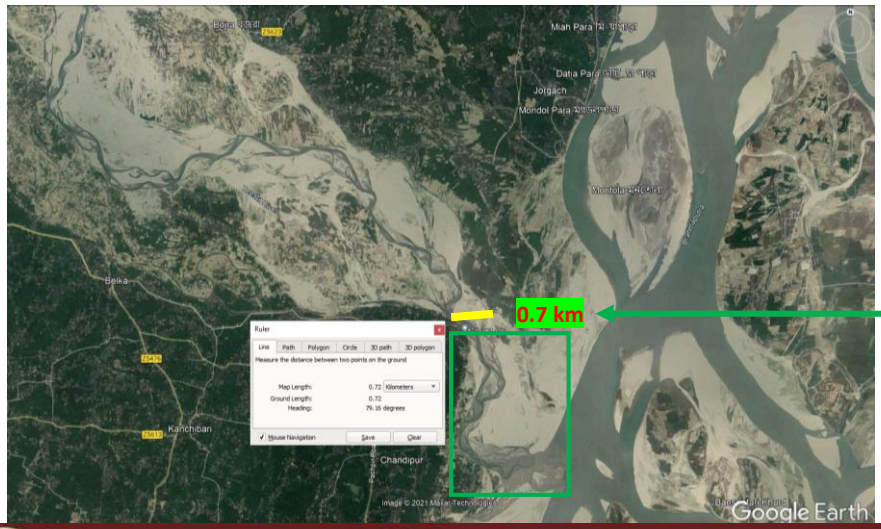
Issues that need addressed

- **The fate of island (char) dwellers**, such as:
  - Char Sendurna
  - Dauabari
  - Dakshin Dewabari (east of Saulmari)
  - Bhotemari
  - Kolkonda
  - Khuniagaach
  - Rajpur
  - Burirhat Bazar - Bojra
- **Riverbank Erosion** at:
  - Rajarhat
  - Ulipur (Bilbinia)
  - Taliganj-Saulmari
  - Sunderganj-Tarapur
  - Bojra (I and T groynes)

Any solutions?

- Continue to pursue hydro-diplomacy at all levels until a holistic compacts on water resources and landuse is reached at basin scale
- Continue to dredge the rivers while maintaining the natural characters of the rivers and with a goal to increase water carrying (next slide) capacity at the confluence that is in congruence with changed landuse in the watershed
- Consider rejuvenating abandoned channels in the watershed.
- Dredged materials can be used to make slabs to stabilize bank erosion
- Bangladesh should ratify the UN Convention (1997) and pursue other countries in the GBM basins to follow suits

Congestion and sedimentation at confluence



The confluence area needs widening and deepening through dredging

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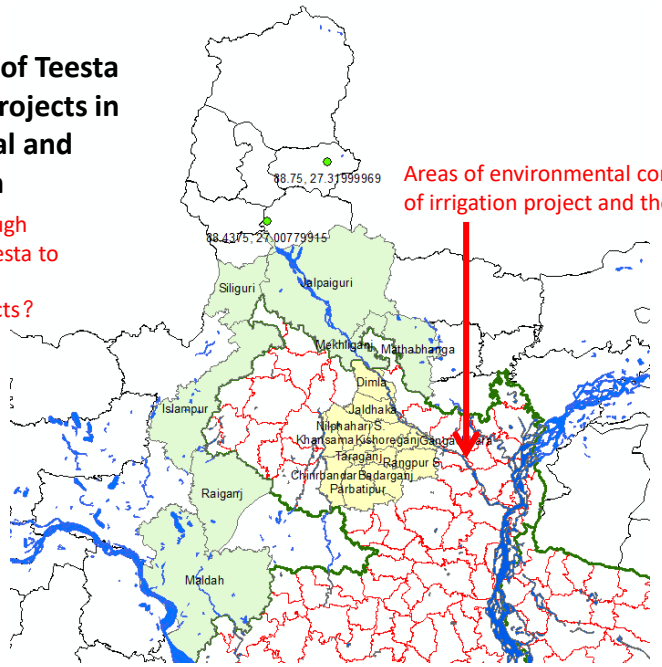
Supplementary data on Teesta Irrigation Project Areas

The extent of Teesta irrigation projects in West Bengal and Bangladesh

Q: is there enough water in the Teesta to support these irrigation projects?

Answer: NO



The Map of Teesta Irrigation Project

Irrigation area in 12 upazilas = 3,307 km2

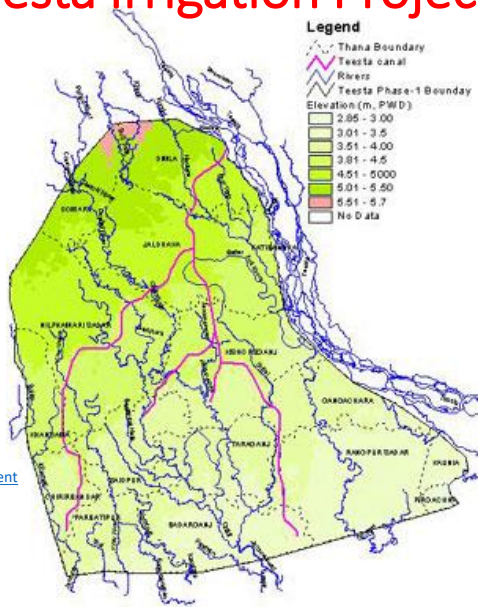
Length of irrigation canals = 649 km

Length of abandoned channels = 532 km

Density of abandoned channels = 0.16 km/km2

Density of channels in Bangladesh = 0.12 km/km2

http://www.bwdb.gov.bd/index.php?option=com_content&view=article&id=132&Itemid=119



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Thanks for your time and patience!!!

Questions?

RIVERS SAVING NETWORK

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