Flow and pollution load of Halda River: implication in integrated river management

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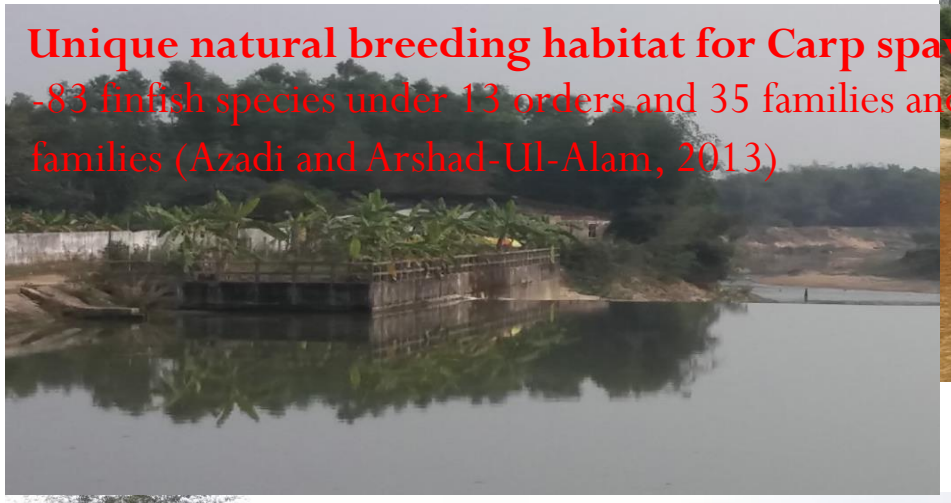
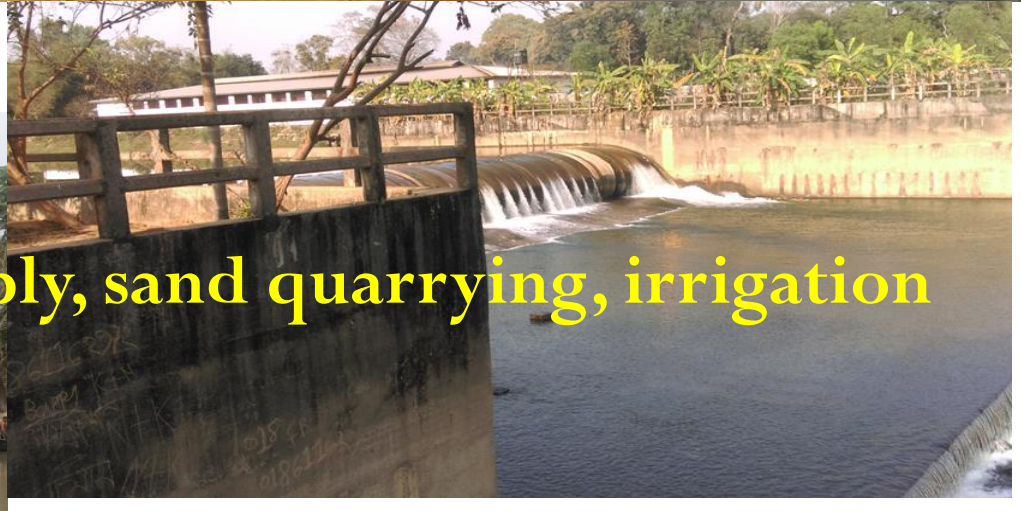
Services



Unique natural breeding habitat for Carp spawning in Southeast Asia.

-83 finfish species under 13 orders and 35 families and 10 shellfish (9 prawns and one crab) under 1 order and 3 families (Azadi and Arshad-Ul-Alam, 2013)



Navigation, drinking water supply, sand quarrying, irrigation

Water uses and Rubber Dam Project

Rubber Dam:
The cross-rubber dam built at Bhujpur in Chittagong 2012 to facilitate irrigation . The Local Government and Engineering Department (LGED) constructed the 4.5meter high dam in 2012
With the dam retaining water up to 4.5m deep in the reservoir,
Cost-$1.25 million, EIA –None,.
Irrigation for Boro and IRRI cultivation on 10,000 acres of land at upstream area, three tea estates – Four Tea Estate-Achhiya, Halda valley, and Khoiyachhari -- draw water.

The increase of salinity in the river now threatens the livelihood of several thousand fishermen and egg collectors. Moreover, around a five-kilometer stretch of the river next to the dam remains dry for around three months from January.

Water Supply issue for 20MLD+90MLD station: Has caused seawater to get into the river, sharply increasing salinity at downstream location

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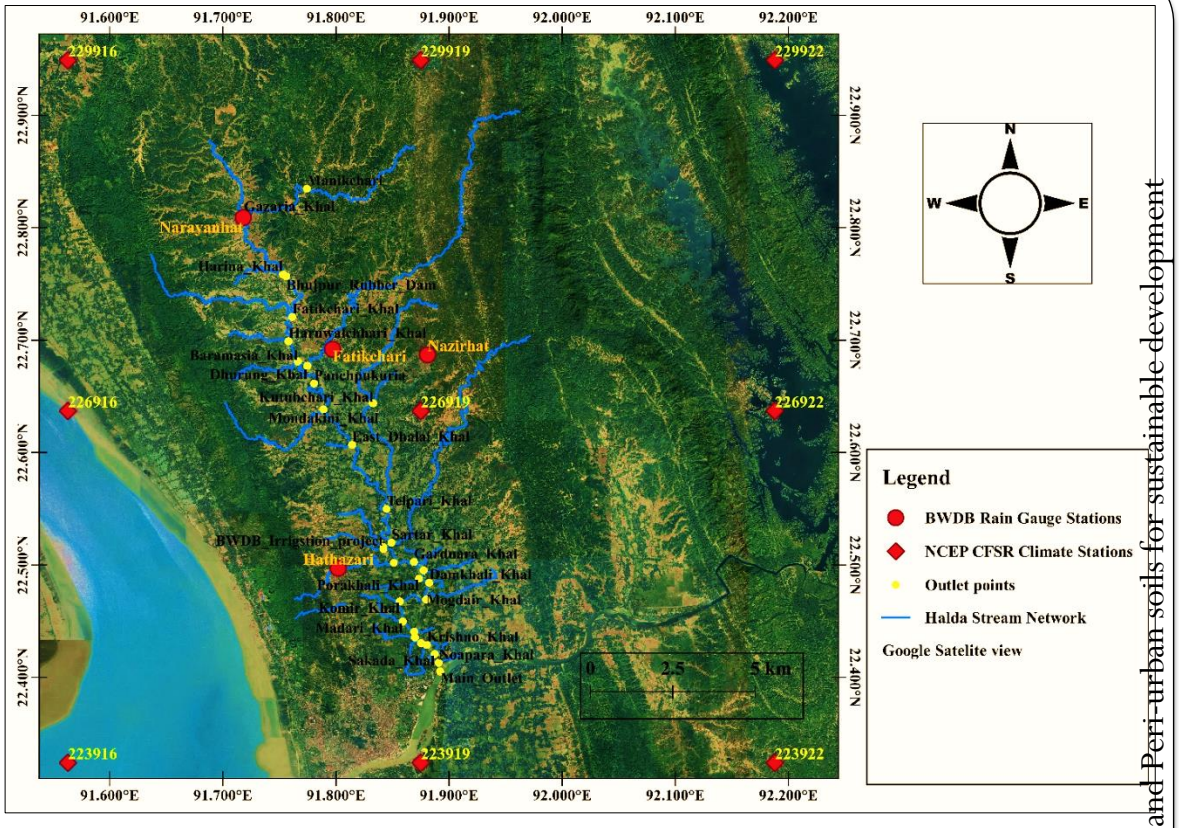
Sand quarry and navigation

This Study

- Evaluation of water level and discharge characteristics, rainfall-runoff process,
- Assessment of siltation and erosion of the river at different cross-sections and
- Water quality of this river considering whole catchment of river.



Sediment load estimation at 4 sections

WASA at Mohara Water Treatment Plant, and DOE at Kalurghat

Monitoring stations: Bangladesh Water Development Board (BWDB).

Spatial data

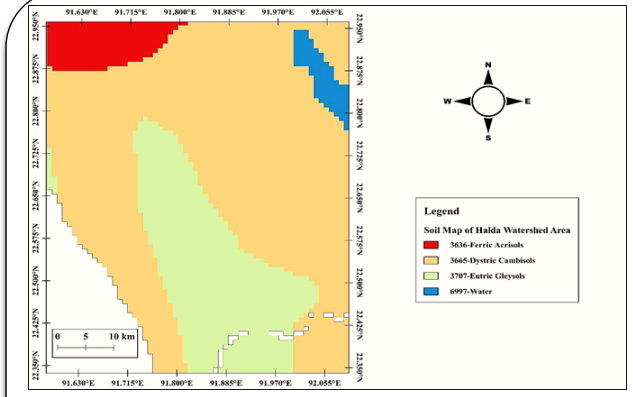
Data sources

❑**Primary Data**

- Cross sectional area and water flow measurement
- Water sampling

❑**Secondary Data**

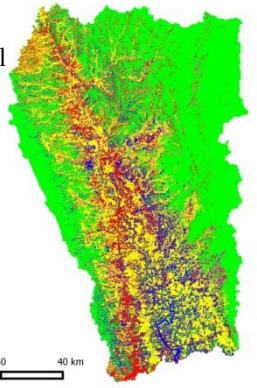
- Cross sectional data (11 cross sections of year 2006, 2009 and 2014)
- Water level data (4 stations of year 1967 to 2017)
- Discharge data (1 station of year 1983 to 2017)
- Rainfall data (4-gauge stations of year 1967 to 2017)
- SRTM 30m Digital Elevation Model (DEM) from USGS.
- Land use & soil map

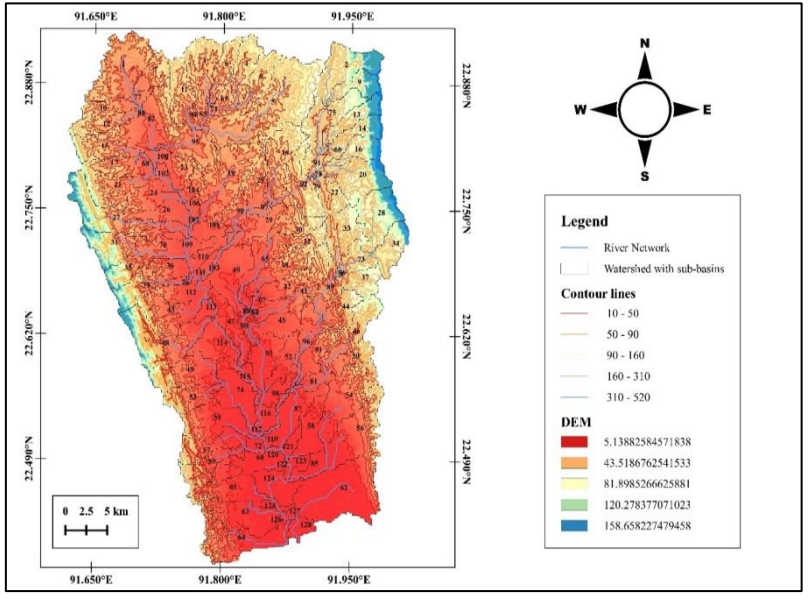


forest and cultivable land cover ~93.76% of the total areas excluding water body.

~ 42.51% of the area is agricultural land and 51.27% of the area is forest.

The total cultivable land in the area is 167661m^2.



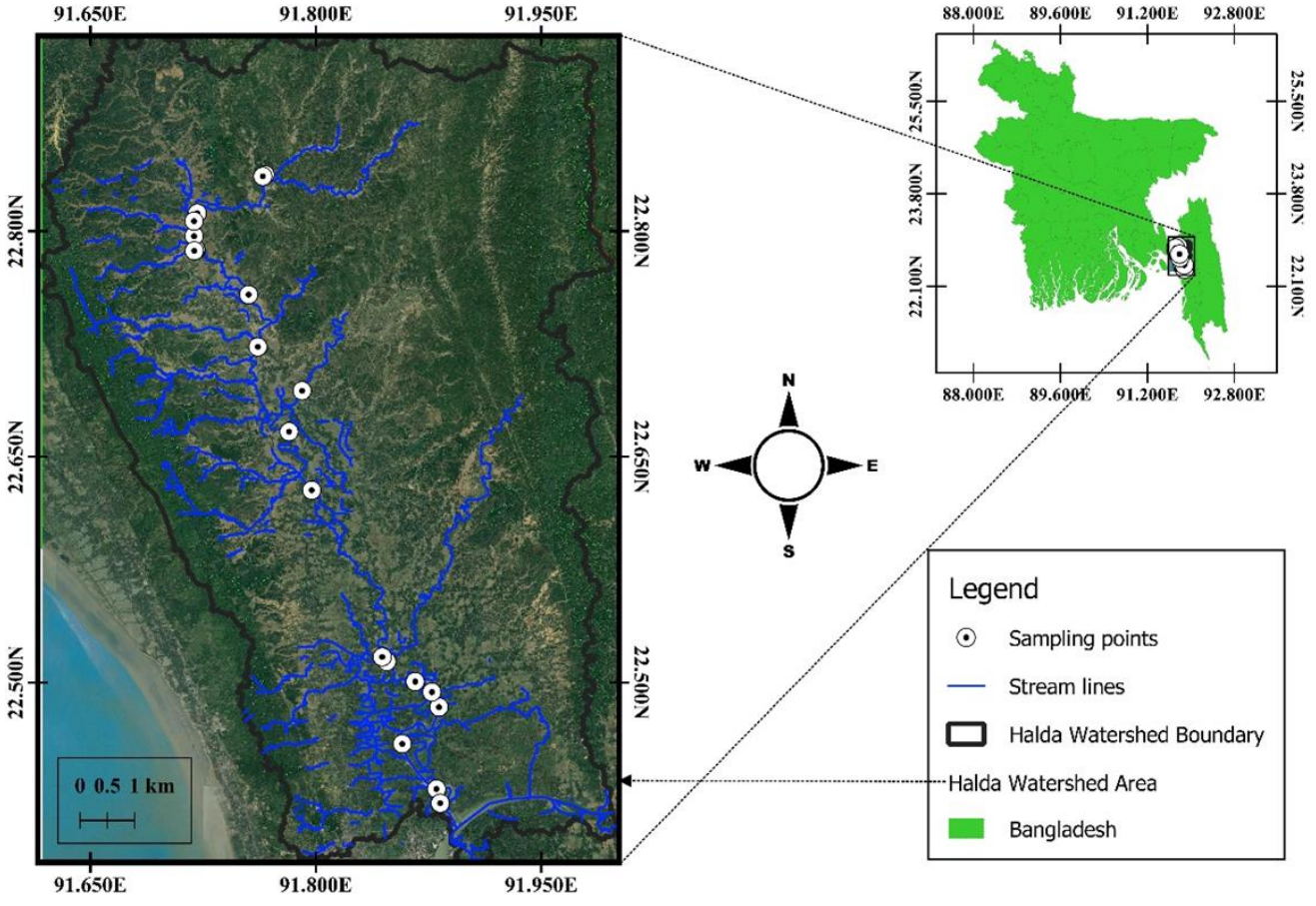


The overall length of the river is approximately 107 km (Siddique, 2018) and the total catchment area is about 645 square miles (Badiuzzaman, 1978).

The average depth of the Halda River is 21 feet (6.4 meters) and the utmost depth is 30 feet (9.1 meters).

The discharge of water during 1983-2012 varies from 0.06–548.67 m3s-1 at Panchpukuria station (Akter et al., 2012; BWDB, 2017)

Details of watershed Characteristics	SRTM
Numbers of sub-basin and actual HRUs (nos.)	128.00
Sub-basin Area (km^2)	1726.95
Mean Elevation (m)	35.37
Mean Maximum Elevation (m)	90.29
Mean Minimum Elevation (m)	17.48
Mean slope (%)	3.05
Cumulative sub-basin stream length (km)	1100.65



30 places, From Upstream,
Semutang gas field,
Narayanhat,
Halda Khal,
Habiburghata,
Karmashi stream,
Rubber dam,
South Paindong,
Dhurung Khal,
Panchpukuria
Nazirhat,
Boalia Canal,
Sattarghat,
Gorduara,
Kagotia,
Azmir ghat,
Ramdashhat,
Krisno canal and
Enayat station

The sample are collected in two times one is low tide time and another is high tide time

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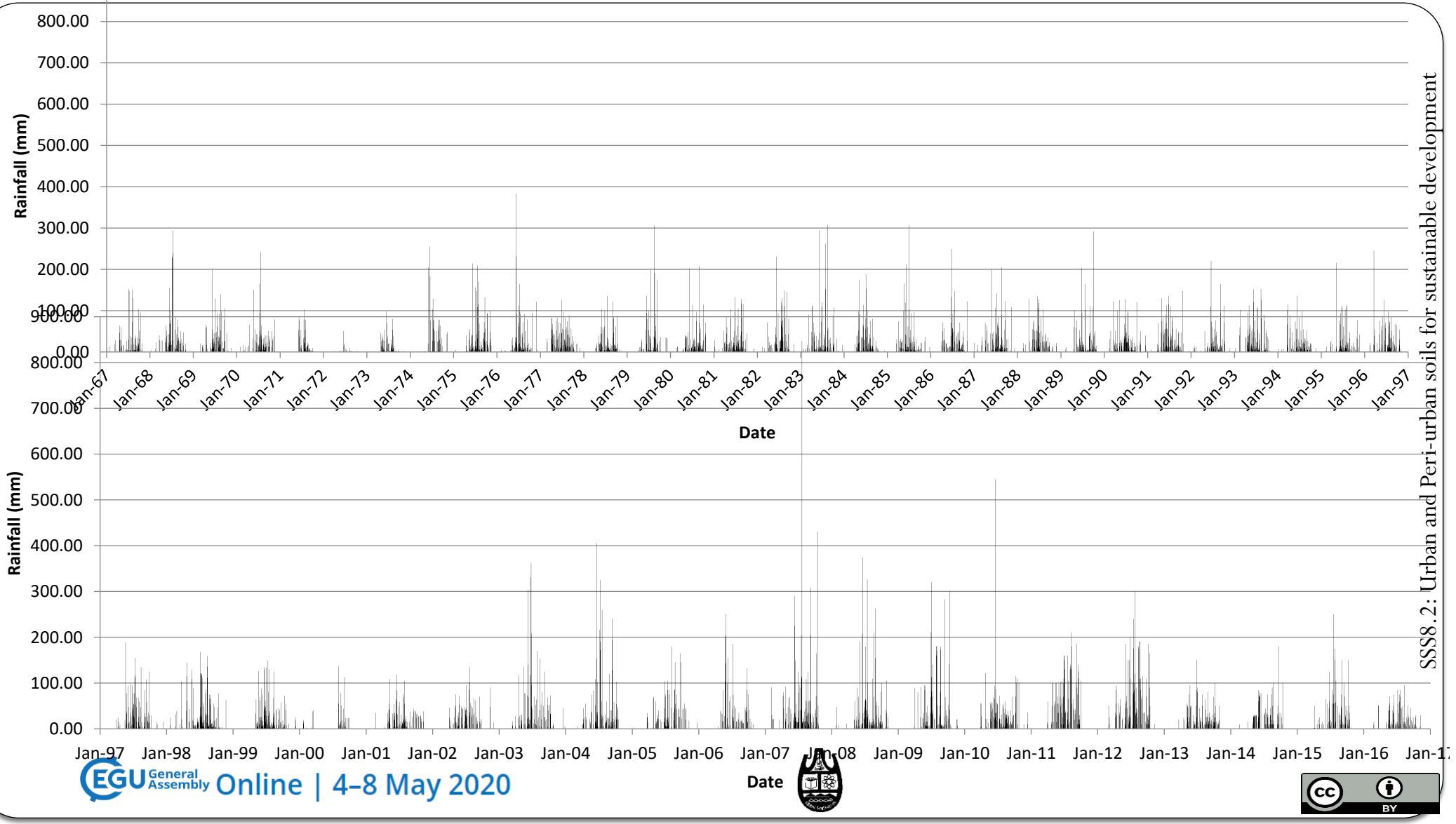

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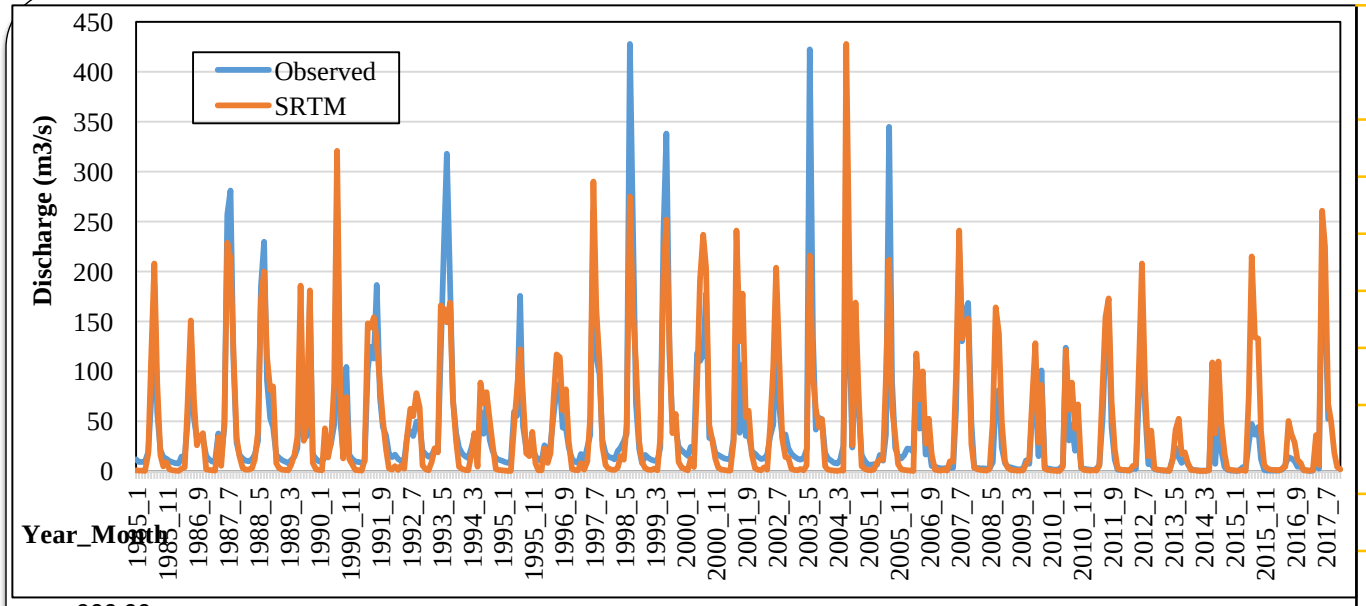
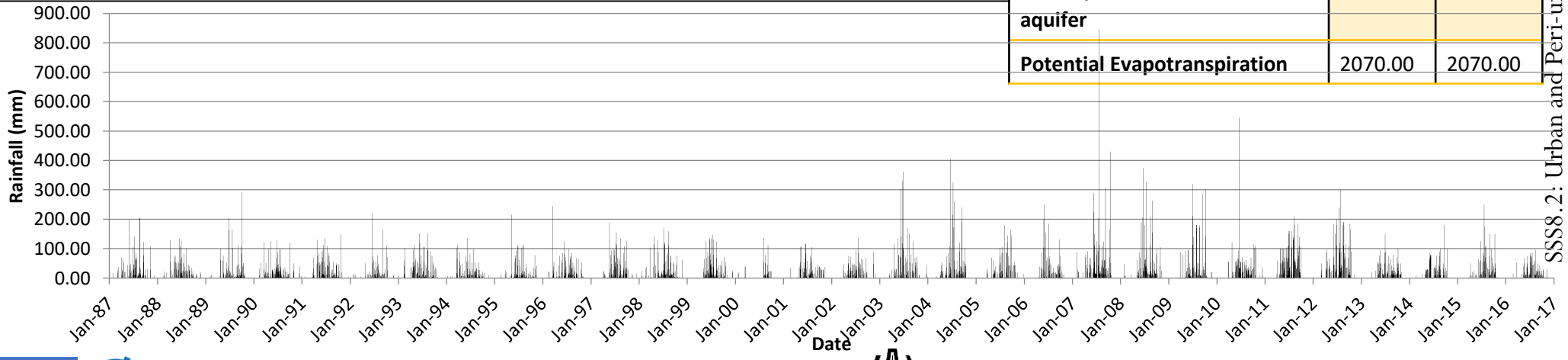
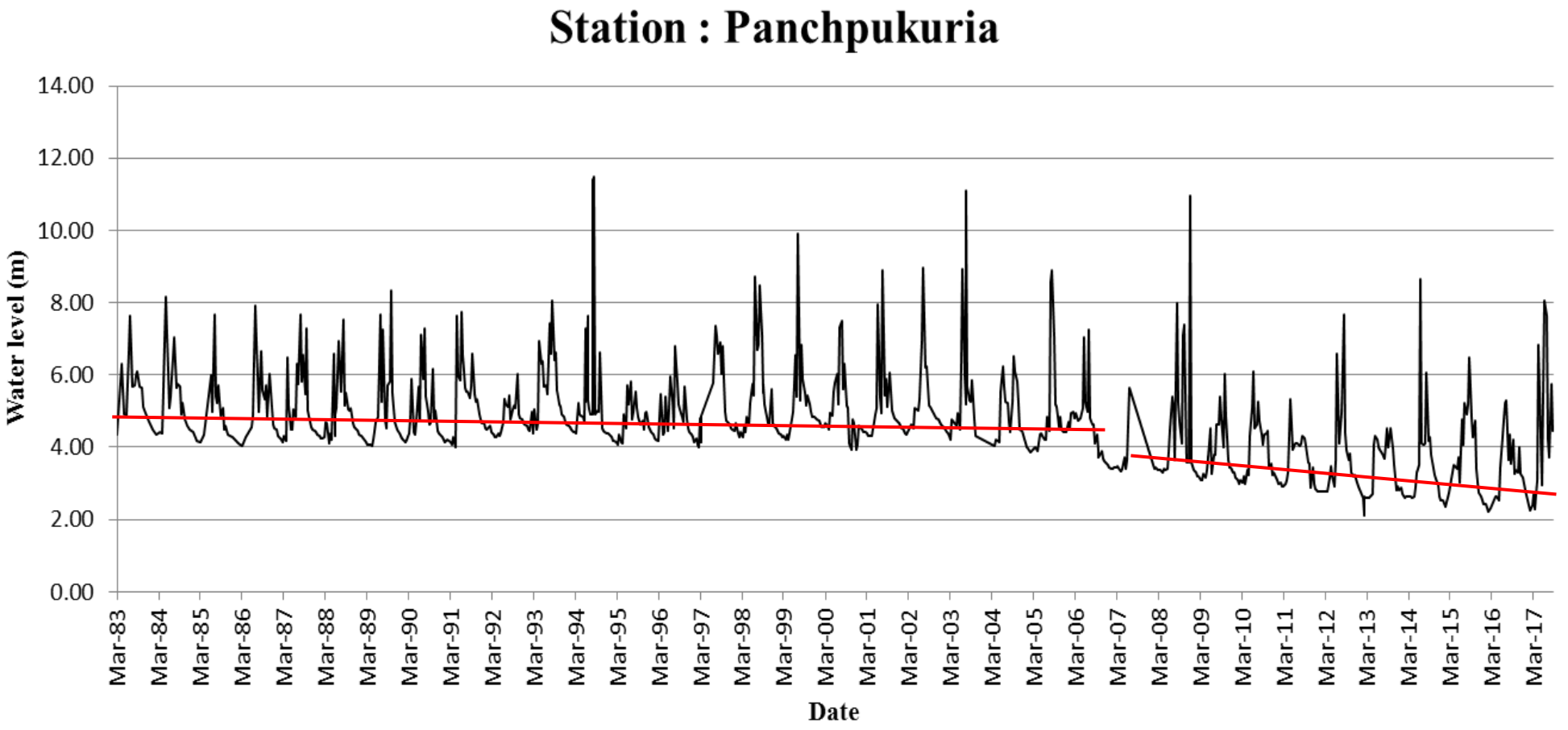


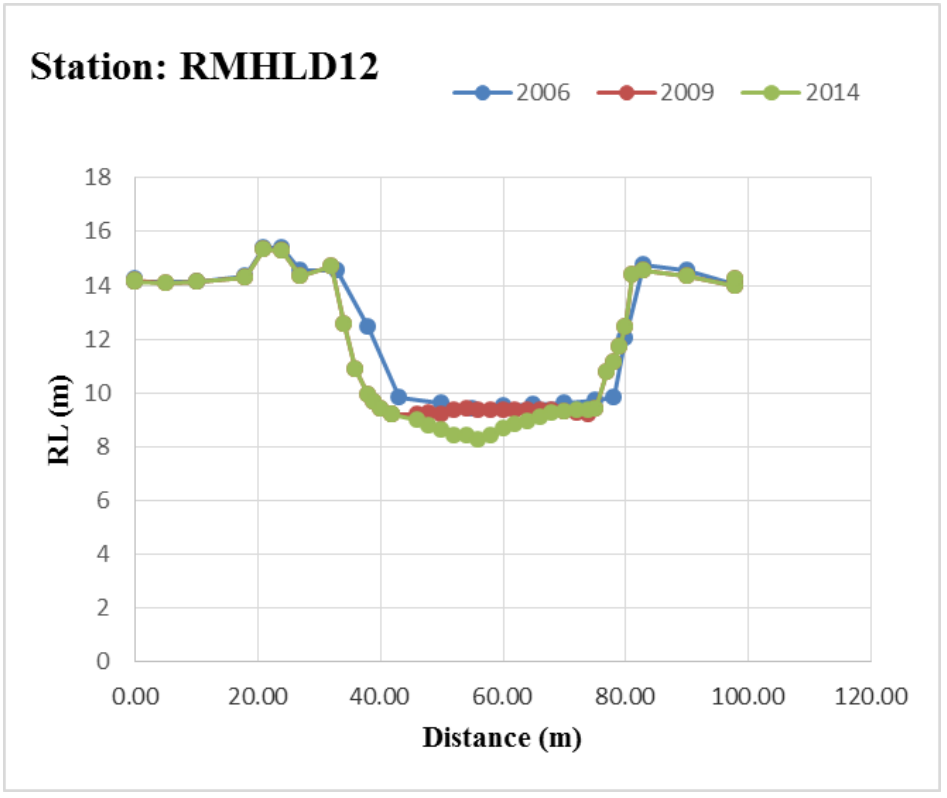
Parameter	SRTM	
	Before	After
Precipitation	2972.70	2972.70
Evapotranspiration	868.10	948.90
Surface Runoff	1454.36	984.54
Lateral Flow to stream	5.73	11.47
Return Flow to stream	568.25	761.53
Percolation to shallow aquifer	642.63	1027.06
Groundwater recharge	32.13	108.87
Re-evaporation from shallow aquifer	41.40	156.90
Potential Evapotranspiration	2070.00	2070.00

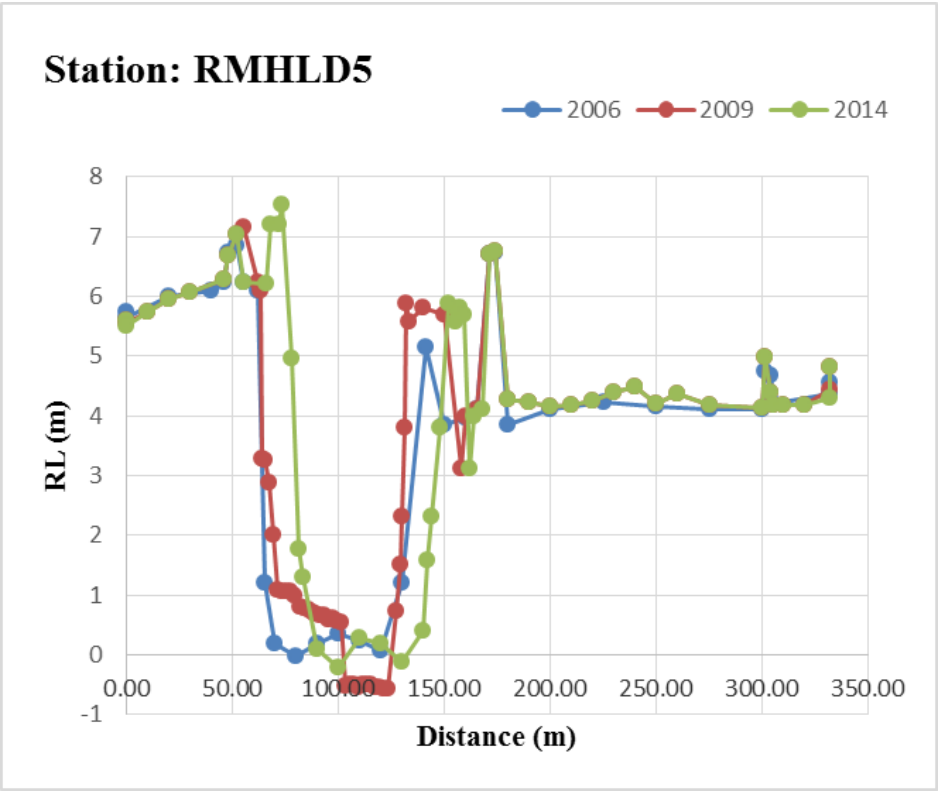




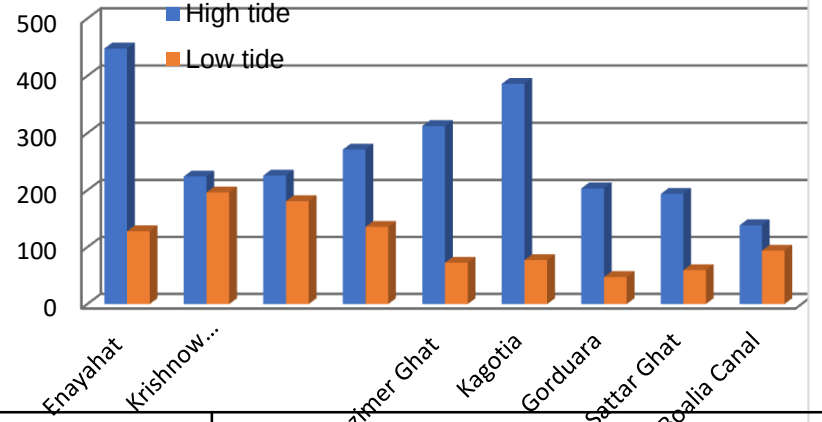
Water level at Panchpukuria station and this section indicates a rapid recession of water level and flow after 2006

Sand Quarrying caused frequent change in river bank

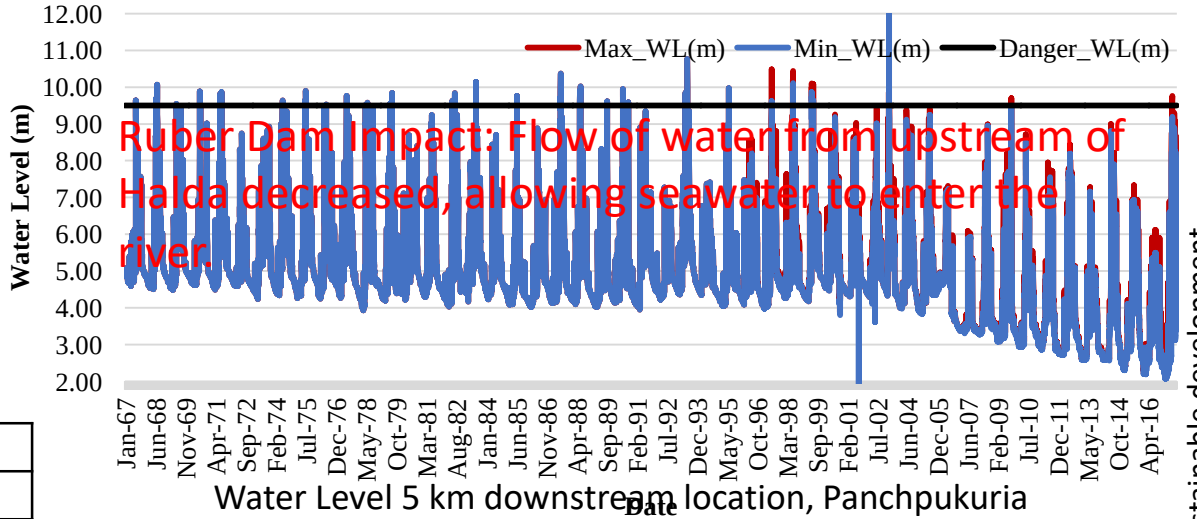




River cross-section estimated at downstream & middle-stream locations

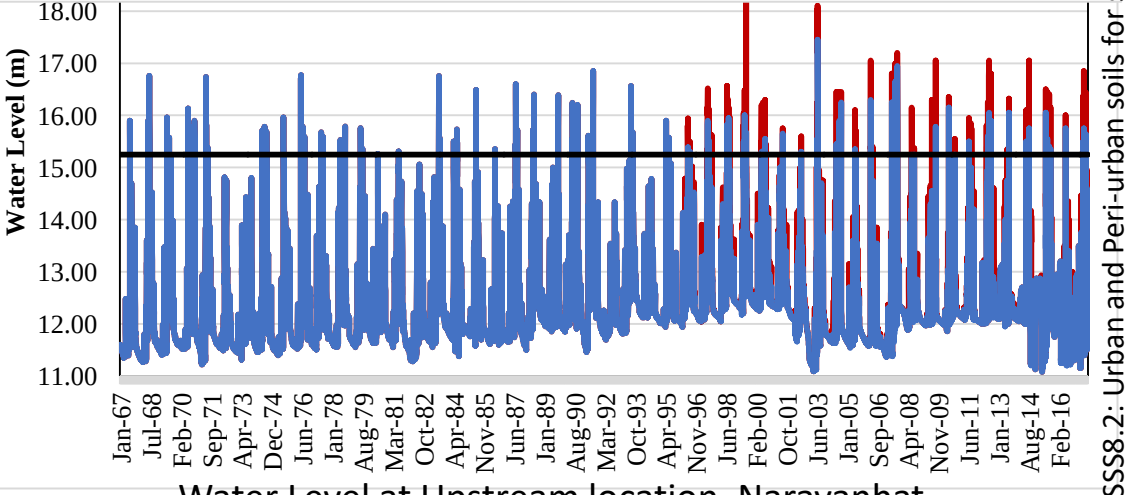


Cross-sections	Amount of siltation/erosion in respective years (m²)		
	2006-2009	2006-2014	2009-2014
Enayethat	-115.22	+159.31	+274.53
Ramdash Hat	+663.55	+706.63	+43.08
Gorduara	-133.77	+298.94	+432.71
Sattarghat	-60.87	+40.49	+101.36
Telpari	-103.38	-104.76	-1.38
Dhalai	-8.56	-8.88	-0.32
Nazirhat	+21.98	+45	+23.02
Panchpukuria	-86.36	+24.41	+110.77
Dhurung	+25.48	+34	+8.52
Bhujpur	+7.45	+13.75	+6.30
Narayanhat	+31.91	+46.28	+14.37



Ruber Dam Impact: Flow of water from upstream of Halda decreased, allowing seawater to enter the river.

Water Level 5 km downstream location, Panchpukuria



Water Level at Upstream location, Narayanhat

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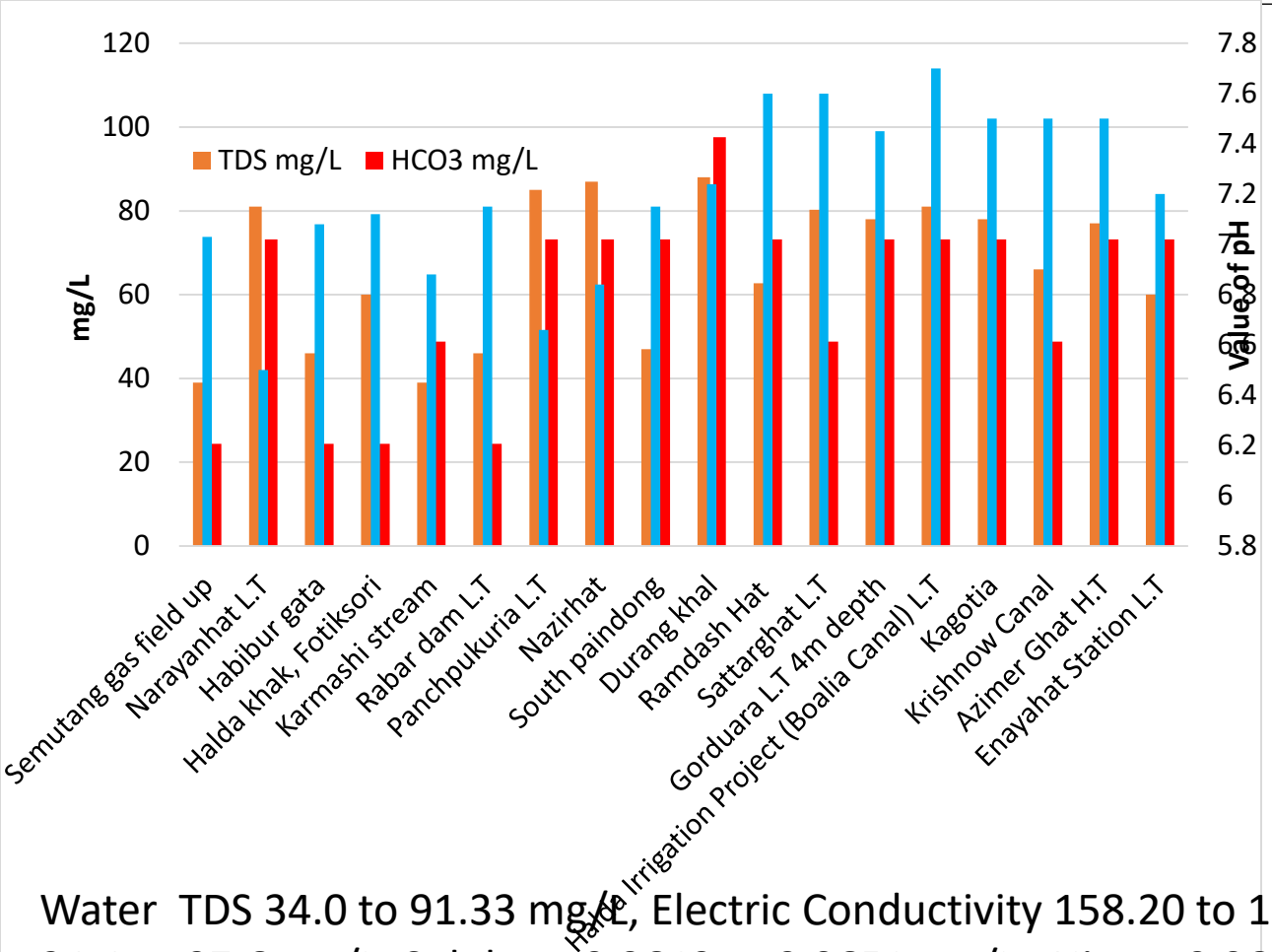
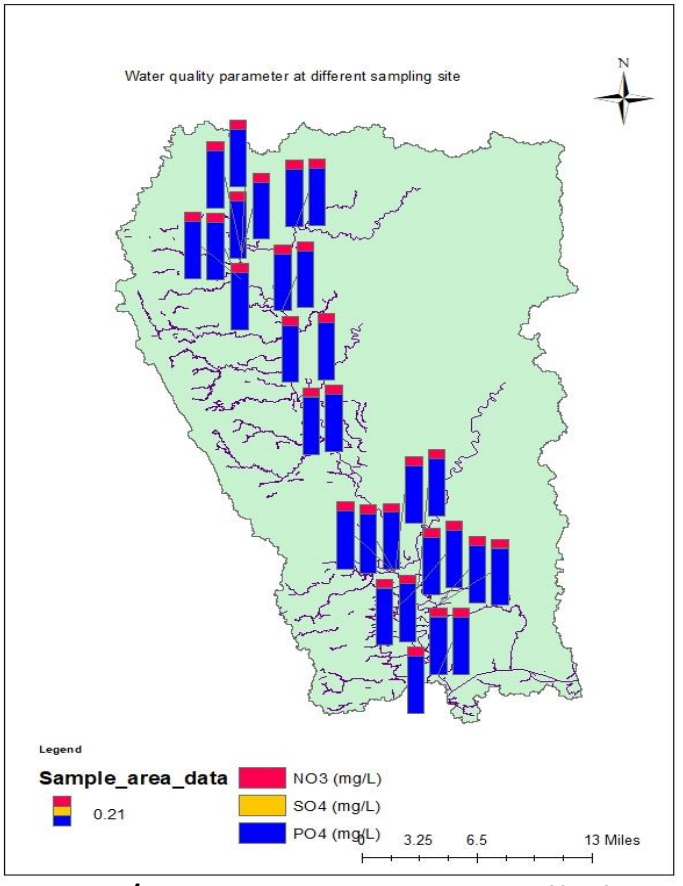
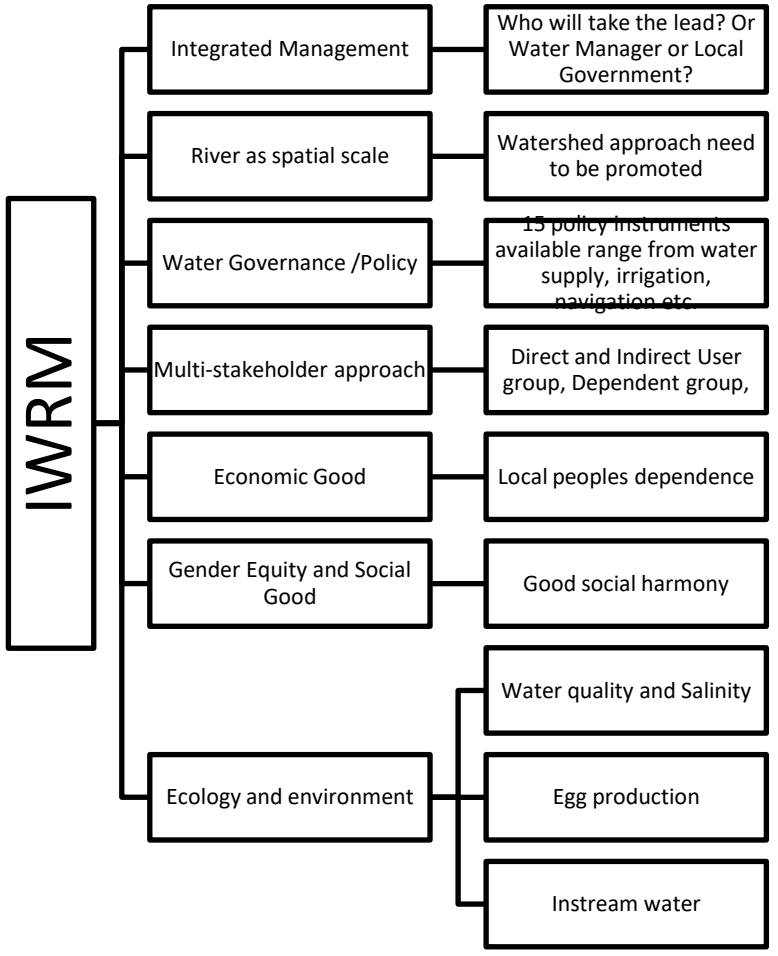
- Turbulent water was found in summer and monsoon months due to the high current velocity, turbidity and water temperature in the river.
- Chemical measurements of the water were high in winter months (Patra et al., 1985).
- Some strong positive linear relation had found between the water quality parameters indicating common origin entirely from industrial effluents, municipal wastes, and agricultural activities (Bhuyan et al., 2017).
- Halda River pollution caused by industrial waste (53%), sewage contamination (20%), tobacco farming (13%), the rubber dam (8%) and sand extraction (6%) (M. Islam et al., 2017).
- Regular alkalinity with 5.9-8.4 mgL^{-1} DO, 0.3-2.8 mgL^{-1} BOD and 24-96 mgL^{-1} COD were found in river water. (Karim et al., 2019)





Water TDS 34.0 to 91.33 mg/L, Electric Conductivity 158.20 to 182.22 µS/cm, pH 6.5 to 7.25, Alkalinity 24.4 to 97.6 mg/L, Sulphate 0.0649 to 0.0651 mg/L , Nitrate0.0649-0.0651 and Phosphate 0.414 to 0.426mg/l



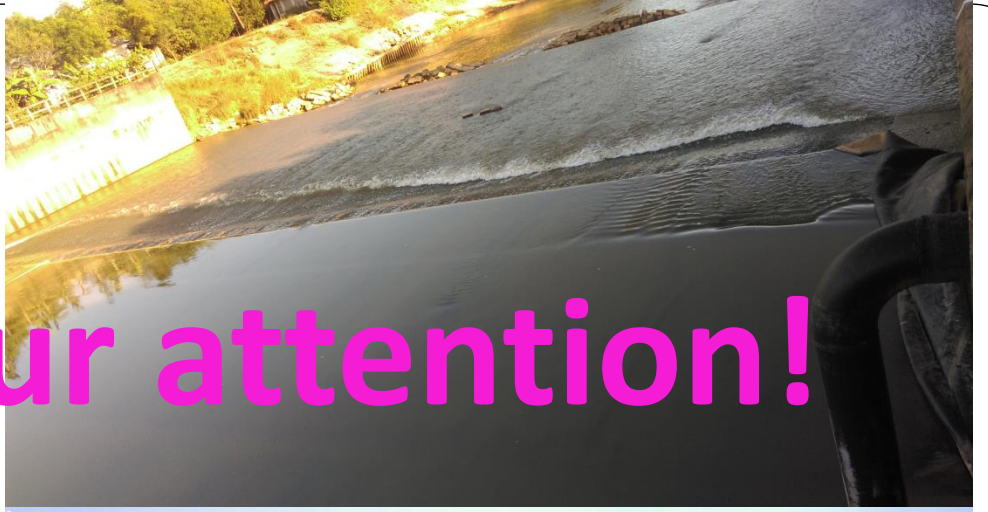
- **Water Quality** is under a satisfactory level since peoples intervention on it. **Soil conservation** measure to implement
- The **upstream-downstream linkage** is heavily regulated by **irrigation dam and rubber barrage** on it major tributaries at upstream.
- The **higher sediment load and siltation** in its downstream and at different hydraulic structure points would be attribute to land use change and flow regulation.
- The **mean flow** in the river decreases during pre-monsoon season in last 6-10 years.
- **Floods** are more likely to occur in downstream region compared to upstream region in same hydro-meteorological regime.
- Akter and Ali (2012) the **minimum water level** as 1.5 m to ensure fish spawning
- **Alternative income generation** activity to reduce direct dependence
- **Urban Waste and wastewater** treatment and management.

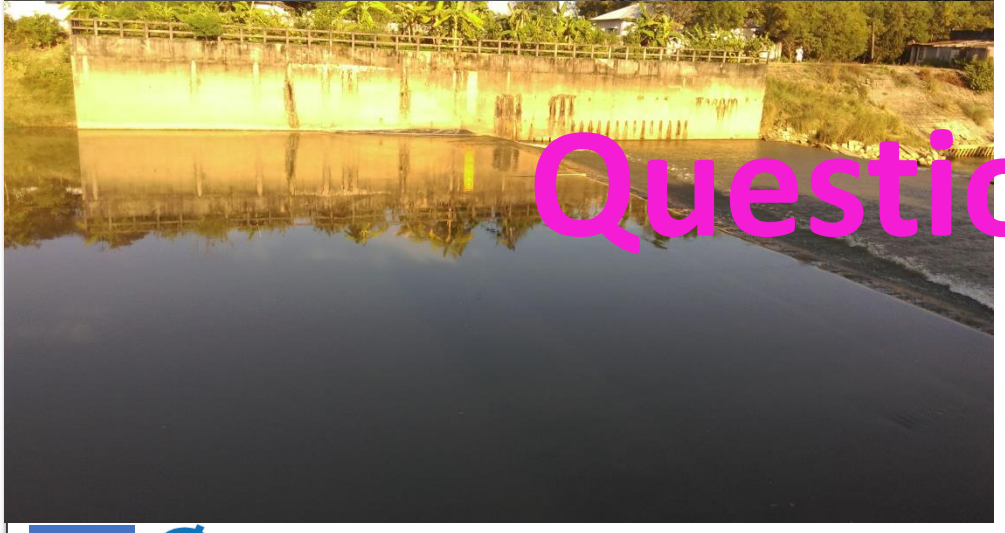
Around 8 Institutions and including 5 Ministries,
1 City Corporation, 5 Poroshavas dependent for water supply for more than 5 million

Final Remarks

- There were four parameters considered for water quality monitoring where all the parameters showed within the standard level.
- The upstream-downstream linkage is heavily regulated followed by construction of irrigation dam and rubber barrage on it major tributaries at upstream which had great influence on the ecology of the river.
- The higher sediment load and siltation in its downstream and at different hydraulic structure points would be attribute to land use change and flow regulation.
- The average flow in the river decreases during pre-monsoon season in last 6-10 years.
- Floods are more likely to occur in downstream region compared to upstream region in same hydro-meteorological regime in this basin.
- QSWAT was applied in the study area for the first time, that is significant improvement in SWAT catchment modelling effort.

Acknowledgement: The authors are thankful to the Research and Publication Cell, University of Chittagong for funding of this study. Thanks to the students, who took part in several field campaign.





Thanks for your attention!

Questions?