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 querying, 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,
EIA or SIA –None, Cost-$1.25 million.
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
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 section and by WASA at Mohara Water Treatment Plant, by DOE at Kalurghat
Monitoring station: 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 167661 m².

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)

The Details of watershed Characteristics

Numbers of sub-basin and actual HRUs (nos.)
128.00

Sub-basin Area (km²)
1726.9

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

SSS8.2: Urban and peri-urban soils for sustainable development

Legend
River Network
Watershed with subbasins
Contour Lines
30–70
70–140
140–300
300–540
DEM
7.4909456288058
47.852798111906
81.160450682308
128.504051090411
188.8407558521
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
SSS8.2: Urban and peri-urban soils for sustainable development

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SRTM Before</th>
<th>SRTM After</th>
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<tbody>
<tr>
<td>Precipitation</td>
<td>2972.70</td>
<td>2972.70</td>
</tr>
<tr>
<td>Evapotranspiration</td>
<td>868.10</td>
<td>948.90</td>
</tr>
<tr>
<td>Surface Runoff</td>
<td>1454.36</td>
<td>984.54</td>
</tr>
<tr>
<td>Lateral Flow to stream</td>
<td>5.73</td>
<td>11.47</td>
</tr>
<tr>
<td>Return Flow to stream</td>
<td>568.25</td>
<td>761.53</td>
</tr>
<tr>
<td>Percolation to shallow aquifer</td>
<td>642.63</td>
<td>1027.06</td>
</tr>
<tr>
<td>Groundwater recharge</td>
<td>32.13</td>
<td>108.87</td>
</tr>
<tr>
<td>Re-evaporation from shallow aquifer</td>
<td>41.40</td>
<td>156.90</td>
</tr>
<tr>
<td>Potential Evapotranspiration</td>
<td>2070.00</td>
<td>2070.00</td>
</tr>
</tbody>
</table>
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
Ruber Dam Impact: Flow of water from upstream of Halda decreased, allowing seawater to enter the river.
• 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, Nitrate 0.0649-0.0651 and Phosphate 0.414 to 0.426 mg/l.
• The total value of tangible resources 20.5 million US$ (fishing 0.07, fish fry 0.005, irrigation 15.78, drinking water 1.33, water transportation 0.12, sand extraction 2.51 million US$ (Kabir et al., 2013).

• Total indirect use Tk. 29.50 million and non-use value Tk. 31.46 million were per year and from the river respectively where bequest value was Tk. 14.85 million and option value was Tk. 16.61 million (Kabir et al., 2013).
IWRM

- Integrated Management
  - Who will take the lead? Or Water Manager or Local Government?
- River as spatial scale
  - Watershed approach need to be promoted
- Water Governance /Policy
  - 15 policy instruments available range from water supply, irrigation, navigation etc.
- Multi-stakeholder approach
  - Direct and Indirect User group, Dependent group,
- Economic Good
  - Local peoples dependence
- Gender Equity and Social Good
  - Good social harmony and
- Ecology and environment
  - Water quality and Salinity
  - Egg production
  - Instream water

- Water Quality is under a satisfactory level since peoples intervention on it.
- 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 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.
- Akter and Ali (2012) the minimum water level as 1.5 m to ensure fish spawning

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

• 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 modeling effort.

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Thanks for your attention!

Questions?