

Assessing of Water Pollution of Shitalakkhya River of Bangladesh Using River Pollution Index

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Abstract

Background: *The main sources of water of Bangladesh are rivers. River pollution problems are the biggest issues in different parts of our country, particularly in industrial cluster areas. Pollution of river's water led the bad impacts on every sector of our lives.*

Objective: *To assess the pollution sources and pollution status using River Pollution Index (RPI).*

Methods: *Water samples were collected from 08 sampling points. 04 points from upstream and 04 from downstream of Shitalakkhya river. Dissolved Oxygen (DO), pH, COD, EC, TDS, TSS, Temperature, Biochemical Oxygen Demand (BOD₅), Suspended Solid (SS) and NH₃-N were tested by PPI.*

Results: *The water quality of upstream points of Shitalakkhya river found less polluted than downstream. Industrial waste effluent, domestic wastewater and agro-based chemical discharge from the catchment area were the major sources of pollution.*

Conclusion: *For improving water quality of the Shitalakkhya River, we have to control the pollution and illegal discharge of harmful pollutants into the river.*

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INTRODUCTION

Bangladesh is a riverine country¹ and filled with 700 rivers including tributaries. Water sources are mainly of Rivers, lakes, glaciers, rain water, ground water² etc. The environment, economic growth and development of Bangladesh are highly influenced by water-its regional and seasonal availability of surface and groundwater. In terms of quality, the surface water of the country is unprotected from untreated industrial effluents and municipal wastewater, agricultural runoff containing of chemical fertilizers, pesticides, oil and so on.³ Water quality also depends on effluent types and discharge quantity from different type of industries, types of agrochemicals used in agriculture, seasonal water flow and assimilative capacity by the river system.

Shitalakkhya is the most important river for Dhaka dwellers in terms of its use in domestic life.³ This river is considered as a big resource of fish. However, water quality of this river is being danger due to toxic hazard industrialization. Many categories toxic and chemicals of different industrial units are discharging their effluents directly into the river. Approximately more than 59,255 metric tons of effluent water are being drained to the shitalakkhya river in a day.¹⁹ But the water of this river is also being used for many purposes such as for agricultural production, fish production and also for domestic uses. Poor people have no alternatives but using the river water. So, they are more affected by the polluted water of this river. As a result, that makes serious problems to aquatic flora and fauna.⁴ Polluted water reduces fish production and availability of fish and also has bad impacts on other aquatic resources in the water. The dark color of the waste water exhibits the toxic effects on the biota and inhibits the photosynthetic activity by reducing the sunlight.⁵ RPI indicates the quality of water but need to determine only 4 parameters. It is less cost and quicker process to test water quality. The rivers of Bangladesh are the worse victim of pollution, especially the rivers

which stands in the neighborhood of the Dhaka city is being polluted tremendously.

Causes:

- Rapid and unplanned urbanization and industrialization, brickfield development, Dying factories, chemical factories, textile, paper mills, cement and fertilizer factories grabbing up the river.
- The slum dwellers use unhygienic open latrines, wash clothes; take bath even cows and goats bathe in the river.
- Untreated wastes are thrown into the river as most of the industries have no Effluent Treatment Plant (ETP). According to an industrial survey conducted by Bangladesh Center for Advanced Studies (BCAS) in 2009, only about 40% industries have ETPs. In 10% industries, ETPs are under construction and about 50% industries have no ETP establishment. That is, more than 50% of waste generated by the industries eventually goes to the rivers untreated.
- Oil spills of boats and different water vessel.
- Using agrochemicals in agricultural land.⁵

Many industries like—Shah Cement, Metrocem Cement Limited, Premier Cement Mill's Limited, Akij Cement Factory, Barnali Textile and Printing Industries Pvt Ltd, Seven Horse Cement. Orion Pharma park, Super Oil Refinery Ltd, Sinha Textile and Opex Group. Sonali Paer Mill's (Younes Group), Navana pharmaceuticals, Hima food, Momin Uddin Textile, Mir Cement Factory, Lina paper mills, Fatullah dying mill, Mahbub dying mill., J.M.S.Glass Industries Limited, Pusti Soyabin Oil, Scan Cement, Haripur power station, Shiddirganj power station, Desh Energy Limited -100MW, Adamjee Jute mill's Ltd, Crown Cement Ready Mix Concrete, Padma Oil Company Limited, ACI Pharmaceutical's Ltd, Bangladesh Paper Mill's Ltd, Rubel Steel Mill'S Ltd, Bangladesh Edible Oil Limited, City Group, City Suger Mill's, Creative Paper Mill's, Globe Edible Oil, Bangla Tissue, ACI Salt Limited, Amber Super paper Mill's Limited, Amber Jeans and Washing Limited, Partex Paper Mill's Limited, Purbachal Paper Mill's, Papertech Paper industries, Bishal Hollow Brick And Ceramic Industry, Taiheiyo Cement Factory, RFL Industrial Park, Varosha Agro Chemicals Ltd, Sunman Capital Paper's Ltd, Seven Ring's Cement Industry, Ghorashal Power Plant,

Omera Petroleum Limited LPG Satellite Plant, Deshbandhu Suger Mill's Ltd, Deshbandhu Polymer Limited Ltd, & Ghorashal Fertilizer Factory are situated in the study area.¹⁸ Shitalakkhya River is also known as Lakhya River. The river flows through Gazipur forming its border with Narsingdi for some distance and then through Narayanganj. It's upper course is known as Banar River. It flows from southwest direction and then east of the city of Narayanganj in central Bangladesh until it merges with the Dhaleshwari near Kalagachhiya. The river is about 110 km long and at it widest near Narayangani and 300 meters in width⁶. The river reaches of the Lakhya River is 20600 meters. The river's maximum depth is 70 feet (21 m) and average depth is 33 feet (10 m).⁷ It is connected with Balu River and Saydabad Water Treatment Plant (SWTP) intake canal. Wastes of Dhaka city fall into the Lakhya River through Balu River.⁹



Figure 1: Shitalakkhya River, upstream is connected with Brahmaputra river.

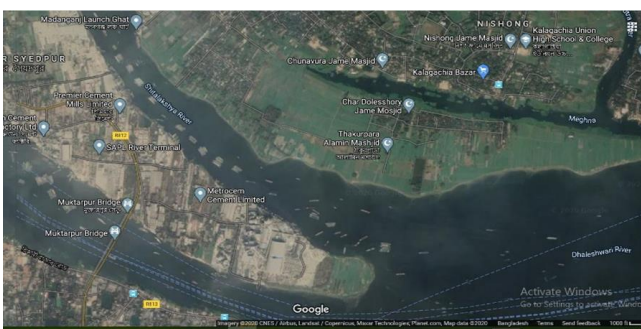
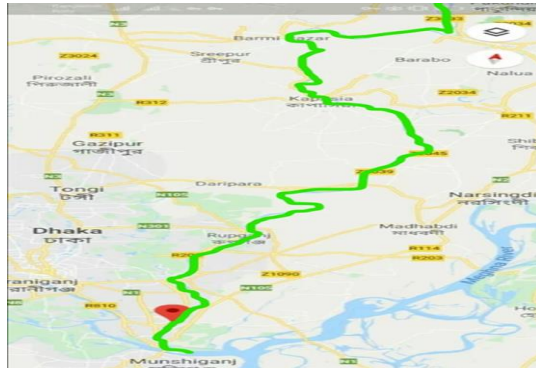


Figure 2: Shitalakkhya River, downstream is connected with Dhaleshwari river.

Its highest discharge has been measured at 2,600 cusecs at Demra area.^{8,16,17} It remains navigable year-round. The river flow remains

very low in dry season and high in monsoon. The water level in the river system varies from 1m PWD to 1.50m PWD having average level 1.35m PWD during dry period.⁹⁻¹³ The river system gets virtually no fresh water inflows from upstream except some wastewaters and agricultural returned water in the dry season.



Average channel widths at level of 1.5 m PWD is 260 m. Storage volume and open area of the river system at 1.25 m PWD level (an average water level in dry season) are 75 million m³ and 32 million m² respectively. Tidal influence is very much apparent in this river. During tidal period pollution intensity remains low.^{10,11} Thus, it is important to study and measure the pollution level of Shitalakkhya river using River pollution Index (RPI).

MATERIALS AND METHODS

River Pollution Index (RPI) was used to measure the pollution sources and pollution status. Water samples were collected from 08 points. 04 points of upstream (Max Power Ltd Pump Intake, and Palash Baza Ghat of Narshingdi, and Ghorashal Railway Bridge Ghat and Chanchan Bridge Ghat, Rupgonj of Naraangonj).¹⁹⁻²¹ 04 points (Atlashpur Gudara Ghat, Rupgonj Ferry Ghat, Demra Bridge Ghat, and Siddhirganj River port Ghat)²² of downstream of Shitalakkhya river. These water samples were collected in the morning to afternoon hours between 09 am to 03 pm at date of 15 March 2020 in spring (dry) season. Immediately after collection, water sample were transferred to the laboratory of Bureau of Research testing & Consultation (BRTC), BUET, DHAKA and Amber Super Paper

limited (ASPL) Rupganj, Narayanganj, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD₅), COD, EC, pH, TDS, TSS, Temperature, Suspended Solid (SS) and NH₃-N were tested by PPI. The parameters were tested at laboratory of Department of Civil Engineering, and Sonargaon University, Dhaka.

RESULTS AND DISCUSSION

At first calculated points score. Then the total point score is divided by the number of items for determining water quality of upstream and downstream of Shitalakkhya River. (i.e.18/4=4.5). The obtained value 4.5 was then compared to the “Pollution Index Integral Value”.

Table 1: Showed different test parameters of upstream area of Shitalakkhya River

Shitalakkhya River's Up Stream water test Result										
Sl.no	Sampling Point Location	TEST PARAMETER								
		pH	TDS	Conductivity	DO	TSS	BOD	COD	Ammonia-Nitrogen	Temp.
		mg/l	μS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	°c
1	Max Power Ltd. Water pump intake, Narshingdi	7.64	213	426	2.94	56	2.6	9	0.41	27.3
2	Palash Bazar Ghat, Narshingdi	7.59	211	424	4.30	33				27.8
3	Ghorashal Railway Bridge Ghat, Narshingdi	7.38	213	424	1.90	77				27.3
4	Kanchan Bridge Ghat, Rupganj.	7.76	204	407	5.6	14				26.9
Average		7.59	210	420	3.69	45	2.6	9	0.41	27.33
Shitalakkhya River's Down Stream water test Result										
Sl.no	Sampling Point Location	TEST PARAMETER								
		pH	TDS	Conductivity	DO	TSS	BOD	COD	Ammonia-Nitrogen	Temp.
		mg/l	μS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	°c
5	Atlashpur, Masumabad Gudar Ghat	7.71	222	443	3.68	11	32	87	14	28.8
6	Rupganj Fare Ghat, narayanganj.	7.51	266	532	0.67	45				29.1
7	Demra Bridge Ghat, Rupganj.	7.06	425	850	0.01	74				28.2
8	Siddhirganj River port Ghat	7.12	445	894	0.01	84				28.5
Average		7.35	340	680	1.11	54	32	87	14	28.7

Which is in the ranged from 3.1 to 6 and that was moderately polluted. This results supported by Khaleda Begum.³ When the total point score was found 40, the RPI was (40/4) 10. This obtained value 10 was then compared to the above “Pollution Index Integral Value”, and found 10 (more than 6). So, it was determined as severely Polluted. Almost same results found from another researcher.⁷

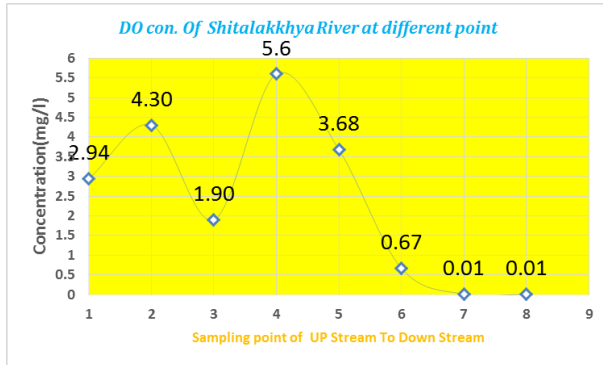


Figure 1: DO concentration of Shitalakkhya River at different points.

The average DO concentration of upstream and downstream in Shitalakkhya river is very low. The highest (5.6mg/l) DO concentration was found Kanchan Bridge Ghat, Rupganj at Sampling point 4 at upstream. Lowest (0.01mg/l) DO concentration was found Demra Bridge Ghat, Rupganj and Siddhirganj River port Ghat at sampling point 7 and 8 at Downstream respectively.

Table 2: Water Quality Parameter (Index Score) of Shitalakkhya River of Bangladesh

<u>Water Quality Parameter INDEX SCORE for Shitalakkhya River</u>						
SL. NO	Parameter/Items	Unit	Monitoring Data from Shitalakkhya River (Upstream)	Index Scores	Monitoring Data from Shitalakkhya River (Downstream)	Index Scores
1	Biochemical Oxygen Demand(BOD ₅)	mg/l	2.6	1	32	10
2	Dissolved Oxygen(DO)	mg/l	3.68	6	1.11	10
3	Ammonia- Nitrogen(NH ₃ -N)	mg/l	0.41	1	14	10
4	Suspended Solids (SS)	mg/l	217	10	376	10
Total Point Score			18		40	
RPI			4.5		10	
Ranks			Moderately Polluted		Severely Polluted	

Figure 2: Biomedical Oxygen Demand (BOD₅) Result Upstream and Downstream

The highest value BOD₅ was recorded 32 mg/L at the downstream of the Shitalakkhya River which is highly polluted or severely polluted and the

lowest value was recorded 2.6 mg/L at the upstream of the river which is Unpolluted.

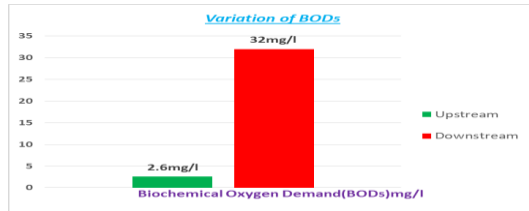


Figure 3: Dissolved Oxygen Results of Upstream and Downstream of Shitalakkhya River

In the present study, the Dissolved Oxygen (DO) was recorded 3.68 mg/l at the upstream of the Shitalakkhya River which is Moderately polluted and the lowest was recorded 1.11 mg/l at the downstream of the the Shitalakkhya River which is Severely polluted. (Table-3.1)

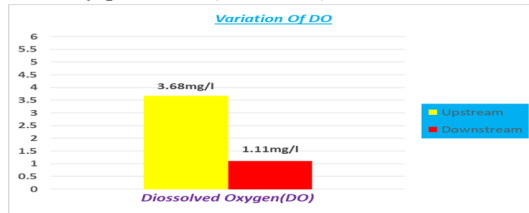


Figure 4: NH₃-N Results of Upstream and Downstream of Shitalakkhya River

The observed value NH₃-N was recorded 0.14mg/l at the upstream of the Shitalakkhya River which is unpolluted and the value was recorded 14mg/l at the downstream of the Shitalakkhya River which is severely polluted.

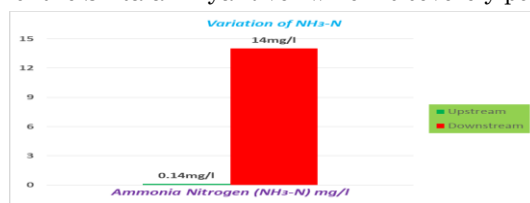


Figure 5: Suspended Solids (SS) Results of Upstream and Downstream of Shitalakkhya River

The highest value SS was recorded 339mg/l at downstream of the Shitalakkhya River which is severely polluted and the lowest value was recorded 217mg/l at the upstream of the Shitalakkhya River which is severely polluted.

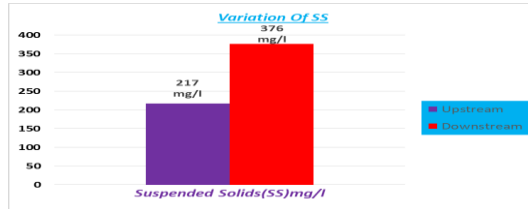


Figure 6: PH Result Upstream and Downstream

In the present study, pH level was recorded 7.59 in the upstream and 7.35 in the downstream of the Shitalakkhya river.

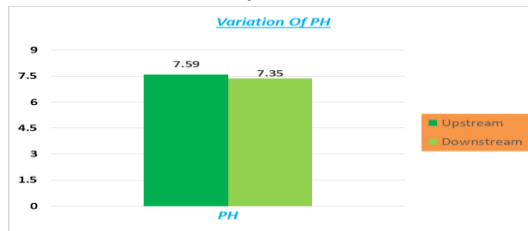
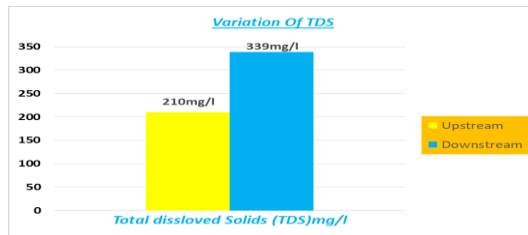


Figure 7: shows the Total Dissolved Solids (TDS) values of upstream and downstream points of Satkhira river (n=8)

The study found 210 mg/l at the upstream and 339 mg/l at downstream of the Shitalakkhya River.



CONCLUSIONS

The pollutions intensity of Shitalakkhya river varies with seasons. The river becomes highly polluted in dry season and low in wet season. Downstream of the shitalakkhya river water color is blackish with very poor level of DO showing fish unavailability and unacceptable smell at Demra & Siddhirganj River Port ghat. The water quality of upstream of river is better than downstream.

RECOMMENDATIONS

Different actions can be taken to combat with the water pollution's problems associated with Shitalakkhya river; like-

- The number of the industry need to be made aware of the health and economic impacts of Shitalakkhya river water pollution, and Stakeholders across all sectors also need to work together in order to prioritize and adopt actions affecting water quality.
- All industries effluent treatment plant infrastructure should be connected to all properties that are accessible waste water treatment solutions according to state policy.
- Government may take initiative to increase public education, multi-sectors collaborative solutions, and the proper implementation and enforcement of the river conservations Act.

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