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Water quality and fish diversity of Rupnarayan River in Purba Medinipur district, West Bengal

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Abstract
West Bengal is the land of rivers. Human population growth and related activities on river banks have gradually increased over the years. Considering the very high ecological diversity of the water assets and the blessings of the river network, most of the industrial development in this state occurred close to the rivers and the population density is likewise very excessive in these areas. As an end result, rivers receive liquid waste like commercial discharges, municipal sewage and solid waste are also being dumped near the banks of the river. The water parameter test identifies the incoming pollutants and quality of the Rupnarayan River. Water parameter studied such as temperature, pH, BOD, COD, Dissolved Oxygen, conductivity, calcium, magnesium, hardness, alkalinity, nitrate, sulfate, chloride and sodium were recorded from all Sampling Stations. During this study total 36 fish species under 24 families, 8 orders and 26 genera were recorded.

Keywords: Fish diversity, Rupnarayan River, physicochemical parameter, conservation status

1. Introduction
To shape the earth and control the climate water plays an important role as the most precious resource. It is being treated as the most important compounds which is favourable for all living organisms. The natural elements of water is usually characterised in step with its chemical and biological components. The aquatic environment is being heavily and largely polluted due to rapid industrialization and randomly use of insecticides and chemical fertilizers in agricultural purpose, as a result the deterioration of water satisfaction and depletion of aquatic life are in great threat (Gorde & Jadhav, 2013) [1].
When nutrients are mixed into the river, they deplete the oxygen within the water that aquatic animal need to stay alive. Nitrogen and phosphorus usually enter river and ocean from fertilizers, industrial effluents and other sources. Pesticides and industrial discharges that enter river water can also damage or kill fish. Synthetic insecticides used for weed and bug management are poisonous in even small amount. Heavy metals released by the burning of fossil fuels infiltrate the aquatic ecology, eventually finding their way into river water. Heavy metals create impairness of fishes capability to scent, disturbing its mobility to look out food and they failed to protect itself from predatory animals and fish. Often, these chemical compounds are determined at concentrations that are not immediately harm to fish. Nevertheless, at sub lethal concentrations, exposure can result in harmful effects and doubtlessly affect population. When riverine fish can't keep away from chemical pollution, certain pollution activates detoxification mechanisms may additionally regulate their phenotype in reaction to chemical exposure (Hamilton *et al.*, 2015) [2].

2. Materials and Methods
2.1. Study area
The Rupnarayan River begins in West Medinipur, when the Dwarakeswa River meets the Shilabati River about 6 kilometres east of Ghatal. Rupnarayan then joins Damodar distributaries and later confluences with the Ganga at Gadiara-Geonkhali. The stretch of this river has been diagnosed as "Polluted" after the Kolaghat Bridge and contrary to the antique and historical past port metropolis Tamluk of Purba Medinipur.

The river in particular the polluted stretch is in a very lively tidal sector and has a giant inflow of Ganga water two times a day.
The study was done during April 2018 to November 2020.

Table 1: Study site details

Sl. No.	Sampling Station's name	Area name	Latitude & Longitude of the Sampling Station
01.	Station A	Natshaler Char	22°12´29´´N 88°00´53´´E
02.	Station B	Tamluk Town (Steamer Ghat)	22°17´25´´N 87°56´05´´E
03.	Station C	Kolaghat Rail Bridge	22°26´08´´N 87°52´59´´E

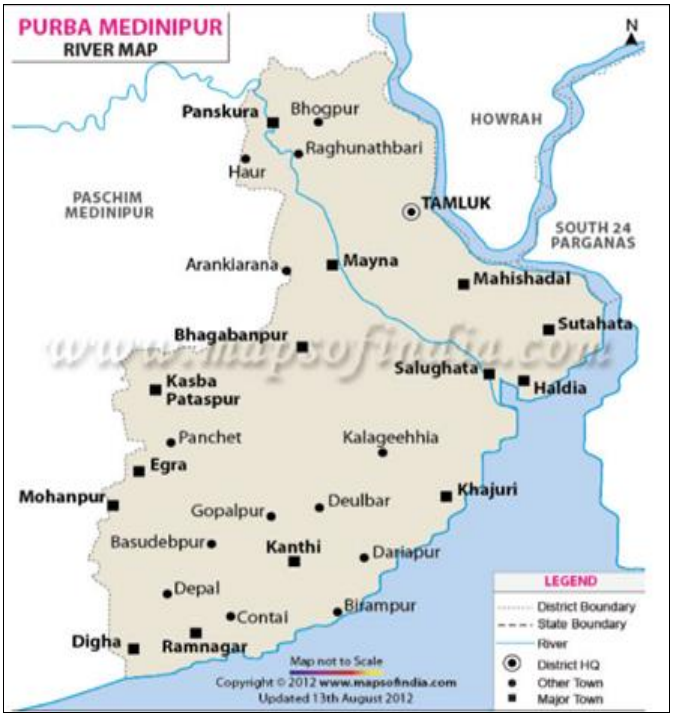

Fig 1A: Purba Medinipur river map

Fig 1B: Satellite view of Rupnarayan River

Fig 2A: Satellite view of Sampling Station A

Fig 2B: Satellite view of Sampling Station B

Fig 2C: Satellite view of Sampling Station C

Fig 2D: Location map of the study area

2.2. Collection and identification of fish species

As per suggestion of local fishermen monthly sampling was done during April 2018 to November 2020 from 3 Sampling Stations. Fish species were collected from different Sampling Stations using cast net, gill net, drag net and hand net. 10%

formalin solution were used for fish preservation. Fischer (2013) [4], Jayaram (2002) [5], Schultz (2004) [6] and Jhingran (1978) [7] did a lot to find out the taxonomic characterization of fish and also their identification.

2.3. Analysis of the water sample

Water samples were collected from 3 Sampling Stations during early morning weekly of every month within study periods for analysis of physicochemical parameter. Following the methods APHA (1998) [3], BOD, COD, alkalinity, nitrate, calcium, magnesium, sulphate, sodium, and chloride of water were analyzed. Digital pH meter (Model No - KONVIO NEER: 040120211) was used to measure pH, while temperature was measured with the help of digital thermometer (ACETEQ Model DC-2). Using conventional Winkler's method Dissolved Oxygen was estimated. Hardness was measured by EDTA method and conductivity was analyzed by digital conductivity tester (HANNA conductivity tester Model- H198301).

3. Results

Table 2: Physicochemical parameter of River Rupnarayan of Sampling Station A during 2018 - 2020

Parameter	2018		2019		2020	
	Wet season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season
Temperature (°C)	28.4	35.5	28.6	35.8	28.8	36.1
pH	7.43	7.55	7.52	7.63	7.51	7.62
Dissolved Oxygen (mg/l)	4.1	3.6	4.4	4.1	4.2	4.3
BOD (mg/l)	3.4	3.2	3.3	3.6	4.1	4.3
COD (mg/l)	5.6	5.8	4.5	5.7	4.6	4.9
Conductivity(µs/cm)	1433	1489	1489	1511	1471	1517
Calcium (mg/l)	28	29	27	28	26	27
Magnesium (mg/l)	10	11	09	11	12	11
Total Hardness (mg/l)	130	129	128	132	135	136
Total Alkalinity (mg/l)	135	137	136	137	130	135
Nitrate (mg/l)	2.3	3.3	2.9	3.2	3.7	3.3
Sulfate (mg/l)	71.64	69.41	71.62	71.12	69.45	71.21
Chloride (mg/l)	244.22	245	245.21	246	242	241
Sodium (mg/l)	35.47	36.14	35.9	36.71	36.1	35.1

Table 3: Physicochemical parameter of Rupnarayan River of Sampling Station B during 2018 - 2020

Parameter	2018		2019		2020	
	Wet season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season
Temperature (°C)	28.9	35.5	28.6	35.8	28.8	38.1
pH	7.35	7.42	7.57	7.44	7.52	7.57
Dissolved Oxygen (mg/l)	4.3	4.8	4.7	4.2	4.8	5.5
BOD (mg/l)	3.3	4.5	3.9	3.5	3.7	4.2
COD (mg/l)	4.8	5.4	4.9	5.2	5.1	5.3
Conductivity(µs/cm)	1500	1512	982	1221	1467	1441
Calcium (mg/l)	37	31	37	43	39	41
Magnesium (mg/l)	23	37	18	27	23	31
Total Hardness (mg/l)	221	257	249	371	285	313
Total Alkalinity (mg/l)	138	111	121	141	127	131
Nitrate (mg/l)	2.4	3.5	2.6	3.4	2.9	2.5
Sulfate (mg/l)	73.11	68.17	75.62	77.12	69.75	73.25
Chloride (mg/l)	258.34	247.12	269.11	289	271	221
Sodium (mg/l)	39.47	36.14	41.1	32.71	31.1	39.1

Table 4: Physicochemical parameter of Rupnarayan River of Sampling Station C during 2018 - 2020

Parameter	2018		2019		2020	
	Wet season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season
Temperature (°C)	28.9	35.5	28.6	35.8	28.8	36.1
pH	7.40	7.46	7.42	7.53	7.62	7.57
Dissolved Oxygen (mg/l)	4.1	3.9	4.7	5.1	4.2	5.8
BOD (mg/l)	4.1	3.8	3.4	3.9	4.5	4.2
COD (mg/l)	4.9	5.7	4.7	5.8	5.2	5.1
Conductivity(µs/cm)	1012	1508	982	1123	1417	1438
Calcium (mg/l)	34	39	34	43	37	41
Magnesium (mg/l)	22	31	19	28	26	33
Total Hardness (mg/l)	231	261	239	271	281	333
Total Alkalinity (mg/l)	131	101	120	131	107	134
Nitrate (mg/l)	3.1	3.7	2.8	2.4	3.9	3.7
Sulfate (mg/l)	74.16	69.11	75.42	78.12	67.75	77.25
Chloride (mg/l)	257.22	261.12	259.11	263	271	281
Sodium (mg/l)	39.67	37.11	42.1	30.31	32.1	39.7

Table 5: Fish species, purpose of use and conservation status (IUCN) in Rupnarayan River

Sl. No.	Fish Species	Family	Station A	Station B	Station C	IUCN	Purpose of use
Order - Siluriformes							
1	*Mystus seenghala*	Bagridae	15	9	4	LC	Ornamental /Commercial
2	*Mystus tengara*	Bagridae	22	11	7	LC	Commercial
3	*Mystus cavasius*	Bagridae	7	1	1	LC	Commercial
4	*Mystus vittatus*	Bagridae	14	9	8	LC	Ornamental/Commercial
5	*Silonia silondia*	Schilbeidae	8	7	4	LC	Commercial
6	*Clarias batrachus*	Clariidae	3	2	1	LC	Commercial
7	*Arius maculatus*	Ariidae	12	11	9	NE	Commercial
8	*Ompok pabda*	Siluridae	15	12	7	NT	Commercial
9	*Ompok bimaculatus*	Siluridae	7	6	4	NT	Commercial
10	*Heteropneustes fossilis*	Heteropneustidae	4	5	7	LC	Commercial
11	*Wallago attu*	Siluridae	5	4	3	VU	Commercial
12	*Pangasius pangasius*	Pangasiidae	7	6	7	LC	Ornamental/Commercial
Order - Cypriniformes							
13	*Amblypharyngodon mola*	Cyprinidae	28	25	24	LC	Commercial
14	*Puntius ticto*	Cyprinidae	13	11	10	LC	Commercial
15	*Puntius sarana*	Cyprinidae	17	12	13	LC	Commercial
16	*Puntius vittatus*	Cyprinidae	9	8	5	LC	Ornamental/Commercial
17	*Chela cachius*	Cyprinidae	5	6	2	LC	Commercial
Order - Perciformes							
18	*Colisa chuna*	Osphronemidae	20	16	21	LC	Ornamental
19	*Channa marulias*	Channidae	14	13	13	LC	Aquaculture
20	*Colisa fasciata*	Anabantidae	9	6	7	LC	Ornamental
21	*Chanda nama*	Amassidae	9	11	8	LC	Aquaculture/Ornamental
22	*Lates calcarifer*	Latidae	8	0	3	LC	Aquaculture/Commercial
23	*Channa punctata*	Channidae	7	5	6	LC	Commercial
24	*Glossogobius giuris*	Gobiidae	6	2	4	LC	Aquaculture/Commercial
25	*Johnius coitor*	Sciaenidae	0	4	2	LC	Commercial
26	*Oreochromis mossambicus*	Cichlidae	5	4	0	VU	Aquaculture
27	*Channa striata*	Channidae	0	0	2	LC	Commercial
Order - Clupeiformes							
28	*Gudusia chapra*	Clupeidae	20	21	13	LC	Commercial
29	*Tenualosa ilisha*	Clupeidae	9	12	10	LC	Commercial
30	*Setipinna phasa*	Engraulidae	21	15	12	LC	Commercial
Order - Mugiliformes							
31	*Mugil parsia*	Mugilidae	15	5	8	LC	Aquaculture/Commercial
32	*Mugil cephalus*	Mugilidae	2	1	1	LC	Aquaculture/Commercial
Order - Polinemiformes							
33	*Polynemus paradiseus*	Polinemidae	35	20	12	LC	Commercial
Order -Synbranchiformes							
34	*Monopterus cuchia*	Synbranchidae	7	4	8	LC	Commercial
35	*Macrognathus pancalus*	Mastacembelidae	4	0	2	LC	Commercial
Order - Anguilliformes							
36	*Anguilla bengalensis*	Anguillidae	9	3	2	NT	Aquaculture/Commercial
Total			391	287	250		

IUCN Red List: LC - Least Concern, VU - Vulnerable, NE - Not Evaluated and NT - Near Threatened

Table 6: Species richness, abundance and diversity profiles of Rupnarayan River

Sampling station	Abundance	Species richness	Evenness index (e)	Shannon index (H')
Station A	391	34	0.95	3.34
Station B	287	33	0.94	3.28
Station C	250	35	0.93	3.30

Table 7: Order Wise percentage of fish species from different Sampling Station

Orders	Station A	Station B	Station C
Siluriformes	30.43%	28.92%	24.8%
Cypriniforms	18.41%	21.60%	21.6%
Perciformes	19.95%	21.25%	26.4%
Clupeiformes	12.79%	16.72%	14.00%
Mugiliformes	4.35%	2.09%	3.6%
Polinemiformes	8.95%	6.97%	4.8%
Synbranchiformes	2.81%	1.39%	4.00%
Anguilliformes	2.30%	1.05%	0.8%

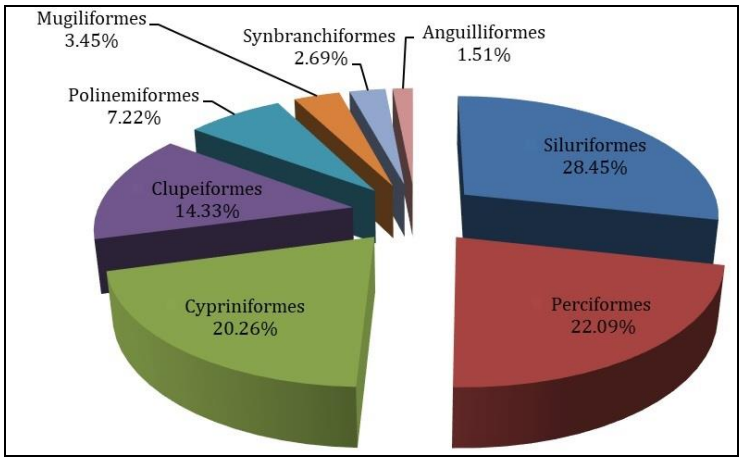

Fig 3: Order wise representation of fish species in Rupnarayan River

4. Discussion

In the Rupnarayan River, anthropogenic activities are the major cause of water pollution. Many fish species are extinct due to water pollution. Water quality and fish health depend on each other. Fishes mainly die because of human interference at the riverside. Water pollution changes fish's behavior. Impure river water blocks fish migration. River pollution can affect the oxygen level of river water. Various chemical pollutants slowly affect the fish population. As a result, fish suffers from pollution related diseases like liver damage, gill disease, neoplasia, hyperplasia, epidermal papilloma, ulceration and fin/tail rot.

In total 36 fish species belonging to 8 orders, 24 families and 26 genera were found. The maximum number of species belonging to family Cyprinidae (5 species) followed by the family Bagridae (4 species). Family Siluridae and Channidae represented with 3 species each. Shannon index (H') in Sampling Station A - 3.34 is higher than Station B - 3.30 and Station C - 3.28. The highest value of Eveness index (e) in Samping Station A - 0.95 and lowest value in Station C - 0.92. Among the all fish species, *Ompok pabda*, *Ompok bimaculatus* and *Anguilla bengalensis* are Near Threatened (NE) and *Wallago attu* and *Oreochromis mossambicus* are Vulnerable (VU) categories.

Sampling Station A, Natshaler Char is a village, located in Mahisadal Tehsil of Purba Medinipur district in West Bengal, India. This place is surrounded by plants on both sides of the river bank. Anthropological activity of this region is low. Sampling Station B is located in Tamluk town. According to Indian Census 2011 Tamluk town had 65,306 population in 17.86 km^2 area. The present Municipal waste per day is 54 TPD (Tons per day). Also hospital biomedical wastages are discharged directly or indirectly through the river. Sampling Station C is Kolaghat Thermal Power Station. Kolaghat Thermal Power Plant (K.T.P.P) is located right side of the Rupnarayan River. Per day 7800 - 8400 metric tons of fly ash deposited in this surrounding area. Fly ash contains various type of pollutants. It has changed the physicochemical characters of Rupnarayan River.

5. Conclusion

80% of the world population is beneath the imminent danger of water insecurity and biodiversity loss. These environmental stresses endanger nearly every person on the planet and have the potential to cause catastrophic illness, starvation and conflict. An extensive variety of manmade chemical compounds expire most fish population. Fish fails to avoid chemical pollutants. Water pollutants impact the fish significantly and prove lethal to them. The relationship between human beings and rivers, which constitute freshwater environments is complex. Rivers serve in general as a source of freshwater and as sinks for domestic and commercial waste. The outcomes of this utilization result from a variety of activities that are rooted in complex interdisciplinary systems and practices.

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