

PHYSICO-CHEMICAL CHARACTERISTICS OF RIVER RAPTI NEARBY INDUSTRIAL AREAS OF BALRAMPUR, UTTAR PRADESH, INDIA

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ABSTRACT

Present paper deals with the physico-chemical characteristic of River Rapti in District Balrampur. Most physical and chemical parameters like colour, odour, temperature, pH, EC, TDS, DO, BOD, COD, sodium, potassium, magnesium and nitrate are reported beyond the tolerance limits which indicates the degradation of water quality. The degradation of water quality is reported maximum at Nahar Balaganj and Bhagwatiganj spots.

INTRODUCTION

Rapid industrialization, urbanization and other anthropogenic activities are responsible for contamination of water bodies. The contamination occurs due to haphazard and unplanned discharge of industrial wastes and effluents, extensive use of fertilizers and discharge of domestic sewage etc. About 80% water pollution occurs due to domestic wastes according to WHO.

Balrampur city is situated at Indo-Nepal border in the foothills of Sivalik range. It is a fast growing industrial city of tarai region. Many industrial units like sugar industry, distillery, paper mill, fertilizer as well as power plant are running as major industries of this city. Besides these, approximate 76 small scale industries are also present here.

Suvaw Nala (wastewater drain), which is situated in the middle of Balrampur city and passes through various industrial areas, carries various types of industrial effluents and domestic wastes into it. This Nala ultimately discharges its wastes into River Rapti. Therefore, it is essential to know the level of pollution in Suvaw Nala and river Rapti. The water of the river is used for irrigation of various crops and vegetables as well as for portable purposes for humans and cattle.

SELECTION OF SAMPLING SITES

The name of sites, their location and types of sources are as below:

<i>Sites</i>	<i>Type of Source</i>	<i>Location</i>
I	Suvaw Nala	Nahar Balaganj
II	Suvaw Nala	Bhagwatiganj
III	Rapti River	Confluence point of River Rapti and Suvaw Nala
IV	Rapti River	Half km upstream of River Rapti
V	Rapti River	1 km down stream of River Rapti

MATERIALS AND METHODS

The water samples of River Rapti and Suvaw Nala were collected monthly in clear pre-sterilized polythene bottles. Various physical and chemical parameters like temperature, pH, EC, alkalinity,

hardness, salinity, BOD, COD and different ions were estimated as per standard methods (APHA 1995).

RESULTS AND DISCUSSION

The water quality of Rapti river and Suvaw Nala was assessed and compared with the standards given by different agencies like CIFE Mumbai for aquaculture. The results of the study are given in Tables 1, 2, 3, 4 and 5. In the present study pH of all the samples was between 7.10 and 8.80. It has been observed that in premonsoon increase in pH is accompanied with increase in alkalinity. Increase in pH values could be outcome of industrial effluents and sewage in accordance with the reports of Mathur et al. (1989). pH of river water at the point of confluence was higher in compression to upstream and down stream. This is mainly due to discharge of industrial and domestic effluent through Suvaw Nala into the river. DO levels ranged from 2.02mg/L to 7.8mg/L. Lowest value of DO was found in Suvaw Nala near Bhagwatiganj (Site-II) during premonsoon season. This is mainly because of the organic industrial effluents as well as sewage load of Suvaw Nala. During summer the volume as well as rate of flow of water decreases, while disposal of wastewater and sewage remain virtually the same. BOD of Suvaw Nala is between 100.1 and 162 mg/L, while COD is between 175 and 380 mg/L. BOD and COD of Suvaw Nala are significantly high throughout the year due to increase in effluents of industries into Suvaw Nala. The BOD and COD values of Rapti river ranged from 55-79 and 115-153 mg/L in different months of the year. These values indicate high organic matter load in the river due to effluents, which comes from different big and small industries in Balrampur district. There is no treatment plant for Suvaw Nala, so water becomes highly polluted increasing the values of BOD and COD.

The TDS value of samples from Suvaw Nala were high ranging from 3.33 to 3.94g/L. Increase in TDS after addition of industrial effluents as well as sewage is in consonance with the findings of Ramesh et al. (1992) who also observed similar condition in Reh and Krishna rivers. TDS is positively correlated with sulphate, nitrate and alkalinity. In the samples from Suvaw Nala, average value of total alkalinity of effluent water was beyond 200mg/L; the highest being 655.00 and lowest 268.00 mg/L. Total alkalinity was lower in monsoon due to dilution of the nutrients by rain water. From alkalinity of samples, it is clear that alkalinity increases due to addition of industrial and domestic wastes from Suvaw Nala and attains maximum value at confluence point (655.00 mg/L) during winter and pre-monsoon periods of the year.

Polluted water of Suvaw Nala was hard ranging from 805-935 mg/L, which is due to the effect of industrial effluents. Increase in hardness was more marked in the river water during premonsoon periods probably due to the reduced flow of Rapti water and prevalence of more untreated sewage and industrial wastes in the river. It is noteworthy that calcium hardness was higher in winter in almost all the samples collected from Suvaw Nala and Rapti river.

The electrical conductivity was highest in Suvaw nala samples. It is well known that conductance of water increases with salt content. Conductivity is proportional to TDS values. A positive correlation was noted between EC and hardness. Chloride value was higher in all the water samples tested. Highest values were shown by samples from Suvaw Nala followed by Rapti river water down stream and Rapti river water upstream. This increase is an indication of pollution, especially through domestic sewage. The chloride content was maximum in winter followed by summers and rainy season. Earlier, high values of chlorides have been reported by Murthy et al. (1994) and Singh & Mahaveer (1997) in Tungbhadra and Ganga river waters after mixing with domestic sewage.

Table 1: Physico-chemical characteristics of Suvaw Nala at Site-I.

Parameters	Winter	Pre-monsoon	Monsoon	Post-monsoon	Standard for aquaculture	Standard for irrigation
pH	8.600.16	8.48±0.35	8.22±0.01	8.45±0.11	6.7-8.5	55-9.0
EC (mS/cm)	3.14±0.18	2.54±0.20	2.15±0.10	2.85±0.25	-	<2
TDS (g/L)	3.70±0.32	3.62±0.34	3.30±0.25	3.50±0.30	<500	-
DO (mg/L)	3.28±0.05	3.12±0.02	5.02±0.02	3.82±0.05	5-10	-
BOD (mg/L)	145±12.45	150±14.11	98.14±5.75	125.75±8.11	<10	100
COD (mg/L)	214±15.92	213±14.11	173±12.92	185±13.20	<50	-
Alkalinity (mg/L)	620±50.44	560±50.81	475±42.00	510±38.00	50-300	-
Hardness (mg/L)	890±47.1	875±45.11	840.06±41.22	870±38.50	30-180	-
Ca Hardness (mg/L)	235±14.40	230±18.40	155.40±10.70	200±17.65	-	-
Chloride (mg/L)	670±40.00	590±45.10	445±40.44	515±30.4	31-50	600
Salinity (mg/L)	1215±105.00	1050±101.0	755.8±64.40	930.40±60.3	<0.5	-
Sodium (mg/L)	1770±151.00	1760±142.00	1692±132.00	1642±120.61	-	-
Potassium (mg/L)	810±60.80	6456±50.10	500±38.0	540.5±45.60	0.5-10	-
Magnesium (mg/L)	165±5.40	155.35±6.80	165.1±7.10	161±6.12	-	-
Sulphate (mg/L)	27.0±16.10	260±22.75	180±17.55	181±14.00	-	-
Nitrate (mg/L)	74.25±6.10	68.44±5.64	62.10±5.20	65.5±14.71	-	-

Table 2: Physico-chemical characteristics of Suvaw Nala at Site-II.

Parameters	Winter	Pre-monsoon	Monsoon	Post-monsoon	Standard for aquaculture	Standard for irrigation
pH	8.80±0.16	8.40±0.25	8.32±0.25	8.47±0.9	6.7-8.5	55-9.0
EC (mS/cm)	3.33±0.32	2.64±0.16	2.27±0.30	2.45±0.07	-	<2
TDS (g/L)	3.94±0.50	3.84±0.50	3.76±0.56	3.80±0.35	<500	-
DO (mg/L)	2.02±0.02	2.00±0.01	4.22±0.03	3.32±0.02	5-10	-
BOD (mg/L)	160±13.50	156±12.00	105±8.60	124±12.00	<10	100
COD (mg/L)	380±25.0	343±20.00	242±16.00	284±15.00	<50	100
Alkalinity (mg/L)	655±24.00	560±46.00	480±14.00	505±4.00	50-300	-
Hardness (mg/L)	934±30.00	890±30.00	802±16.00	825±22.00	30-180.0	-
Ca Hardness (mg/L)	272±20.00	250±20.00	234±18.00	240±12.00	-	-
Chloride (mg/L)	760±60.00	570±45.00	361±30.00	410±25.00	31-50	600
Salinity (mg/L)	1370±38.00	1078±165.00	655±57.00	750±60.00	<0.5	-
Sodium (mg/L)	1840±175.0	1910±14.0	1850±120.0	1600±75.0	-	-
Potassium (mg/L)	804±45.00	791±145.00	402±22.0	365±18.00	0.5-10	-
Magnesium (mg/L)	161±8.32	156±4.0	135±8.06	140±2.60	-	-
Sulphate (mg/L)	281±20.0	285±22.0	202±15.0	210±15.00	-	-
Nitrate (mg/L)	94.70±8.8	91±6.21	74±6.01	82±5.20	-	-

Sodium concentration was higher in all the samples from Suvaw Nala as well as Rapti water. Sodium ion concentration was highest during the winter and premonsoon season. Potassium ion concentrations were high all the year around except in monsoon. The concentration of sulphates was below the admissible limit in all the samples. Sodium was positively correlates with potassium and sulphate. In the present study, nitrate ions were below the permissible limits varying between 0-18mg/L in all the water samples. Nitrate concentration was highest during winter season in all samples.

The values of these parameters were compared with standards for agriculture, aquaculture and drinking water. From the present study it is clear that Rapti water is unfit for agriculture, although the pH was found to be within the limits of agriculture but the level of EC was higher than the normal

Table 3: Physico-chemical characteristics of water at the confluence point of Rapti river and Suvaw Nala at Site- III.

Parameters	Winter	Pre-monsoon	Monsoon	Post-monsoon	Standard for aquaculture	Standard for irrigation
pH	7.65±0.42	7.70±0.28	7.34±0.24	7.48±0.21	6.4-8.3	5.5-9.0
EC (mS/cm)	1.50 ± 0.14	1.60±0.12	1.31±0.12	1.45±0.068	-	<2
TDS(g/L)	3.40±0.21	3.42±0.36	2.65±0.21	3.18±0.30	<500	-
DO (mg/L)	5.64±0.030	5.64±0.030	7.10±0.18	5.81±0.038	5-10	-
BOD (mg/L)	77.50±5.45	75.60±4.55	68.75±3.45	70.15±7.20	<10	100
COD(mg/L)	148.30±8.68	150.30±12.45	138±10.50	148.5±10.50	<50	-
Alkalinity(mg/L)	370.64±30.45	375±16.30	260.01±24.50	340±52.50	50-300	-
Hardness (mg/L)	835±23.05	830±25.42	695.6±14.90	825±20.17	30-180	-
Ca Hardness	224±14.15	216.85±10.5	100.5±10.35	185.4±8.50	-	-
Chloride (mg/L)	350±24.02	364.2±24.50	230±15.80	301±14.15	31-50	600
Salinity (mg/L)	705±30.20	656.2±20.25	410±24.65	554.1±35.5	<0.5	-
Sodium (mg/L)	810±40.24	845±75.10	720±230	760±62.26	-	-
Potassium (mg/L)	410±70.50	460±80.70	310±21.10	410±10.40	0.5-10	-
Magnesium(mg/L)	145±10.80	150.02±5.02	144±2.70	155.10±11.20	-	-
Sulphate (mg/L)	40.5±0.28	44.2±0.10	28.2±8.40	33.3±2.90	-	-
Nitrate (mg/L)	5.0±0.10	4.0±0.40	3.4±0.10	3.4±0.15	-	-

Table 4: Physico-chemical characteristics of river Rapti at Site-IV.

Parameters	Winter	Pre-monsoon	Post-monsoon	Standard for aquaculture	Standard for irrigation
pH	7.20±0.10	7.30±0.12	7.10±0.12	6.7-8.0	5.5-9.0
EC (mS/cm)	1.58±0.12	1.40±0.12	1.30±0.12	-	<2
TDS(g/L)	2.60±0.20	2.60±0.20	2.50±0.10	<500	-
DO (mg/L)	6.20±0.20	6.30±0.20	7.30±0.40	5-10	-
BOD (mg/L)	50.20±4.60	55.40±2.50	50.70±4.40	<10	100
COD(mg/L)	120±6.20	120.30±8.90	110.0±7.00	<50	-
Alkalinity(mg/L)	345.70±16.4	310.80±12.40	280.60±16.40	50-300	-
Hardness (mg/L)	610.60±40.30	608.40±30.50	590±11.21	30-160	-
Ca Hardness	200±20.05	155.3±12.40-	125.4±11.10	-	-
Chloride (mg/L)	285.50±10.40	298.10±21.80	190.6±9.85	31-50	600
Salinity (mg/L)	550±24.00	530.03±41.50	350.4±15.2	<0.5	-
Sodium (mg/L)	630.60±40.0	670±38.40	430.40±30.1	-	-
Potassium (mg/L)	345.5±24.50	398±20.0	290±18.40	0.5-10	-
Magnesium(mg/L)	100.00±8.20	100.4±8.40	110.9±12.06	-	-
Sulphate (mg/L)	30.40±3.5	30.24±2.00	15.2±1.40	-	-
Nitrate (mg/L)	3.25±0.10	3.0±0.15	2.50±0.10	-	-

limit (< mmho). In such higher range seeds do not germinate. The concentration of chloride and sulphate is harmful at seeding stage and maturity of the plant. The water is also not suitable for aquaculture and drinking purpose.

In conclusion, it may be pointed out that water of River Rapti is highly polluted as revealed by the tested parameters. As there is a no sewage treatment plant, so it is essential that there should be treatment plants to control water quality of River Rapti at Balrampur.

Table 5: Physico-chemical characteristics of river Rapti at Site-V.

Parameters	Winter	Pre monsoon	Monsoon	Post-monsoon	Standard for aquaculture	Standard for irrigation
pH	7.45±0.10	7.40±0.10	7.30±0.10	7.40±0.10	6.7-8.5	5.5-9.0
EC (mS/cm)	1.60±0.04	1.70±0.04	1.20±0.04	1.40±0.04	-	<2
TDS(g/L)	2.60±0.20	2.70±0.160	2.45±0.20	2.65±0.10	<500	-
DO (mg/L)	5.70±0.30	5.70±0.10	7.20±0.21	6.00±0.24	5-10	-
BOD (mg/L)	58.7±5.40	65.60±4.85	58.2±5.20	50.0±3.40	<10	100
COD(mg/L)	135±10.04	130.2±12.40	110.2±10.5	130.5±12.60	<50	-
Alkalinity(mg/L)	355±20.85	3.70±25.80	280±30.50	310±28.10	50-308	-
Hardness (mg/L)	760±28.30	770±30.40	565.3±25.00	760±30.7	30-180	-
Ca Hardness	220.02±18.0	296.6±22.10	117.10±21.80	165.0±7.50	-	-
Chloride (mg/L)	345.0±28.2	324±25.50	230.2±21.0	295±28.3	31-50	600
Salinity (mg/L)	630.60±55.4	570.0±55.80	410.47±402	545±48.0	<0.5	-
Sodium (mg/L)	760.7±65.50	845±70.01	720±50.40	710±50.6	-	-
Potassium (mg/L)	385±35.20	450±35.10	280±20.41	310.5±20.45	0.5-10	-
Magnesium(mg/L)	130.8±10.25	135.2±10.02	102.25±10.01	135.80±8.00	-	-
Sulphate (mg/L)	35.1±5.0	30.3±2.5	15.3±1.80	25.3±2.40	-	-
Nitrate (mg/L)	4.0±0.35	3.5±0.15	2.5±1.65	3.5±0.11	-	-

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