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RESEARCH ARTICLE

Hydrobiological study on Summer, Rainy and Winter season of river Deorania at Bareilly

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ABSTRACT

The waters of the Deorania River have been found to be a good model for studying the effects of sewer pollution. Therefore, the effect on hydrobiology was tested during different extreme points of the winter, summer and rainy season. Samples were collected from three different sites. Site A (unpolluted near Thana Bhojipura), site B (near the city Shamshan Bhoomi, about 50 meters away from the point where major drains of city joint the river) and site C (it is about 3 Km. away from the point where major drains join the river). The water of the river was analysed for hydrobiological parameters; temperature, colour, TSS, transparency, pH, DO, free CO_2, COD, BOD, TDS, and salinity. The results indicate that all parameters at site B and C are beyond the permissible limit and unsuitable for human consumption and unfit for irrigation, dairy form, industrial used. Industrial effluent and domestic sewage contribute a source of pollution in river water. Till date there is no hydrobiological study performed on this river with respect to all three seasons therefore the study will be very beneficial for the whole scientific community.

***Key words*:** River Deorania; Ram Ganga; pH; DO; BOD; TSS; TDS; Free CO_2

1) INTRODUCTION

The district Bareilly is situated between 28055 N to 79060E latitude and the elevation ranges between 160m-200m above the sea level. Bareilly district is centrally located in Rohilkhand Division of Uttar Pradesh and its maximum length from North to South is 75.0 km and breadth West to East is 60 km. Bareilly district is slightly undulation of total geographical area of the district which is 4125 km.

Bareilly city having a population of 903668 as per the census 2011 (Jangarna Karya Nedeshalaya Lucknow). Major part of its domestic wastes; city refuge, debris, animal and human excreta and industrial effluents are discharged mainly into river Deorania through a network of open and underground sewer system [1]. Although there are 10 large open drain (Nalah) collecting wastes from every nook and corner of the city but all unite near Alakhnath temple and discharge their contents into the river Deorania. The underground sewer system of the city also discharges its contents through Bakarganj drain near Bareilly City Station. Moreover, the effluents coming out of Parsakhera industrial area are also discharged into this river.

The river Deorania is a tributary of river Ram Ganga and about 8 km of its stretch passes through the thickly populated area of Bareilly city and joins river Ram Ganga near Unchagaon and thus pours tons of organic and inorganic wastes into river Ram Ganga. River Ram Ganga is one of the major tributaries of Ganga river which originates from Kotdwar of Pauri Garwal and after covering a stretch of 250 kms, it finally kisses Ganga near Farrukhabad. It is, therefore, evident that river Ram Ganga is responsible for contaminating Ganga river significantly.

The study of water quality of different rivers in India by Pandey and others has shown remarkable work in pollution research level [3-8]. Considering the present condition of water quality of Ganga river, hydrobiological condition of the river Deorania at Bareilly is quite essential. Therefore, the present study is highly significant to trace the hydrobiological analysis in western uttar pradesh.

2) MATERIALS AND METHODS

Present study was conducted on water of three different sites of deorania river. Site A was near the industrial area and Site B (near the city Shamshan Bhoomi, about 50 meters away from the point where major drains of city joint the river) and site C (it is about 3 Km. away from the point where major drains join the river) was set to collect the sample near drain point in main Ramganga river situated district Bareilly.

Sample Collection

All the samplings has been done in the second week of

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summer (March to May), rainy (August to September) and winter (December to January). Five water samples were examined for Temperature, Transparency, pH, BOD, DO, COD, nitrate, alkalinity, total solids, total dissolved solid. Water samples were collected in pre-cleaned plastic containers and sterilized braved mounted laboratory bottles and preserved according to standards (APHA, AWWA and WPCT 1995) at extreme monthly intervals from the selected sampling sites from 2005, 2015 and 2020 and brought to laboratory for analysis [9].

Water temperature was recorded with centigrade thermometer in ^{0}C; Colour was estimated by Forel Ule colour scale method while transparency of water was measured according to the method proposed by Secchi [34]. pH was recorded by digital pen pH meter. DO and BOD were estimated by Winkler's method [10]. While Free CO_2, TSS, TDS and salinity were estimated according to APHA et al. [11].

3) RESULTS AND DISCUSSION

The growth reproduction and biota are influenced by physico-chemical parameter i.e. temperature, colour, total suspended solids, transparency, pH, dissolved oxygen, free CO_2, BOD and salinity. During the present investigation in water, temperature showed a tendency to follow the atmospheric temperature. The water temperature of the river stretch explored ranged between 10.5^{0}C to 34.8^{0}C. The minimum was recorded during winter (January) and the maximum during summer (June) seasons. The pattern of fluctuation was more or less similar at all stations. This minimum and maximum temperature of the river shows a clear correlation with atmospheric temperature. It was already reported about the water temperature which followed the atmospheric temperature being hottest during May and June and lowest during December and January and also suggested by MacCambie in 1953, that the duration and intensity of light were the most important factors controlling algal periodicity [11-12].

A seasonal change was observed in water temperature and was always correlated with similar behavior of atmospheric temperature. The decrease in water temperature increases the capacity of oxygen to dissolve in water were observed by Hutchinson [13] and Wong [14]. Similar results were observed in the present study of river water Deorania. From the results of present findings, the colour of river water Deorania during rainy season at site A appeared muddy due to heavy silting. While in winter and summer seasons it was greenish blue due to decrease in water level and presence of good vegetation of macrophytes which indicated high transparency and penetration of light correlated with increased plankton to production. As observed by Saxena and Chauhan [15] and Trivedi and Goel [16], due to heavy silting during rainy season colour of the river water Yamuna was muddy. Site B and C which were set up near the last drain points appeared blackish brown in colour during summer and winter season, it was also observed that due to heavy sewage and industrial pollution the transparency and penetration of light in these sites was very poor.

The ISI value of Total suspended solids (TSS) is 5.0mg/l. In this study, all samples collected from river Deorania exceed this standard value. The maximum concentration of TSS was at site B (590.8. mg/l) in August and minimum was at site A (220.0mg/l) in December was investigated. The peak values of TSS were observed during rainy while the minimum values were observed during winter. Similar findings were observed by Trivedi and Goel [16] and Singh and Rai [17]. Transparency is another important limiting factor in the population and distribution of freshwater planktons and other organisms. Transparency in the river Deorania was low in monsoon due to heavy rains while it increased in summer and winter at sites A, B and C.

Determination of pH is one of the important objectives for the treatment of waste. Significant changes in pH occur due to the disposal of industrial wastes and acid mine drainage [9]. Blum [19] in 1956, observed that the majority of flowing water are neutral to alkaline in nature. In river Deorania the minimum pH value was 6.5 at site B which was registered in summer season and the maximum pH was 9.5 at site B in winter [19]. However, seasonal variations of pH ranging between 6.5 to 9.5.

Dissolved oxygen is an important physico-chemical parameter for assessing the quality of water which depicts the process of operating within the water. The maximum concentration of dissolved oxygen was recorded as 7.8 mg/l at clear site A during summer (June) while minimum concentration (0.2 mg/l) recorded at the sites B and C during summer. This might be due to high overloading concentrations of organic and industrial wastes with receding water level in these months. The same observations were reported by Maruthy et al. [21]. The low DO values at stations B and C indicated the high levels of pollution on these points. Carbon dioxide is one of the essential constituents of an aquatic ecosystem. The abundance of CO_2 exerts certain specific effects on aquatic biota [15]. The river Deorania exhibited maximum free CO_2 as 12.4 mg/ at sites C during summer (June) whereas the lowest concentration of free CO_2 (0.3 mg/l) was recorded at site A during rainy season. The present findings correlate that the level free CO_2 showed inverse relationship with dissolved oxygen this observation is also supported by Prasanna et al. [22]. Habib et al. [23] the direct relationship of free CO_2 with pH was also observed in the present investigations. Measurement of BOD is crucial for the assessment of organic pollution load on a natural water course and is the amount of oxygen utilized by micro- organisms in stabilizing the organic matter. On an average basis the demand for oxygen is proportional to the amount of organic wastes to be degraded aerobically. Hence BOD approximates the amount of oxidizable organic matter present, and the BOD value can be used as a measured of waste strength. The high BOD may be due to decay of the plant parts from the near vegetation [22]. During the present course of studies, the BOD values increased rapidly from site A to B. The maximum BOD as 18.5 mg/l was observed at site B during winter and summer whereas, the minimum BOD 3.2 mg/l was recorded at site A during rainy season.

Table 1: Hydrobiological properties of water in Summer, rainy and winter season of year 2005, 2015 and 2020

Years of Study/Sites	2005			2015			2020		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
TEMPERATURE (° C)									
Summer	33.2	34.4	34.2	32.8	34.8	34.7	31.5	31.9	31.8
Rainy	29.2	30.0	29.9	29.8	30.2	30.2	29.4	29.7	29.7
winter	10.5	11.8	11.6	18.7	19.3	19.4	17.2	18.3	18.4
TRANSPARENCY (cm)									
Summer	43.5	28.0	29.0	43.5	30.0	30.5	48.0	36.0	36.5
Rainy	41.0	25.0	26.0	40.5	29.1	29.2	42.5	32.8	33.6
winter	47.0	29.0	30.0	45.5	30.5	31.0	46.5	33.8	34.6
pH									
Summer	7.5	7.1	7.2	7.8	6.5	6.8	7.6	7.4	7.5
Rainy	7.8	9.2	9.1	8.1	6.9	6.9	7.4	6.6	6.8
winter	8.4	9.5	9.2	8.2	6.7	6.8	7.8	6.8	6.3
TSS (mg/l)									
Summer	255.0	530.2	528.2	265.5	580.6	580.5	220.5	330.9	328.6
Rainy	295.5	584.4	580.5	297.6	590.8	490.9	201.43	367.9	356.5
winter	220.0	512.5	512.0	222.5	530.4	528.4	343.5	496.4	354.7
DO (mg/l)									
Summer	7.9	0.9	0.8	7.1	0.9	0.9	7.6	1.2	1.3
Rainy	7.2	0.9	0.9	7.5	1.5	1.6	7.6	0.4	0.8
winter	6.2	0.2	0.2	7.3	1.1	1.2	7.8	0.6	0.3
BOD (mg/l)									
Summer	4.3	18.3	18.4	4.9	18.5	18.3	3.9	17.8	17.5
Rainy	3.8	17.5	17.8	4.5	17.5	17.5	3.2	15.4	15.4
winter	4.1	17.5	14.7	4.7	18.5	18.4	2.9	16.6	16.6
COD (mg/l)									
Summer	12.5	88.5	89.0	14.2	90.5	90.0	11.3	77.5	76.8
Rainy	11.0	80.6	80.5	12.5	88.2	87.5	15.7	87.5	46.7
winter	12.0	84.0	83.0	13.2	89.2	88.6	13.6	88.6	87.5
TDS (mg/l)									
Summer	158.0	924.2	936.2	212.0	1020.5	1021.5	171.5	882.5	853.6
Rainy	138.0	701.0	699.7	180.5	990.5	992.6	180.5	990.5	992.6
winter	145.2	790.0	788.0	190.5	999.5	999.7	190.5	999.5	999.7
SALINITY (mg/l)									
Summer	0.1	0.5	0.4	0.2	0.4	0.5	0.2	0.6	0.5
Rainy	0.1	0.2	0.2	0.3	0.6	0.5	0.1	0.2	0.5
winter	Nill	0.3	0.3	0.1	0.6	0.8	0.3	0.5	0.8

Jain et al. [24] observed the role of wastes, effluents and sewage on the BOD of different waters. The present study also infers that the BOD values at site B and C which receive wastes shows a rise in the BOD values and can be used as an indicator for investigating the pollution load of river water Deorania in Bareilly (U.P.) [23-24]. Salinity is an important ecological parameter which influences distribution of planktons and animals and constitutes one of the most important pollution indicators. Rajgopal [25] reported the impact of salinity over the growth and distribution of phytoplanktons in aquatic ecosystem [25]. In the present studies the salinity was either absent or present in negligible amounts with a maximum of 0.8 ppm at site C during winter while negligible at site A during winter. The same observation was recorded by Bhattacharya [26], Patel and Patel [27], Haniffa et al., [28] and Faniran et al. [29].

Sharma and Kaur [30] while working on river water sample of Thittagudi recorded very high values of TDS, the reason may be sewage and sludge entering the river . Singh et al. [31] stated that TDS value rises due to contamination by leaching process through surface water during rainy season.

In the present study TDS values were considerably high having a maximum value of 1021.5 mg/l at site C in

summer. The minimum value of TDS was recorded as 138.0 mg/l at site A during mansoon.
Gonzalves and Joshi [32] stated that in May, most of the vegetation decarfed and thus a rise in the amount of dissolved solids was natural as the products of decaying matter returned to the river water and also observed that total solids varied in proportion to temperature and rarely varied inversely to the water level. Verma et al. [33] observed same values of TDS in their study of Kedarabad drain.

4) Conclusion

It is suggested that due to high alkalinity river water, it is not suitable for agriculture. The highest values in winter may be attributed to increase industrial discharge from industries. Chemical oxygen demand (COD) was observed much higher than Biological oxygen demand (BOD). It further indicates that most of the pollution in Deorania, in the study zone, is caused by industrial discharge. But where the pollution scenario kept rising in from 2005 to 2015. It was significantly noted that during lockdown pollution dropping significant and if the pollution kept in limited range than that day is not so far when these rivers can revive their originality.

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