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Some physicochemical characteristics of River Bakulahi within Pratapgarh District

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Abstract

The rivers of India play an important role in the lives of the Indian people. The river systems provide irrigation, potable water, cheap transportation, electricity, and the livelihoods for a large number of people all over the country. This easily explains why nearly all the major cities of India are located by the banks of rivers. The rivers also have an important role in Hindu mythology and are considered holy by all Hindus in the country. The water-rich areas of the world are truly the richest place on Earth.Bakulahi River originates from Bharatpur Lake of Rae Bareli district of Uttar Pradesh. The Bakulahi river flows through Rai bareili district and Pratapgarh district of Uttar Pradesh. Bakulahi river falls down in Sai river (Tributary of Gomti river) in Kajurni village of Mandhata block.Water samples have been collected from a part of Bakulahi River along different points and analyzed for various water quality parameters. This study involves determination of physical, biological and chemical parameters of surface water at different point. A systematic study has been carried out to assess the water quality index of River Bakulahi in Pratapgarh District. water samples from five sampling stations were collected and analysed for physico-chemical parameters (Temp, pH, dissolved oxygen, C.O.D., B.O.D., Carbonate, Bicarbonate, total alkalinity, hardness, turbidity, calcium, magnesium, sodium, potassium, nitrate, phosphate, chloride, sulphate, electrical conductivity, total dissolved solids and total suspended solids.)The study area experiences a seasonal climate and broadly divided into three seasons as winter (November to February), Summer (March to June) and rainy (July to October). The samples were collected and analysed for two consecutive years 2009 and 2010. Each parameter was compared with the standard desirable limit of that parameter in river water as prescribed by different agencies.The analytical data of various physicochemical parameters indicates that some parameters like pH, electrical conductivity, total dissolved solids , total suspended solids, turbidity and sodium are found to be in excess than the prescribed limit in some water samples of the study areas. The WQI value indicates that water samples of some sampling stations are quite unfit for drinking purpose because of high value of dissolved solids and sodium. It was also observed that the water in the year 2009 was of a better quality than in the year 2010. Suitable suggestions were made to improve the quality of river water.

Keywords*: Water pollution, Bakulahi river water, physicochemical analysis, Water quality index, potability.*

Introduction

With the rapid development in agriculture, mining, urbanization, and industrialization activities, the river water contamination with hazardous waste and wastewater is becoming a common phenomenon. The water quality and human health are closely related. The domestic waste from each building along with the effluent of small scale industries is disposed off into the open drains and gutters which ultimately enter into the rivers. The quality of water is mainly deteriorated by human activities[1]. They use dispose the waste directly or indirectly into the river water, which affects the BOD, COD, turbidity and also causes the physico-chemical changes. Rivers are getting contaminated due to waste disposing into them. Waste comprises liquid waste discharged by domestic residences. Most of the Indian rivers and their tributaries viz., Ganges, Yamuna, Godavari, Krishna, Sone, Cauvery Damodar and Brahmaputra are reported to be grossly polluted due to discharge of untreated sewage disposal and industrial effluents directly into the rivers sharma *et al*. (1996). The indiscriminate dumping and release of wastes containing the hazardous substances into rivers might lead to environmental disturbance which could be considered as a potential source of stress to biotic community.Similarly many rivers were surveyed during past two decades with respect to

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their pollution status. In addition to domestic and industrial discharge into the rivers, there were continued surface run off of agricultural areas, mines and even from cremation on the river banks Mishra and Patel (2005). According to a report, over 32 thousand dead bodies were cremated at the major burning Ghats per year in Varanasi alone in the year 1984.The present study is carried out to get an attention of public and government towards eco management of water. As the pollution load on the water of Bakuahi River has been enhanced tremendously at Pratapgarh, thus this river has been selected for study to improve the quality of Bakulahi by having the study of physicochemical parameters certain cheap, best and convenient methods have been applied to get water purified for drinking purposes. The Bakulahi water get polluted through the number of ways subjected to the problem we have. The District that forms a part of Faizabad Division is named after its headquarters town Belha Pratapgarh, commonly known as Pratapgarh. Pratap Singh, a raja of the locality who flourished between 1628–1682, fixed his headquarters at Rampur near old town of Aror. There he built a garh (fort) and called it Pratabgarh after his own name. Subsequently the locality around the fort came to be known as Pratapgarh. When the district was constituted in 1858, its headquarters was established at Belha, which came to be known as Belha Pratapgarh, the name Belha presumably being derived from the temple of Belha Bhawani on the bank of river Sai. It is popularly known among the masses as "Belha Devi" - meaning mother goddess belha. Most popular historical shivling temple "bhayaharan nath dham' katra gulab sing, Pratapgarh. The District lies between the parallels of 25°34' and 26°11' north latitude and between the meridians of 81°19' and 82°27' east longitude extending for some 110 km. from west to east. It is bounded on the north by district Sultanpur, on the south by district Allahabad, on the east by district Jaunpur and on the west by Fatehpur and north-east by district Rae Bareli. In the south-west the Ganges forms the boundary of the district for about 50 km. The water samples were collected from six spots. Sampling station (Vishwanathganj) Sampling station B (kharwaibadi) Sampling station C(khajurni) Sampling station D (Chandaipur) Sampling station E (Nurpur) Sampling station F (Pirthiganj) .Accurate and timely information on the quality of water is necessary to shape a sound public policy and to implement the water quality improvement programmes efficiently. One of the most effective ways to communicate information on water quality trends is with indices. Water quality index (WQI) is commonly used for the detection and evaluation of water pollution and may be defined as "a rating reflecting the composite influence of different quality parameters on the overall quality of water." WHO, (1993).The indices are broadly characterized in to two parts: the physico-chemical indices and the biological indices Villanveva (2008). Here attempt has been made to calculate the water quality index of the Ganga river water in Haridwar on the basis of Harkins Bhoi *et al.*(2005), Lohani Bhandari *et al.* (2008) and subsequently modified by Tiwari based on physico-chemical data Manivaskam N. (1986).

Material and Methods

Water samples were collected from six different spots during different seasons over a period of two years (November 2009 to October 2010). The samples were taken in BOD bottles and plastic jerry canes and brought to the laboratory with necessary precautions. All samples were labelled properly. Some parameters like temperature, pH and dissolved oxygen were measured on site. Grab sampling was generally applied during the sampling. Water samples were analysed by standard methods APHA (1995).The samples were analyzed for following physico chemical parameters:Water Temperature (ºC),pH, hardness (mg/l), turbidity (JTU), total dissolved solids (mg/l),total suspended solids (mg/l), electrical conductivity (µmho/cm),dissolved oxygen (mg/l),B.O.D(mg/l), C.O.D. (mg/l), alkalinity (mg/l), chloride (mg/l), calcium (mg/l), magnesium (mg/l), sodium (mg/l), potassium (mg/l),carbonate (mg/l), bicarbonate (mg/l) and sulphate (mg/l).Eleven parameters were taken for calculation of water quality index : Ca, Mg, Na, K, NO_3^-, SO_4^{2-}, Cl^-, hardness, TDSD, B.O.D. and total alkalinity. It is an established fact that the more harmful a given pollutant is the smaller is its standard permissible value recommended for drinking water. It is an

established fact that the more harmful a given pollutant is, the smaller is its standard permissible Value recommended for drinking water. Therefore the "Weights" for various water quality characteristics are assumed to be inversely proportional to the recommended standards for the corresponding parameters. that is,

$$W_i = K\backslash S_i$$

Where W_i is the unit weight and Si is the recommended standard for the ith parameter P_i. The constant of proportionality K in equation can be determined from the condition

$$\Sigma W_i = K\Sigma\ (1\backslash\ S_i)$$

The quality rating q_i for the ith parameter P_i is calculated from the following equation:

$$q_i = 100(V_i/\ S_i)$$

Where V_i is the observed value. The subindex S_i for the the parameter P_i is given by $(S_i) = (q_i w_i)$

The overall WQI can be calculated by aggregating the quality rating (q_i) or subindices, linearly, and taking their weighted mean, i.e.

$$WQI = [(\Sigma q_i w_i/\Sigma w_i)]$$

Results and Discussion

The results obtained from analysis of water samples of river Bakulahi are shown in table 1 and table 2.

The reported values refer to the mean value of water samples collected in different seasons at different areas along the stretch of Bakulahi river. The results indicate that the quality of water varies considerably from location to location. A summary of the findings is given below:

Table 1:

S.No.	Parameters	Range	Mean
1	pH	7.4 - 8.8	8.05
2	Turb (JTU)	11 -224	86.278
3	Cond (µmhos/cm)	223 -766	479.667
4	TH (mg/l)	78 – 245	180.167
5	T.Alk. (mg/l)	56 – 283	185.889
6	CH (mg/l)	64 – 224	113.667
7	MH (mg/l)	44 – 198	87.861
8	Cl (mg/l)	5.8 – 24	12.072
9	TDS (mg/l)	198 – 760	337.931
10	D.O (mg/l)	3.4 - 7.1	5.1556
11	T.fe (mg/l)	0.0081 - 0.089	0.0619
12	Silica (mg/l)	9 - 18.5	13.975
13	NO_3 (mg/l)	0.074 - 1.8	1.053
14	NO_2 (mg/l)	0.24 - 0.75	0.425
15	Na (mg/l)	12 -355	35.417
16	K (mg/l)	5.5 – 17	10.11
17	SO_4 (mg/l)	9.0 – 26	18.625
18	B.O.D (mg/l)	1.75 – 38	12.754
19	C.O.D (mg/l)	2.0 – 24	6.706
20	O.M (mg/l)	1.9 – 23	6.188

It may be stated that the water quality requirements differ from one age to another and thus any polluted water may be considered suitable for some of the beneficial uses but may remain unsuitable for other purposes. Maruthi (2004) gave the rating of water quality as shown below

Sampling Station	Vishwanathganj		Kharwaibadi		Khajurni		Chandaipur		Nurpur		Pirthiganj	
Parameters	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
pH	7.942	0.39802	7.975	0.25642	8.1	0.20000	8.017	0.16330	8.317	0.40702	7.952	0.25396
Turb	83.500	66.46729	106.667	69.35609	90.667	76.65681	55.333	51.79060	85.500	75.67232	96.000	84.24488
Cond	462.167	182.752	470.16667	144.87845	478.8333	151.6224	468.3333	137.6106	496.8333	197.2413919	501.6667	174.2075391
TH	177.833	50.456	177.66667	42.73016	187.8333	58.08758	183.8333	43.92	182.3333	50.03065727	171.5	54.85890994
T.Alk.	184.833	62.646	178.66667	69.86463	192.5	65.54006	180.8333	71.35942	195.1667	68.71511236	183.3333	62.5672971
CH	142.167	54.20117	99.333	13.72103	102.333	10.98484	130.333	48.94350	106.167	15.45855	101.667	15.12173
MH	113.333	42.96821	80.833	23.66784	83.833	15.14486	85.167	18.81932	79.500	15.64289	84.500	15.82087
Cl	13.833	6.62319	12.450	4.59032	11.967	3.50466	11.350	3.68985	11.750	3.37387	11.083	3.38255
TDS	338.587	76.95889	313.500	81.60821	370.500	208.35907	284.833	85.00686	346.833	173.52281	373.333	212.10061
D.O	4.017	0.45350	6.250	0.72319	4.017	0.45350	3.817	0.27869	6.717	0.29269	6.117	0.90203
T.fe	0.063	0.01365	0.061	0.02857	0.064	0.00915	0.063	0.01213	0.060	0.01087	0.061	0.00987
Silica	14.917	2.97349	14.667	3.83858	14.000	1.78885	13.333	2.44268	13.933	1.68127	13.000	2.36643
NO3	1.213	0.47878	1.080	0.51521	0.938	0.19374	1.090	0.33220	1.082	0.30109	0.916	0.42290
NO2	0.460	0.17833	0.488	0.19020	0.343	0.08687	0.456	0.14766	0.365	0.12708	0.437	0.15319
Na	23.667	4.76095	78.667	135.62989	28.000	5.32917	27.500	9.37550	28.000	11.08152	26.667	8.26236
K	9.342	3.15443	9.400	2.64197	10.667	1.63299	11.167	1.60208	10.750	4.23969	9.333	1.63299
SO4	14.500	5.08920	17.750	5.27551	21.167	2.13698	21.167	2.56255	18.500	5.68331	18.667	6.31401
B.O.D	2.440	0.53610	2.623	0.67592	20.000	2.36643	20.500	3.08221	28.333	6.50128	2.625	0.69264
C.O.D	2.342	0.29735	2.445	0.56846	7.667	2.33809	9.633	3.35956	15.000	6.13188	3.150	0.88713
O.M	2.342	0.35835	2.475	0.33928	6.400	1.52315	6.333	1.11295	16.667	5.31664	2.913	0.63013

Table2: Mean and standard deviation of different parameters at different sampling Stations

WQI Level	Water Quality Rating
0 - 25	Excellent
26 - 50	Good
51 - 75	Poor
76 - 100	Very Poor
> 100	Unfit for Drinking Purpose

Table 3:

In the present study water of river Bakulahi was found to be in excellent quality in winter season at all the six sampling sites as the WQI ranged from 22.80 to 30.32 for both the years. Water of River Bakulahi was found to be of poor quality in rainy season as WQI at all sampling stations ranges from 32.30 to 49.81. The WQI starts increasing from winter to summer and it further increases from summer to rainy season.

Conclusion

From present investigations we concluded that the quality of most of the water samples under study was suitable for drinking purpose except in rainy season. In rainy season WQI increases due to increased concentration of sodium and dissolved solids. Because of high concentration of sodium, there is potential Mean and Standard deviation of different parameters at different sampling Stations risk of getting cardiovascular diseases and in women toxemia associated with pregnancy. From WQI values, it is suggested that further improvement is required to treat the Bakulahi water at Pratapgarh.

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