

Analysis of Physico-Chemical and Biological Characteristics of River Ramganga at Bareilly

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Research Article

Received: 20/11/2018

Accepted: 18/12/2018

Published: 24/12/2018

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Keywords: River ramganga, Physico-chemical parameters, Natural liquid, Water samples

ABSTRACT

Water is a unique natural liquid which is quite essential for all kinds of life. Rivers are the best examples of fresh water. River Ramganga is a major tributary of Ganga River that flows to the south-west from Kumaun Himalayan. Domestic water, solid wastes, industrial and agricultural effluent from various areas is dumped into the river Ramganga through different drains. Water samples from five different sites of river Ramganga were collected and analyzed for physicochemical and biological parameters such as Temperature, transparency, pH, Total Solids, Total Dissolved Solids, Dissolved Oxygen, BOD, COD, Electrical Conductivity, turbidity, alkalinity, calcium, nitrate, and total biomass during the rainy season, to assess the quality of the river. The study revealed that as per physicochemical and biological parameters which exceed the permissible limits render the water of the river Ramganga to be unfit for drinking purposes and it is unhealthy for the aquatic life too.

INTRODUCTION

River Ramganga is the best example of a freshwater ecosystem originated from Doodhatoli ranges in the district of Pauri Garhwal, Uttarakhand and flows to the south-west from Kumaun Himalayan^[1]. It is a tributary of the River Ganga which originates from the high altitude zone of 800 m-900 m. Some cities Bijnor, Moradabad, Bareilly, Shahjahanpur, and Hardoi of Uttar Pradesh are situated on its bank. During the month of September and October, an annual festival of Ganga Dussehra is organized on its banks. Ramganga River has drainage basin of 30,641 km² (11,831 sqm)^[2,3]. River Ramganga along with its tributaries (Kho, Gangan, Aril, Kosi, and Deoha) are a very important river of the Uttarakhand and Uttar Pradesh. It has been a symbol of purity but on the day, it is becoming more polluted and is a complete disregard for its serenity^[4-6].

Today, all the nooks and corners of the world hear the crying of pollution. It has become a major challenge and threat to mankind's existence on earth. Rivers have been named as sacred and is making lifeline in India and other countries. India's old cultural heritage and symbol of civilization, the Ramganga River is an on a unique position in the ethics of the Indian people^[7-11]. The love of Indian people for this river is beyond bounds, limits, and reasons. River Ramganga, the lifeline of millions of people, provides water for the essential needs of life.

Ramganga river, a holy river, and a tributary of River Ganga are under tremendous pressure for the last few years. Most of its water in the upper part is converted into canals, untreated sewage and industrial pollution are put in many places in the river and pesticides and insecticides residues used in the fields are washed in it. Mostly in the rainy season, some of the most serious contributing factors are industrial wastes, a mixture of chemicals, heavy metals are discharged all over the water and it is difficult to clean them^[12]. This leads to deforestation resulting in silting, flooding and reduced navigation possibilities. River Ramganga is once valued for its purity, has become a site for environmental disasters in the last hundred years.

It is a fact that good water quality produces healthy humans from one of the qualities of poor water quality. River Ramganga is the lifeline of Bareilly and it is used for domestic and agricultural purposes, hence effective maintenance of water quality and necessary through proper measurements^[13]. The quality of water of physicochemical and biological characteristics can be described; hence, an analysis of the physical and chemical parameters of Ramganga river water was done by many persons.

MATERIAL AND METHODS

Study Area

River Ramganga (at Bareilly) is one of the main tributaries of the holy river Ganga. Several types of wastes mixed in river

Ramganga. Domestic and agricultural wastes of this city and villages (situated on its bank) are responsible for degrading survey and literature available; five different sites were selected for collecting the water sample [14,15]. These sites were selected on the basis of various activities occurring in the surrounding area of the river. Water samples were taken at the following points during the rainy season of year, 2017 and 2018:

Site 1: River Ramganga at Ajampur Balarau village

Site 2: River Ramganga at Ghura Raghavpur village

Site 3: River Ramganga at Sarai Talfi village

Site 4: River Ramganga at Uncha Gaon

Site 5: River Ramganga at Kundara village

Sampling Procedure

The water of river Ramganga was collected during the rainy season in 2017 and 2018. The table shows the average values of the physicochemical and biological parameters of river water. The surface water quality changes time to time and gets easily polluted. For this purpose, samples were collected from both years in the rainy season. Water samples were collected in clean 5-liter plastic bottles, labeled properly and brought to the laboratory for analysis.

Methods of Sampling

Water samples of river Ramganga were collected from about 40 cm to 50 cm depth from the water surface, to avoid the collection of surface impurities and analyzed for fourteen physicochemical and biological parameters followed by Standard Methods [16]. A separate sample was collected in BOD bottles for analysis of DO and fixed it at the sampling locations. The water temperature and transparency were measured at the sampling site using standard mercury thermometer and Secchi disk. Total biomass was measured by filtering 5 liters of river water in wet cloth on each site and weighting. The rest of the parameters were analyzed in the laboratory following Standard Methods [16].

Parameters

The analysis was carried out for fourteen water quality parameters such as Temperature, transparency, pH, Total Solids, Total Dissolved Solids, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Electrical Conductivity, Turbidity, Alkalinity, Calcium, Nitrate, Total Biomass [17].

RESULT AND DISCUSSION

In the current study, an analysis of physicochemical and biological characteristics of the water of river Ramganga is based on physical characteristics like pH, temperature, transparency, turbidity, conductivity, total solids and TDS in conjunction with chemical characteristics such as dissolved oxygen, BOD, COD, alkalinity, calcium and nitrate, the quality of water has been assessed and the result of these various physicochemical and biological parameters are presented in **Table 1** of both year 2017 and 2018 at rainy season.

Table 1. Physico-chemical and biological parameters.

S. No	Temperature		Transparency		pH	
	2017	2018	2017	2018	2017	2018
Site A	29.25	29.45	8	5.75	7.575	7.75
Site B	29.2	28.75	7	4.8	7.645	7.33
Site C	29.15	29.25	5.75	4.55	7.335	8.135
Site D	29.35	29.95	5.5	5.35	7.015	8.095
Site E	29.5	29.45	5.75	5.3	7.13	7.305
	Total solids		Total Dissolved Solids		Dissolved Oxygen	
	2017	2018	2017	2018	2017	2018
Site A	545	530	535	510	3.955	4
Site B	620	782	570	730	3.735	3.85
Site C	690	400	620	389	2.925	3.6
Site D	690	335	650	328	3.735	3.65
Site E	565	635	580	625	3.445	3.7
	B. O. D.		C. O. D.		Electrical Conductivity	
	2017	2018	2017	2018	2017	2018
Site A	18.5	19.35	42.55	42.05	380	405
Site B	13.8	15.05	39.8	40.4	414	457.5
Site C	25.2	26.6	67.15	67.8	420	412.5
Site D	21.7	22.85	51.55	51.45	409.5	426

Site E	19.15	20.3	43.35	43.8	407.5	414.5
	Turbidity		Alkalinity		Calcium	
	2017	2018	2017	2018	2017	2018
Site A	360	363.5	312.5	260.5	104.2	27.124
Site B	330	350.5	305	190	96.19	11.598
Site C	330	363.5	345	342.5	80.16	14.81
Site D	345	355	357	287.5	76.15	17.264
Site E	330	392	307.5	276	62.12	16.542
	Nitrate		Total Biomass			
	2017	2018	2017		2018	
Site A	0.97	0.855	12.5		14	
Site B	0.915	1.015	10.5		12.5	
Site C	1.21	1.36	23		21.5	
Site D	1.065	1.12	13.5		17.5	
Site E	1.005	0.945	11.5		16	

Many environmental conditions may affect the temperature of the water. These elements increase the sunlight or solar radiation, heat transfer from the atmosphere, stream confluence and turbidity. Compared with deep water, shallow and surface water are more easily affected by these factors. The higher value of temperature indicates that the river water quality would be contain affected by these parameters.

Nutrients and sediments pollutants are the main causes of poor water clarity. When additional nutrients run in nearby waterways, they can promote the development of water clouding algae. Similarly, when the soil is washed into the rivers, streams and the bay, the sediment particles can be suspended in water. Based on the weather conditions, water clarity naturally fluctuates. Storms wash dirt and pollutants into the river water, which can be muddy the water. Because of this, the water becomes clear during the drying conditions.

pH is a term that is universally used to express the intensity of the acid or alkaline state of a solution. The observed value of pH ranging from 7.015 to 8.135 in the rainy season of both the year 2017 and 2018. These value ranges indicate that water samples were slightly alkaline. Changes in pH can be an indicator of an industrial pollutant, photosynthesis or algae respiration which is feeding on the pollutants.

Total solids determined in this study range from 335 mg/l to 782 mg/l in the rainy season of both the year 2017 and 2018. Total solids analysis has a great effect on the control of biological and physical wastewater treatment processes. The largest amount of total solid substances combines in the highest turbidity and electrical conductivity.

Total dissolved solids indicate the salinity behavior of the river's water. TDS content of the river water was range from 328 mg/l to 730 mg/l in the rainy season of both year 2017 and 2018. Higher TDS in the water system increases the demand for chemical and oxygen and ultimately reduces the dissolved oxygen level in the water.

Dissolved oxygen varied from 2.925 mg/l to 4.000 mg/l in the rainy season of both year 2017 and 2018. Dissolved oxygen appearance to be caused by its biggest solubility, reduces the microbial decomposition of low organic matter and low organism at low temperatures reduces respiratory demand and increases the progressive growth of immersed macrophytes. The quantity of DO determines whether the process running in water is aerobic and anaerobic.

Biological oxygen demand is an important parameter and it is widely used to determine the pollution load of water bodies. BOD values were ranged from 13.8 mg/l to 26.6 mg/l in the rainy season of both year 2017 and 2018. These values of BOD were due to the high rate of decomposition of organic matter on the high temperature, turbidity, and low water current.

Chemical oxygen demand is a test that is used to measure and quantify valuable information about industrial effluents and domestic sewage pollution. In the present study, the values of COD were varied from 39.8 mg/l to 51.55 mg/l in the rainy season of both year 2017 and 2018. Highest values of COD indicated that most of the pollution in the study zone in the Ramganga river is caused by domestic sewage discharge by nearby villages and Bareilly city.

Electrical conductivity in natural waters is the generalized solution of the water's ability to flow electricity. Electrical conductivity values varied from 380 µmoh/cm to 457.5 µmoh/cm in the rainy season of both year 2017 and 2018. High E.C. indicates a large number of dissolved mineral salts, making it sour and inappropriate for drinking.

Turbidity is that such material in water which affects the transparency or light scattering of the water due to the presence of particulate matter such as lay or slit, finely divided organic matter, planktons, and other microscopic organisms. The range of turbidity was from 330 NTU to 392 NTU in the rainy season of both year 2017 and 2018.

Water's alkalinity is the ability to inactivate strong acids, which mainly give carbonate, bicarbonate and hydroxide content and is formed due to the dissolution of CO₂ in water. The alkalinity of the samples is in the value range from 190 mg/l to 357 mg/l in the rainy season of both year 2017 and 2018. Higher alkalinity levels in surface water will buffer acid rain and other acid waste and will prevent pH changes which are harmful to aquatic life.

Calcium is an important determinant of water hardness and gives a better taste to water. It also acts as a pH stabilizer due to its buffering properties. Calcium of water samples was in the value range from 11.598 mg/l to 104.2 mg/l in the rainy season of both year 2017 and 2018. Water containing low calcium levels is usually oligotrophic and can support sparse plants animal life. High calcium levels are typical of eutrophic water.

The presence of normal levels of nitrate unlike temperature and DO usually does not have a direct effect on aquatic life. However, extra levels of nitrate in water can lead to conditions that survive for aquatic living. The observed nitrate was ranging from 0.855 mg/l to 1.36 mg/l in the rainy season of both year 2017 and 2018.

In an ecosystem, biomass contains the mass of all living and dead organic substances. There is an incremental increase in biomass produced by organisms during production time. Estimates of biomass and production are a measure that can be used to assess the health of the aquatic ecosystem. High biomass is not necessarily high production and vice versa.

CONCLUSION

Analysis of physicochemical and biological standards clearly indicated that some monitoring sites from the Ramganga river are known as the continuously polluting zone. The source of pollution can be direct discharge through drainage outlet, untreated pollution discharge, agricultural runoff, domestic activities etc. The heavy load of pollution accumulated in the river as a result of the heavy discharge. As a result, it was indicated that at present the aquatic system of the river is being treated but is not biologically dead. Increasing pollution causes the elimination of aquatic fauna. In such stressed situations, the reduction of oxygen content through carbon dioxide causes an increase in organic matters. The conditions recorded were not suitable for aquatic life. To maintain the balance of the natural ecosystem with the diversity of flora and fauna and it is time to face the problem of pollution by taking necessary action and careful measures for continuous water quality of River Ramganga.

ACKNOWLEDGMENT

The author is very thankful to Head, Department of Zoology, Dr. Asheesh Gaur, I.F.T.M. University, Moradabad for laboratory work and other facilities and supports.

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