

Assessment of water quality of River Ganga at Haridwar with reference to Water Quality Index

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Abstract

The holy River Ganga at Haridwar is largely affected by that effluent from varius industries and untreated sewage disposed from insufficient sewage treatment plants. Along with that the pilgrims that take holy dip in the pious river throughout the year, all these situations worsens the condition a lot. The quality and quantity of surface water in a river basin is influenced by natural factors such as rainfall, temperature and weathering of rocks and anthropogenic changes that curtail natural flow of the river, or alter its hydrochemistry. A study related to water quality indexing of River Ganga was conducted for four months, and four sampling stations were selected for physico-chemical parameters. WQI of the River during the study period was 46.03 which fall in the good water quality. DO values ranged from 10.32 - 13.24 mg/l, BOD values were 1.08 – 3.66 mg/L, COD ranged from 5.50 – 11.50 mg/L. Other physico-chemical parameters were observed well in the range.

Keywords: River Ganga, Dissolved Oxygen, Water Quality Index, Physico-chemical parameters

Introduction

Although statistics, the WHO reports that approximately 36% of urban and 65% of rural Indian were without access to safe drinking water. Fresh water is one of the most important resources crucial for the survival of all the living beings. It is even more important for the human being as they depend upon it for food production, industrial and waste disposal, as well as cultural requirement. In total, there is 1400 million billion liters of water, but most of this water is not used for drinking purpose, because 97% is sea water and only 3% is fresh water, out of which 2% is lidged in the polar ice caps and glaciers, only 1% water is available for portable use; whereas more water goes for irrigation than to drinking sanitation and all other uses (WHO, 2004). Rivers are of immense importance geologically, biologically, historically and culturally. Although they contain only about and nutrients to areas all around the earth. They are

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Water plays an essential role in human life. 0.0001% of the total amount of water in the world at any given time, rivers is vital carriers of water critical components of the hydrological cycle, acting as drainage channels for surface water - the world's rivers drain nearly 75% of the earth's land surface. Various factors like temperature, turbidity, nutrients, hardness, alkalinity and dissolved oxygen play an important role for the growth of plants and animals in water body, on the other hand biological oxygen demand indicate the pollution level of the water body (Kamal et al., 2007; Ruhela et al., 2017). It is estimated that community waste from human activities accounts for four times as much wastewater as industrial effluents, most of which is discharged untreated/partially treated into the water courses in India (Sahu, 2005). They are prime factors controlling the global water cycle and in the hydrologic cycle, they are the most dynamic agents of transport. The quality and quantity of surface water in a river basin is influenced by natural factors such as rainfall, temperature and anthropogenic changes that curtail natural flow of the river, or alter its hydrochemistry (US EPA, 2009) Study area: Uttarakhand is a state located in the northern part of India. It extends from 28° 43' N to 31° 27' N longitude and 77° 34' east to 81° 02' E



latitude. Haridwar district, covering an area of Total dissolved solid (mg/l): minimum 350 mg/l in about 2360 km², is in the southwestern part of Uttarakhand state of India. Its latitude and longitude are 29.96 degree north and 78.16 degree east respectively.

Sampling Sites

For the analytical work of physico-chemical parameter of the river Ganga the sampling network was designed to cover a wide range of determinants characteristics at selected sites. Four sampling sites were selected in the river Ganga.

Sampling sites 1: Parmarth Niketan (Rishikesh): This site is situated near the parmarth niketan ashram, Rishikesh

Sampling sites 2: Har ki pauri: This site is situated on right side of the platform of clock tower of Har ki Pauri.

Sampling sites 3: Prem Nagar Ashram Ghat: This site is situated behind the Prem Nagar Ashram. Sampling sites 4: Jatwara Bridge: This site is situated on left side of the Jatwara Pul.

Material and Methods

Analysis of water samples were done according to standard methods as prescribed in APHA (2017), and Khanna and Bhutiani (2007). Samples were collected at 7 a.m to 10 a.m and were bottled in jerry cans and immediately transferred to laboratory for the analysis. Water Quality Index (WQI) was calculated by using the Weighted Arithmetic Index method as described by (Cude, 2001, Brown et al., 1970). In this model, different water quality components are multiplied by a weighting factor and are then aggregated using simple arithmetic mean.

Results & Discussion

Site wise observations for various Physicochemical parameters are given in fig(1.1 to 1.12).

Sampling site I

Water temperature (°C): minimum of 10.98 °C in the February and maximum of 13.73 ^oC in the month of April and average value was found $12.47^{\circ}C \pm 1.1.$

Total solids (mg/l): minimum 600 mg/l in the month of March and maximum of 920 mg/l in the month of April and average value was found 774 mg/l ±104.90.

the month of March and maximum of 600 mg/l in the month of February and average value was found 469.5 mg/l± 94.71.

Total suspended solid (mg/l): minimum 200 mg/l in the month of February and maximum of 445 mg/l in the month of April and average value was found $304.5 \text{mg/l} \pm 85.52$.

pH: minimum 7.3 in the month of April and maximum of 7.5 in the month of February and average value was found 7.44 \pm 0.07.

Dissolved Oxygen: Minimum 8.98 mg/l in the month of April and maximum of 10.85 mg/l in the month of February and average value was found 9.84mg/l ± 0.63 .

Biochemical Oxygen Demand (BOD) minimum 1.33 mg/l in the month of February and maximum of 3.66 in the month of March and average value was found 2.44 mg/l \pm 0.91.

Chemical Oxygen Demand (COD): minimum 7.50 mg/l in the month of April and maximum of 11.50 mg/l in month and average value was found $8.74 \text{ mg/l} \pm 1.12.$

Free CO2: minimum 7.7 mg/l in the month of February and maximum of 17.6 mg/l in the month of April and average value was found 12.1 mg/l \pm 3.36.

Alkalinity: minimum 50 mg/l in the month of April and maximum of 80 mg/l in the month of February and average value was found 56.5 mg/l \pm 11.56.

Acidity: minimum 22.50 mg/l in the month of February and maximum of 115 mg/l in the month of April and average value was found 63 mg/l \pm 34.50.

Chloride: minimum 10.65 mg/l in the month of March and maximum of 15.62 in the month of April and average value was found 14.41 mg/l \pm 1.80.

Total Hardness: minimum 201.0 mg/l in the month of April and maximum of 292.0mg/l in the month of March and average value was found 257.0 $mg/l \pm 32.8.$

Calcium: minimum 56.11 mg/l in the month of April and maximum of 76.15 mg/l in the month of March and average value was found 67.13 mg/l \pm 6.43.

Magnesium: minimum 35.53 mg/l in the month of April and maximum of 53.15 mg/l in the month of February and average value was found 46.14 mg/l + 6.93.



Sampling site II

Water temperature (°C): minimum of 10.86 °C in the month of February and maximum of 13.86 °C in the month of April and average value was found $12.76^{\circ}C \pm 1.2$.

Total solids (mg/l): minimum 420 mg/l in the month of March and maximum of 950 mg/l in the month of April and average value was found 758.5 mg/l± 160.94.

Total dissolved solid (mg/l): minimum 200 mg/l in the month of March and maximum of 690 mg/l in the month of February and average value was found 469 mg/l ±143.47.

Total suspended solid (mg/l): minimum 200 mg/l in the month of February and maximum of 450 mg/l in the month of April and average value was found $289.50 \text{ mg/l} \pm 82.27$.

pH: minimum 7.1 in the month of March and maximum of 7.4 in the month of February and average value was found 7.26 ± 0.08 .

Dissolved Oxygen: minimum 9.82 mg/l in the month of April and maximum of 10.6 mg/l in the month of March and average value was found 10.14 mg/l ± 0.21 .

Biochemical Oxygen Demand (BOD): minimum 1.08 mg/l in the month of April and maximum of 2.63 mg/l in the month of March and average value was found 1.60 mg/l \pm 0.47.

Chemical Oxygen Demand (COD): minimum 8.20 mg/l in the month of April and maximum of 10.50 in month of February and average value was found $8.84 \text{ mg/l} \pm 0.75$.

Free CO2: minimum 6.6 mg/l in the month of February and maximum of 18.7 mg/l in the month of April and average value was found $12.32 \text{ mg/l} \pm 4.2$.

Alkalinity: minimum 35 mg/l in the month of March and maximum of 60 mg/l in the month of February and average value was found $48.5 \text{ mg/l} \pm 10.01$.

Acidity minimum 25 mg/l in the month of February and maximum of 100 mg/l in the month of March and average value was found $58.25 \text{ mg/l} \pm 23.86$.

Chloride: minimum of 19.80 mg/l in the month of February and maximum of 12.78 mg/l in the month of April and average value was found 15.26 mg/l \pm 2.33.

Total Hardness: minimum of 195 mg/l in the February and average value was found 49.0 mg/l \pm month of April and maximum of 380 mg/l in the 6.15.

month of February and average the value was found $290.2 \text{ mg/l} \pm 63.36$.

Calcium: minimum of 60.12 mg/l in the month of April and maximum of 90.18 in the month of March and average value was found 71.33 mg/l \pm 11.06.

Magnesium: minimum of 31.93 mg/l in the month of April and maximum of 73.16 mg/l in the month of 73.16 mg/l and average value was found 53.45 mg/l \pm 13.84.

Sampling site III

Water temperature (°C): minimum of 10.8° C in the month of February and maximum of 13.9° C in the month of March and average value was found 12.82° C ± 1.26

Total solids (mg/l): minimum 600 mg/l in the month of March and maximum of 1000 mg/l in the month of February and average value was found 829mg/l \pm 118.27.

Total dissolved solid (mg/l): minimum 400 mg/l in the month of March and April and maximum of 650 mg/l in the month of February and the average value was found $492.5 \text{ mg/l} \pm 104.12$.

Total suspended solid (mg/l): minimum 200 mg/l in the month of February and maximum of 475 mg/l in the month of April and the average value was found $336.5 \text{ mg/l} \pm 96.31$.

pH: minimum 7.1 in the month of March and maximum of 7.7 in the month of February and average value was found 7.36 ± 0.21 .

Dissolved Oxygen: minimum 9.2 mg/l in the month of April and maximum of 10.07 mg/l in the month of February and average value was found 9.69 mg/l \pm 0.26.

Biochemical Oxygen Demand (BOD): minimum 1.40 mg/l in the month of February and maximum of 2.45 in the month of March and average value was found $1.90 \text{ mg/l} \pm 0.30$.

Chemical Oxygen Demand (COD): minimum 5.50 mg/l in the month of February and maximum of 9.20 mg/l in the month of April and average value was found 8.0 mg/l \pm 1.26.

Free CO₂: minimum 7.7 mg/l in the month of April and maximum of 19.8 mg/l in the month of March and average value was found $14.85 \text{ mg/l} \pm 4.70$.

Alkalinity: minimum 40 mg/l in the month of March and maximum of 60 mg/l in the month of February and average value was found 49.0 mg/l \pm 6.15.



Acidity: minimum 22.5 mg/l in the month of Chemical Oxygen Demand (COD): minimum February and maximum of 115 mg/l in the month of April and average value was found 61.25 mg/l \pm 31.16.

Chloride: minimum of 12.78 mg/l in the month of March and maximum of 19.90 mg/l in the month of February and average value was found 15.6mg/l + of March and average value was found 15.62 mg/l 2.21.

Total Hardness: minimum 228 mg/l in the month of April and maximum of 361 mg/l in the month of March and average value was found 293.8 mg/l \pm 40.16.

Calcium: minimum of 60.12 mg/l in the month of February and maximum of 84.16 mg/l in the month of March and average value was found 73.95 mg/l +7.10.

Magnesium: minimum of 37.04 mg/l in the month of April and maximum of 69.01 mg/l in the month of March and average value was found 53.64 mg/l <u>+</u> 9.55.

Sampling site IV

Water temperature (°C): minimum of 10.92 °C in the month of February and maximum of 13.5°C in the month of April and average value was found $12.59 \,{}^{0}\text{C} \pm 0.94$

Total solids (mg/l): minimum 400 mg/l in the month of February and maximum of 850 mg/l in the month of April and average value was found 693 mg/l ± 185.12.

Total dissolved solid (mg/l): minimum 200 mg/l in the month of February and maximum of 525 mg/l in the month of April and average value was found 382 mg/l ± 119.22.

Total suspended solid (mg/l): minimum of 200 mg/l in the month of March and February and maximum of 400 mg/l in the month of April and the average value was found $311 \text{mg/l} \pm 73.29$.

pH: minimum 7.1 in the month of February and March and maximum of 7.5 in the month of April and average value was found 7.24 ± 0.15 .

Dissolved Oxygen: minimum 9.53 mg/l in the month of April and maximum of 10.4 mg/l in the month of Febraury and average value was found $9.73 \text{ mg/l} \pm 0.35.$

Biochemical Oxygen Demand (BOD): minimum 1.08 mg/l in the month of April and maximum of 2.91 mg/l in the month of February and average value was found $1.92 \text{ mg/l} \pm 0.64$.

8.30 mg/l in the month of April and maximum of 11.0 mg/l in the month of February and average value was found 9.18 mg/l \pm 0.94.

Free CO₂: minimum 9.9 mg/l in the month of February and maximum of 23.10 mg/l in the month ± 4.17.

Alkalinity: minimum 30 mg/l in the month of March and maximum of 65 mg/l in the month of April and average value was found 48.7 mg/l ± 11.22.

Acidity: minimum 27.5 mg/l in the month of February and maximum of 102.5 mg/l in the month of March and average value was found 58.5 mg/l \pm 22.71.

Chloride: minimum 11.36 mg/l in the month of April and maximum of 22.01 mg/l in the month of February and average value was found $15.90 \text{ mg/l} \pm$ 3.42.

Total Hardness: minimum 216 mg/l in the month of April and maximum of 339 mg/l in the month of March and average value was found 290.3 mg/l \pm 42.01.

Calcium: minimum of 70.14 mg/l in the month of February and April and maximum of 82.16 mg/l in the month of March and average value was found $75.15 \text{ mg/l} \pm 4.04.$

Magnesium: minimum 35.10 mg/l in the month of April and maximum of 63.15 mg/l in the month of February and average value was found 52.44 mg/l \pm 9.68.

Water Quality Index (WQI)

In current study, Water Quality Index (WQI) was calculated by using the Weighted Arithmetic Index method as described by (Cude, 2001, Brown et al., 1970). In this model, different water quality components are multiplied by a weighting factor and are then aggregated using simple arithmetic mean. For assessing the quality of water in this study, firstly, the quality rating scale (Qi) for each parameter was calculated by using the following equation;

Qn = 100[Vn - Vi] / [Sn - Vi]Where:

qn=Quality rating for the nth water quality parameter,

Vn=Estimated value of the nth water quality parameters of collected sample,















Fig. 1.3: Showing variation in physical parameter at Site III







Fig 1.5.: Showing variation in Chemical Parameter at Sampling Site I contd.



Fig 1.6.: Showing variation in Chemical Parameter at Sampling Site I



Fig 1.7.: Showing variation in Chemical Parameter at Sampling Site II contd.





Assessment of water quality of River Ganga at Haridwar with reference to Water Quality Index

Fig 1.9.: Showing variation in Chemical Parameter at Sampling Site III contd.



Fig 1.10.: Showing variation in Chemical Parameter at Sampling Site III



Fig 1.11.: Showing variation in Chemical Parameter at Sampling Site IV contd.



Sn=Standard permissible value of the nth water Water temperature plays an important factor which influences the chemical, bio-chemical

Vi0=Ideal value of the nth water quality parameter in pure water. (i.e. 0 for all other parameters except the parameter pH and Dissolved oxygen (7 and 14.6 mg/L respectively.) (Let there be n water quality parameters and quality rating or sub index (qn) corresponding to nth parameter is a number reflecting the relative of this parameter in polluted water with respect to its standard permissible value.) Unit weight was calculated by a value inversely proportional to the recommended standard value Sn of the corresponding parameter.

 $WQI = \Sigma qnWn / \Sigma Wn$

Where:

Wn=Unit weight for nth water quality parameter, Sn=Standard permissible value of the nth water quality parameter,

K=Constant for proportionality.

The overall WQI was calculated by aggregating the quality rating with the unit weight linearly.

WQI of the River during the study period was 46.03 which fall in the good water quality.

Table 1. Water Quality Index (WQI) and its status

Water quality Index	Water Quality Status
0-25	Excellent water quality
26-50	Good water quality
51-75	Poor water quality
76-100	Very poor water quality
>100	Unsuitable for drinking

Discussion

The index result represents the level of water quality in a given water basin, such as lake, river or stream. A number of workers all over the world developed WQI based on rating of different water quality parameters. For the evaluation of water quality, WQI was applied to the river water (Abbasi *et al.*, 2012, Ahmad *et al.*, 2012, Alam, 2010, Chauhhan and Singh, 2010, Balan *et al.*, 2012, Chowdhury *et al.*, 2012, Tyagi *et al.*, 2013, Lumb *et al.*, 2006). During the study period WQI of the River indicated good water quality.

Water temperature plays an important factor which influences the chemical, bio-chemical characteristics of water body. In the present study an average fluctuation of water temperature was observed 18.10° C ± 0.08 (minimum) at 04-Feb-2018 and 22.65°C ± 0.51 (maximum) at 02-April-2018. Total average value of temperature was recorded 20.93° C ± 1.88 . A more or less tend has been observed in the Mothronwala swamp, by Gupta (2008).

Total solids were recorded average at $763.63 \text{ mg/l} \pm 113.8$. Minimum average value of total solids were observed on 04-March-2018 (517.50 mg/l \pm 96.05) and maximum at 26-Feb-2018 (897 mg/l \pm 70.89).

Total solid is term applied to all matter except the water contained in liquid materials. Total solids cause ecological imbalance in the aquatic ecosystem by mechanical abrasive action. Same trends were also reported by Yadav and Srivastava (2011). Fouzia *et al.*, (2012) and Bhutiani *et al.*, (2017) were observed similar trend in Tons river.

The total average value of total dissolved solids $453.25 \text{ mg/l} \pm 91.36$. The total dissolved solids recorded to be minimum at 04-March-2018 (292.5mg/l \pm 97.77) and maximum was recorded at 26-Feb-2018(622.5mg/l \pm 83.82). Bera *et al.* (2012); Bhutiani *et al.*, (2018) were observed similar trends at Brahmani River Water. A more or less same trend was observed by Khanna *et al.*, 2014; Bhutiani *et al.*, 2017 and Bhutiani *et al.*, 2018.

pH affects the dissolved oxygen level in the water, photosynthesis of aquatic plants, metabolic rates of aquatic organisms. Most rivers have a neutral to slightly basic pH of 6.5 to 8.5. The monthly average value of pH was observed 7.33 ± 0.06 . The pH was recorded to be minimum at 17-March-2018 (7.25 ± 0.13) and maximum was recorded at 26-Feb-2018 (7.38 \pm 0.24). Gupta et.al (2008) observed pH in Mothronwala swamp, and found more or less similar trends in their study. Same trend were also reported by Dhaka and Minakshi (2011). DO values indicate the degree of pollution in water bodies. Dissolved oxygen was quite high and showed wide fluctuation. Maximum dissolved oxygen was recorded at 26-Feb-2018 (11.14mg/l± 0.39) and the minimum value of dissolved oxygen was observed at 20-Feb-2018 (9.30mg/l± 0.61). The total average value of dissolved oxygen was observed 10.22 ± 0.76 . This trend was also observed by Fouzia and Amir (2012) in the river Tons. Same



trend is also reported by Khanna *et al.*, (2003) and Bhutiani *et al.*, (2016) in the Ganga river system in foothills, of Garhwal Himalaya. Sayeswara *et al.*, (2011) also observed similar trend on Sominkoppa pond at Shivamagga, Karnataka. Kumar *et al.* (2010) was observed identical result in Beas river. Imnatoshi *et al.* (2012) observed DO in Doyang river at Nagaland and found more or less similar trends in their study.

BOD or biochemical oxygen demand represents the amount of oxygen that microbes need to stabilize biologically oxidizable matter. In the present study, maximum BOD was recorded at 11-March-2018 ($2.62\text{mg/l} \pm 0.91$) and the minimum value of BOD was recorded at 02-April-2018 ($1.64\text{mg/l} \pm 0.24$). The total average value of BOD was observed 1.96mg/l \pm 0.76. Same trends were of BOD have shown by Karla *et al.* (2012) in ground water taken from five blocks. Khanna *et al.* (2014), Bhutiani *et al.* (2017) was also observed same trend in limnological parameters.

COD determine the amount of organic pollutants found in surface water, making COD a useful measure of water quality. It is expressed in milligrams per liter (mg/l), which indicates the mass of oxygen consumed per liter of solution. The total average value of COD were noted 8.69 mg/l± 0.72 whereas, minimum average value was found at 20-Feb-2018 (7.94 mg/l± 1.33) and maximum at 12-Feb-2018(10.30 mg/l± 1.03). Total average value of free Carbon dioxide was recorded 13.72 $mg/l \pm 3.37$. The minimum average value was found at 04-Feb-2018(8.25 mg/l ± 1.42) and maximum average value was found at 04-March- $2018(18.7 \text{ mg/l} \pm 4.67)$. Alkalinity of water is a measure of weak acid present in it and of the cations balanced against them. Alkalinity may also increase due to decomposition of organic matter that has settled at the bottom.

Total Alkalinity in water is due to salts of weak acids and bicarbonates of highly alkaline water. Alkalinity values of 20-200 ppm are common in freshwater ecosystems. Total average value of alkalinity was recorded as $50.68 \text{ mg/l} \pm 7.83$. The maximum average value of alkalinity was at 20-Feb-2018 (63.75 mg/l± 11.09) and the minimum was at 02-March-2018(40 mg/l± 4.08).Same trend is also reported by Khanna *et al.* (2012) in the Ganga river system in foothills, of Garhwal

Himalaya. The total average value of acidity was recorded 60.25 mg/l \pm 26.14; whereas maximum average value was recorded at 15-April-

2018(93.75 mg/l \pm 17.02).and the minimum average value was at 12-Feb-2018 (26.25 mg/l \pm 4.33). Same trend was found by Khanna and Bhutiani (2003).

Chlorides occur naturally in all types of water. High concentration of chloride is considered to be the indicators of pollution due to organic wastes of animal or industrial origin. Chlorides are troublesome in irrigation water and also harmful to aquatic life (Khan et al., 2012). Total average value of Chloride was recorded 15.28 mg/l \pm 1.96, whereas maximum average value was recorded at 20-Feb-2018(18.98 mg/l \pm 3.34) and the minimum average value was at 04-March-2018(12.96 mg/l± 1.78). Muhammad Naeem et al. (2011), Bhutiani & Ahamad (2018) also observed same trend. Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. The Hardness is a very important parameter in decreasing the toxic effect of poisonous element. Total average value of Total hardness was noted $282.7 \text{ mg/l} \pm 42.06$ and the maximum average value of Hardness was at 04-March-2018(336.25 $mg/l \pm 30.87$) whereas, minimum average value was at 09-April-2018(210 mg/l± 14.90) Fouzia and Amir (2012) observed Hardness in river Tons at Dehradun and found more or less similar trends in their study. Venkatesharaju et al., (2010); Malik and Kumar (2010) was also observed similar trend in ground water.

The total average value of Calcium was observed as 71.89 mg/l \pm 6.17 and the maximum average value of Calcium was at 11-March-2018(82.66 mg/l \pm 5.98) whereas, minimum average value was at 04-Feb-2018(64.13 mg/l \pm 4.33) Similar observation were also obtained by Srivastava *et al.*(2011) in river Ramganga. The considerable amount of magnesium influence water quality The total average value of Magnesium was observed as 51.42 mg/l \pm 9.46 and the maximum average value of Magnesium was at 26-Feb-2018(63.28 mg/l \pm 8.23) whereas, minimum average value was at 09-April-2018(34.9 mg/l \pm 2.15).



Ruhela *et al*.

SITES	Temperature °C	Total Solid(TS) (mg/l)	Total Dissolved Solid(TDS) (mg/l)	Total Suspended Solid(TSS) (mg/l)	рН
Site I	12.47	779.55	472.27	306.36	7.43
Site II	12.76	762.27	474.55	287.73	7.26
Site III	12.82	818.64	488.64	325.45	7.36
Site IV	12.59	700.45	387.27	311.36	7.23
Average	12.66	765.23	455.68	307.73	7.32
± SD	0.16	49.20	46.18	15.59	0.09

Fable 2 Monthly average value	s for Physico-Chemical	Parameter at Sampling Sites contd.
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 Table 2. Monthly average values for Physico-Chemical Parameter at Sampling Sites

SITES	DO	BOD	COD	Free CO2	Alkalinity	Acidity	Cl	Total Hardness	Ca	Mg
Site I	9.59	2.64	8.79	12.38	55.50	64.49	14.56	253.00	67.13	45.16
Site II	10.14	1.60	8.80	11.99	47.82	57.23	15.03	287.64	70.86	52.96
Site III	9.69	1.92	7.99	14.95	48.70	55.25	15.19	297.40	74.34	54.68
Site IV	8.27	1.92	9.20	15.61	47.55	58.18	15.55	290.73	75.06	52.69
Avg.	9.42	2.02	8.69	13.73	49.89	58.79	15.08	282.19	71.85	51.37
± SD	0.80	0.44	0.51	1.81	3.77	3.99	0.41	19.88	3.64	4.23

Table 3. Calculation of WQI

Parameters	Observed value	Standard Value (Sn)	Ideal value (Vi)	unit wt(wn) =k/Sn	qn (Qlty rating)	Wn*Qn
TS(mg/l)	764	2100	0	0.00	36.38	0.02
TDS(mg/l)	453.25	500	0	0.00	90.65	0.18
TSS (mg/l)	309.11	100	0	0.01	309.11	3.13
рН	7.12	7.5	7	0.14	24.00	3.24
DO	12.2	6	14.6	0.17	27.91	4.72
BOD	1.97	5	0	0.20	39.40	7.99
COD	8.7	250	0	0.00	3.48	0.01
Alkalinity	50.68	200	0	0.01	25.34	0.13
Chloride	15.29	250	0	0.00	6.12	0.02
Total Hardness	282.83	300	0	0.00	94.28	0.32
Ca Hardness	71.9	75	0	0.01	95.87	1.30
Mg Hardness	51.42	30	0	0.03	171.40	5.79
				Σ Wn =0.58	$\Sigma Qn = 923.93$	Σ Wn*Qn = 26.86
						WQI = 46.03



Conclusion

The basic aim of WQI is to give a single value to the water quality of a source on the basis of one or the other system which translates the list of constituents and their concentrations present in a sample in to a single value. The index result represents the level of water quality in a given water basin, such as lake, river or stream. During the study period the water quality status of the river was found good, however steps for the cleanliness and implementation of various laws related to River Ganga must be monitored regularly.

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