

RESEARCH ARTICLE

Ecological evaluation of water of Sabarmati, Ahmedabad

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ABSTRACT..... Sabarmati is one of the major rivers in Gujarat. It raises from the Aravalli hills and it covers a distance of 300 km. in the state and finally joins southwards to the gulf of Khambhat. This river can be considered as lifeline of this area, which fulfills the need of hundreds of villages, situated along the banks of the river. Due to anthropogenic activities, rapid industrial growth, domestic and agricultural activities of the region, the river water is being polluted, which is the case with almost all major rivers of the country. A year long study was conducted to measure the various physico-chemical and bacteriological parameters including levels of phytoplankton in the river water. The study revealed that there was indication of pollution in the river and hence preventive measures are required to avoid further deterioration of the river water quality.

KEY WORDS..... Physico-chemical, Phytoplankton, Sabarmati river

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INTRODUCTION.....

Unplanned urban development has posed gigantic problems of environmental pollution. Due to this water of natural bodies are getting polluted at an alarming rate. The physico-chemical characteristics of water have direct impact on prevailing organism as well as on human being using such water (Barua *et al.*, 1984; Chona, 1991). Due to over expanding population and industrial settlements, the demand of fresh water is increasing day by day. In India 80 per cent of the surface water is vulnerable to pollution as more than 95 per cent of the sewage in the country is not treated (Manjappa *et al.*, 2008). Lotic water bodies like rivers and streams play a very important role in maintaining the biodiversity and overall ecological balance in nature. The increase of pollution is caused by population growth and increasing urbanisation. Related to this is the industrialisation that also is causing huge environmental problem (Nirmal, 1997; Jain *et al.*, 1998). A river with its tributaries forms a unique aquatic ecosystem which covers different types of climatic zones, landscapes and bio geographic regions. It is the natural drainage system of the earth which moves continually.

Sabarmati is a perennial river; it raises from the Aravalli

hills and covers about 300 km. River is running from city of Ahmedabad and to check the influence of human habitation on water quality particular stretch of river was selected for study. Ahmedabad is located 23.03°N 72.58°E, covering an area of 205 sq. km. at an average altitude of 53 m above mean sea level (AMSL). The present study is an attempt to characterise the water quality of Sabarmati river with respect to pH, Total dissolved solids (TDS), Total hardness, Calcium hardness, Magnesium hardness, Chloride, Electrical conductivity (EC), Alkalinity, Dissolved oxygen (DO), Biological oxygen demand (BOD).

RESEARCH METHODS.....

The sampling was done at four sites as :

Station (S₁) :

The site of this habitat are located at the upstream where before the Sabarmati river enters in to Ahmedabad city.

Station (S₂) :

This station is located on the main stream of river

Sabarmati in a place just near the confluence point of Narmada canal and sewage water which is at the distance of 3 km from S₁.

Station (S₃):

This is located down stream of industrial effluent discharge, at the distance of 4 km from station S₂.

Station (S₄):

This sampling station is located about 2 km away from S₃.

Collected water samples were brought to the laboratory and samples were analyzed for physico-chemical characteristics and bacteriological study. MPN index were determined by methods given in APHA (1995).

RESEARCH FINDINGS AND ANALYSIS.....

The findings of the present study as well as relevant discussion have been presented under following heads :

Temperature :

Temperature is important parameter for the biochemical and physiological process in the aquatic organisms. Value of water temperature ranged from 28°C to 29°C in all the selected stations. Minimum value of 28°C was recorded at station S₁ and maximum value of 29°C at station S₃ (Table 1).

pH:

Potential of hydrogen ion concentration is represented as pH. Value ranged between 7.50 and 8.40 with minimum value in station S₃. The pH values observed meets the quality of water required for drinking purpose with respect to IS and WHO standards. Results of pH of present study collaborates with pH values registered as 7.16 to 7.82 in Khari and Pushpavati river (Joshi, 2004).

Turbidity :

Turbid water interferes with self-purification of streams by reducing the photosynthetic activity of aquatic plants.

Table 1 : Monthly variation in physico-chemical characteristics of Sabarmati river water at Ahmedabad

Sr. No.	Parameters (December, 2012- November, 2013)	Station S ₁	Station S ₂	Station S ₃	Station S ₄
1.	Temperature	28.00	28.50	29.00	28.4
2.	pH	7.80	8.40	7.50	7.90
3.	Turbidity NTU	5.00	9.00	16.00	7.00
4.	Electrical conductivity μ mohs/cm	210.08	327.25	570.65	265.10
5.	D.O. mg/l	8.20	7.65	6.70	7.55
6.	B.O.D. mg/l	4.16	4.60	4.90	4.20
7.	Nitrates mg/l	8.40	4.85	9.10	5.70
8.	Chlorides mg/l	40.46	48.90	140.85	57.00
9.	Sulphates mg/l	7.65	9.80	17.80	9.00
10.	Total dissolved solids mg/l	132.20	210.12	350.20	170.18
11.	Phosphates mg/l	0.45	0.70	1.60	0.67
12.	Total hardness CaCO ₃ mg/l	82.65	79.10	180.40	96.10
13.	Calcium as Ca mg/l	53.60	63.10	135.26	51.00
14.	Magnesium as Mg mg/l	32.00	35.00	46.00	45.00
15.	MPN index/100ml	1200	1800	2500	1100

Table 2 : Diatoms in Sabarmati, (+) indicates pollution sensitive (December, 2012- November 2013)

Sr. No.	Species/Litre	Station S ₁	Station S ₂	Station S ₃	Station S ₄
1.	<i>Cymbella turgidulus</i> (+)	16	10	9	6
2.	<i>Cymbella tumida</i>	5	4	4	6
3.	<i>Cyclotella menehiniana</i> (+)	7	9	14	13
4.	<i>Diatoma elangata</i> (+)	5	4	3	6
5.	<i>Fragillaria rumens</i> (+)	3	2	1	4
6.	<i>Fragillaria intermedia</i>	11	2	15	8
7.	<i>Melosira granulata</i> (+)	35	28	31	52
8.	<i>Synedra ulna</i> (+)	43	52	65	70
9.	<i>Tubullaria flocculosa</i>	10	6	8	6

The turbidity ranged from 5 to 16 NTU. The results are above the permissible limits prescribed by WHO, IS and ICMR for drinking water standards.

Electrical conductivity :

Electrical conductivity varied from 210.08 μ mohs/cm to 570.65 μ mohs/cm (Table 1). Maximum value was recorded at the station S₃. The total dissolved solid ranges from 132.20 mg/l to 350.20 mg/l. The total dissolved solids mainly consist of inorganic matter and dissolved gases. Electrical conductivity and total dissolved solids values are within the limit prescribed for water quality and for drinking standards under IS and WHO and other quality prescribed for surface water under the classification of A to E.

Dissolved oxygen :

Dissolved oxygen concentration in a water body indicates its ability to support aquatic life. In the present study, the DO level fluctuated between 6.70 mg/l to 8.20 mg/l. Maximum DO 8.20 mg/l was at station S1 and minimum at station S₃. The fluctuation of DO level could be due to the fluctuation of water temperature and the addition of oxygen demanding substances through sewage and industrial waste. Higher DO facilitating the abundant growth of phytoplankton and related zooplankton leading to higher biological activity was observed in river water. The low DO value indicates the bio-degradation of organic matter and decay of vegetation (Singh and Rai, 2003). The dissolved oxygen values are acceptable for the use of water for drinking purpose. However, the BOD values obtained indicates that the water is contaminated by degradable organic impurities.

Biological oxygen demand :

BOD values ranged from 4.16 mg/l to 4.90 mg/l. A

maximum value of BOD was at station S₃ and minimum at station S₁. BOD in general gives a quantitative index of the organic substance, which is degraded quickly. High BOD value observed in station S₃ due to oxidation of the organic waste by natural microorganisms created high BOD.

Sulphate :

Sulphate is naturally occurring anion found in almost all kinds of water bodies. It may undergo transformation to sulphur or hydrogen sulphide. It is also an important anion imparting hardness to the water (Trivedy *et al.*, 1995). The sulphate content in the present study ranged between 7.65 mg/l to 17.80 mg/l (Table 1). Present concentration is acceptable for designated use of water.

Phosphate :

Phosphorus occurs in natural water as various types of phosphates. It is also a critical nutrient like nitrate for the growth of algae in the aquatic realm. The most important sources of phosphates are discharge of domestic sewage, detergents and agricultural runoff (Trivedy *et al.*, 1995). Values of phosphate ranged from 0.45 to 1.60 mg/l. with the minimum value in station S₁ and the maximum value in station S₃.

Chloride :

Chloride is one of the important indicators of pollution. Chlorides are present in sewage and farm drainage. In the present study, the highest chloride level (140.85 mg/l) showed in the station S₃. Chloride increases the degree of eutrophication (Goel *et al.*, 1980), but low level of chloride suggests reduction in eutrophication. Present study indicates that chloride concentration is in the lower concentration except in station S₃ which may be due to the entry of treated effluent from the industry situated on the right bank of the river Sabarmati.

Table 3 : Phytoplankton in Sabarmati river, (+) indicates pollution sensitive (December, 2012 – November, 2013)

Sr. No.	Species/Litre	Station S ₁	Station S ₂	Station S ₃	Station S ₄
1.	<i>Ankistrodesmus falcatus</i>	11	5	6	8
2.	<i>Anabaena</i> (+)	38	30	54	18
3.	<i>Chlorella pyrenoidosa</i> (+)	15	13	8	9
4.	<i>Coelsatrum microporms</i> (+)	4	3	5	6
5.	<i>Closterium moniformum</i> (+)	4	3	5	8
6.	<i>Euglena</i> (+)	9	8	6	5
7.	<i>Nitzia plaea</i> (+)	8	9	11	15
8.	<i>Oscillatoria</i>	11	15	13	17
9.	<i>Oedogonium</i> (+)	15	13	10	9
10.	<i>Pediatrum</i>	9	5	6	8
11.	<i>Phormidium</i> (+)	3	5	3	4
12.	<i>Rivularia</i> (+)	5	3	6	5
13.	<i>Spirogyra</i>	8	5	3	3
14.	<i>Scenedesmus</i>	15	5	16	10

Total hardness :

Total hardness of water is not a pollution parameter but indicates water quality mainly in terms of Ca^{+2} , Mg^{+2} content. Total hardness values observed were 79.10 to 180.40 mg/l. Calcium and magnesium concentration were observed to be in the range 51.00 to 135.26 mg/l and 32.00 to 46 mg/l, respectively. The water quality with respect to Ca^{+2} , Mg^{+2} and total hardness is in the acceptable range for drinking water as per the classification of IS and WHO standards.

Bacteriological studies :

The results of bacteriological studies are given in Table 1. The MPN index was high, which indicated dense pollution of bacteria in the water samples (Adewoye and Lateef, 2004). The comparative analysis of the microbial load indicates that bacteria were encountered more at station S_3 (2500) where effluents were discharged in the river than both the upstream and the downstream. Similar results were obtained in the study area of a polluted Oba river exposed to human agricultural waste (Bakare *et al.*, 2002).

Diatoms and other phytoplankton of Sabarmati river water were indicated with reference to distribution and composition. The major diatoms distributed in the area were *Synedra ulna*, *Melosira granulata* (Table 2) and phytoplankton species included *Anabena*, *Rivulariya*, *Oedogonium*, *Oscillatoria*, *Chlorella pyrenoidosa* occurring in polluted river were common in the area (Table 3).

Conclusion :

Moderate pollution indicated in the study area can be attributed to the anthropogenic activities. Further pollution parameters revealed that these parameters varied from station to station due to discharge of domestic and industrial wastes around the study area.

Based on the investigation, all the parameters are well with the prescribed for drinking water under IS and WHO standards, except with turbidity, BOD and bacteriological

impurities. Therefore, the water can be conveniently used for propagations of wildlife, fishes, irrigation, industries but it should be treated by conventional method followed by disinfection to be used for drinking purposes.

The water quality of river in the present investigation is serious concern due to more microbial threat. The bacterial count indicated alarming level of pollution. The influence of faecal contamination was also noticed in water at station S_3 near Ahmedabad town. As a consequence of this, the people may be susceptible to health hazards like gastro-enteritis, intestinal and urinary tract infections etc.

The ecological status of the study area was found to be impoverished in terms of species composition and density. The communities of phytoplankton and diatoms distributed along the water course indicated the existence of pollution tolerant species. In order to maintain the health of the river with respect to water quality, it is essential that authorities should take immediate steps on the following points :

- The discharge of domestic waste water into this river should be properly treated before being discharged.
- Arrangement should be made to avoid the entry of non-point source of effluent into the river.
- The people be educated by organising awareness programme.
- Monitoring agencies should strictly follow the protocol and take suitable action on defaulting industries and municipal administration.
- Authorities be informed to maintain and operate the waste water/ sewage water treatment plants properly and the discharge from those plants to confirm to the discharge standards.
- Signboard may be erected to indicate the quality of water for designated use.

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