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Water Quality Status of River Sabarmati within Ahmedabad City

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Abstract: With the rise of the environmental protection movement, greater emphasis has been given to the water quality safeguarding in terms of minimizing water pollution and thereby reducing the environmental impact to nature. The contamination and availability of clean water plays an important role in meeting the demand of domestic, industry and agriculture. The fresh river water is depleting at a much faster rate. The study aims at the assessment of water quality of the river Sabarmati within Ahmedabad city. Total six sampling stations have been selected for river water sample collection. Various parameters like pH, TDS, DO, BOD and TC were being analyzed as per the prescribed method of GPCB. Discussion also emphasises on the toxicological impacts of various pollutants to the human health as well as environment and minimizes potential environmental impacts of them. From this study, we concluded that the water quality of river Sabarmati is getting contaminated with impurities and it requires certain water treatments so that it can be directly used for drinking purpose although it is found suitable for agricultural purpose.

Key words: Water quality, physico-chemical and biological parameters, environmental impact, river Sabarmati, Ahmedabad city.

Introduction

Water is the most important essential constituent of all animals, plants and other organisms. It is a precious natural resource for sustaining environment and life. For many years, river water is contaminated by human's anthropogenic activities. Water scarcity is a serious problem in India. Population growth and irrigation requirements have resulted in over-exploitation of natural water, whereas urbanization causes reduction in open soil surface and water infiltration rate and a resultant deterioration in water quality (Patel and Desai, 2004; Patel, 2005; Singh, 2006; Shroff and Vashi, 2009). The present paper assesses the water quality of river Sabarmati within Ahmedabad city, in view of its potability and study of the environmental impact of water quality.

About Ahmedabad

Ahmedabad is located in Gujarat, India. It is the leading industrial and commercial city of Gujarat. Area of Ahmedabad city is 205 km^2. The location coordinates for Ahmedabad are N 23° 1′- E 72° 41′. The city is on the bank of the river Sabarmati. Annual temperature in city ranges from 27 to 42.8 °C. Most of the rainfall occurs in the monsoon seasons from June to September. Rainfall varies from 0.9 to 265.3 mm/month. Average annual rainfall is 803.4 mm. City lies in a region of North Gujarat which is a plain, dry and sandy area. The city covers an area of 47,156 acres. There are no woods or forests nearby. The sea is at a distance of 80.65 kms at the Gulf of Cambay. Sabarmati, one of the longest rivers of Gujarat, bifurcates the city into eastern and western parts

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Notations

pH	Potential of hydrogen
TDS	Total dissolved solids
DO	Dissolve oxygen
BOD	Biochemical oxygen demand
TC	Total coliform
GPCB	Gujarat Pollution Control Board
COD	Chemical oxygen demand
APHA	American Public Health Association
BIS	Bureau of Indian Standards

(Figure 1), connected by five bridges, two of which have been constructed after independence.

Seasonal Variations

Though the Sabarmati river is perennial, it gets practically less water in the summer. It is one of the 24 river basins of India. The river outfalls into the Arabian Sea (more specifically in the Gulf of Cambay, or Khambhat as is well known, locally). The basin has a total drainage area of 21,565 km^2 (Figure 2). The basin has a tropical monsoon climate. The rainfall occurs almost entirely during the monsoon months. The average rainfall of the entire basin is 749 mm. The rate of evaporation is maximum during April to June due to rise in temperature and increase in wind speed. The average annual evaporation losses in the basin are in the order of 1500-2000 mm. The river receives considerable amounts of municipal and industrial wastes which contaminate the receiving water, especially immediately downstream of the outfalls. The river shows annual chemical cycles for most parameters, with elevated values in summer and minimum values in the monsoon season.

Sources of Pollution

There has been a rapid growth of industries in city. Pharmaceuticals, petroleum and petrochemical industries, steel recycling, auto parts manufacturing, beverage production and textile are major industries contributing to water pollution (BIS, 1991; APHA, 1998; Rao and Rao, 2010).

The Vatva, Naroda, Narol and Bavla industrial areas are prominent industrial zone, with major multinational groups having set up manufacturing or processing plants within the limits of Ahmedabad Municipal Corporation.

The overall values between water quality constituents and discharge may be attributed to the irregular discharge

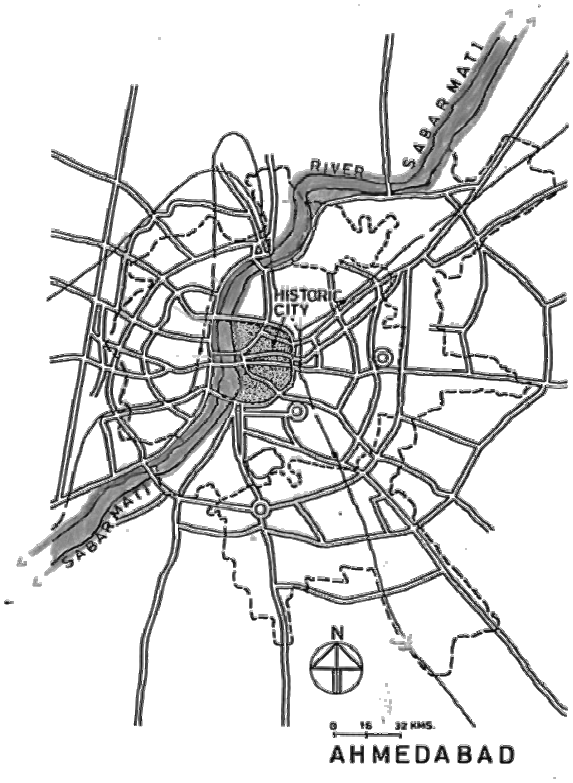

Figure 1: Sabarmati river in Ahmedabad city.

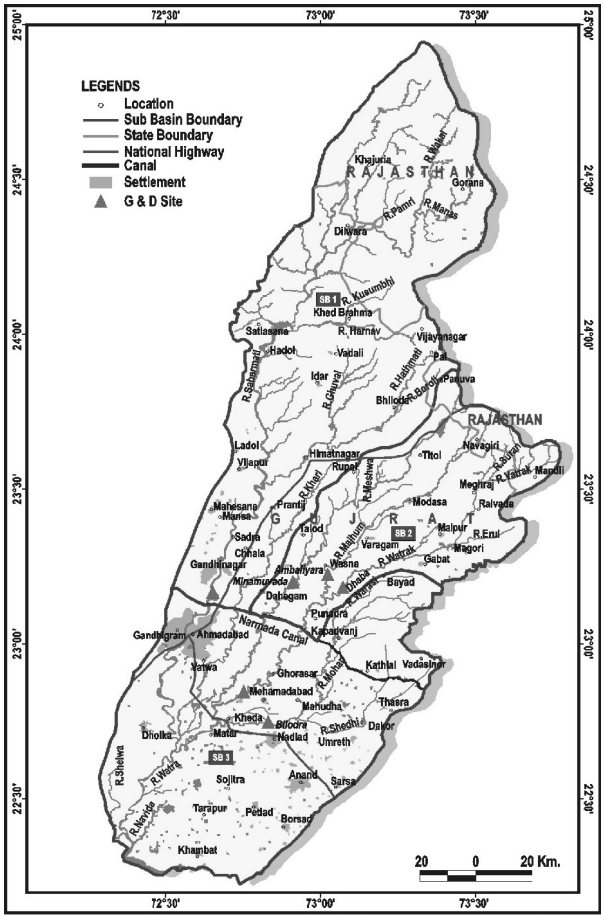

Figure 2: Sabarmati river basin.

of industrial effluents of different kinds, climatic and physiographic controls including temperature, seasonality, the rainfall/runoff ratio, rock type and vegetation.

Material and Methods

A systematic study and planning was done before sampling. The planning involved adequate literature survey, discussion with local subjects' experts in the field and other individuals/organizations.

Total six sampling stations were selected for assessment of water quality of river Sabarmati. The sampling stations were designated S1 to S6. The sampling stations, locations and type of water sources are shown in Table 1.

Table 1: Sampling stations, locations

Sampling Station	*Location*
S1	Vasna Narol station no.0002
S2	Gandhi Bridge
S3	Hansol Bridge
S4	Railway Bridge
S5	Narayan Ghat
S6	Chandrabhaga near Gandhi Ashram

Regular monitoring and sampling collection were started at all stations from January 2008 under the guidance of GPCB. During the period, the Board carried out collection and analysis of water samples with the help of all its Regional Offices and their laboratories including Central Laboratory at Gandhinagar, under the provisions of the Water Act and the Environment Protection Act. Water samples were collected from all the locations on a monthly basis using a Hydro-Bios standard water sampler to obtain a composite sample. All the samples were collected and stored in polyethylene bottles fitted with screw caps. Determination of pH and conductance was performed on site using portable meters (WTW, Germany). For other parameters, samples were preserved by adding an appropriate reagent and brought to the laboratory in sampling kits maintained at requisite temperature for detailed chemical analysis. The physico-chemical and biological analysis was performed following standard methods. The accuracy of the methods is greater than ±10%. The analysis of all samples at all stations was carried out from January 2008 to December 2011. The data is presented in the form of annual average concentration of these protocols.

Result and Discussion

The physico-chemical and biological characteristics (Handa, 1998) of the surface water samples collected and analyzed during January 2008 to December 2011 are shown in Tables 3 to 6 and Figures 3 to 10.

The pH of water is an important parameter to assess its quality as drinking water (Chann et al., 2007). It is a measure of the intensity of acidity or alkalinity and measures the concentration of hydrogen ions in water. In the present study, the pH of the water samples are found to be in the mild alkaline range of 7 to 9 (within

Table 2: Drinking water parameters and its permissible limit as the Bureau of Indian standards

Parameter (in mg/l)	*Permissible limit As per std. for drinking water (IS-10500-(1991))*
pH	7-9.2
Fluoride	0.6-1.2
DO	4
COD	Nil
EC (mS/cm)	0.1-6
Total hardness	500
TDS	-

Table 3: Physico-chemical and biological characteristics of Sabarmati river water of Ahmedabad city (yearly mean value) (year 2008)

Parameter	*Sampling stations*					
	S1	*S2*	*S3*	*S4*	*S5*	*S6*
pH	7	8	8	8	8	8
TDS (mg/l)	-	245	184	217	196	801
DO (mg/l)	1	4	8	5	5	0
BOD (mg/l)	70	11	5	6	5	109
TC (MPN/10)	230	263	315	193	349	15049

Table 4: Physico-chemical and biological characteristics of Sabarmati river water of Ahmedabad city (yearly mean value) (year 2009)

Parameter	*Sampling stations*					
	S1	*S2*	*S3*	*S4*	*S5*	*S6*
pH	8	8	9	8	8	7
TDS (mg/l)	320	238	161	207	433	853
DO (mg/l)	-	5	8	7	5	2
BOD (mg/l)	12	6	7	8	14	78
TC (MPN/10)	1400	386	1267	393	763	14767

Table 5: Physico-chemical and biological characteristics of Sabarmati river water of Ahmedabad city (yearly mean value) (year 2010)

Parameter	*Sampling stations*					
	S1	*S2*	*S3*	*S4*	*S5*	*S6*
pH	7.48	7.72	8.2	7.7	7.7	7.4
TDS (mg/l)	771	385	175	319	907	803
DO (mg/l)	3.2	5.1	8	5.7	5.2	Nil
BOD (mg/l)	28	7	3	12	9	32
TC (MPN/10)	10200	1800	1244	230	208	64871

Table 6: Physico-chemical and biological characteristics of Sabarmati river water of Ahmedabad city (yearly mean value) (year 2011)

Parameter	*Sampling stations*					
	S1	*S2*	*S3*	*S4*	*S5*	*S6*
pH	7.51	7.48	8.07	7.9	7.8	7.5
TDS (mg/l)	671	363	182	222	257	754
DO (mg/l)	3.4	4.9	7.5	6.7	6.1	Nil
BOD (mg/l)	37	17	4	4	6	55
TC (MPN/10)	1342	1603	194	282	1102	18400

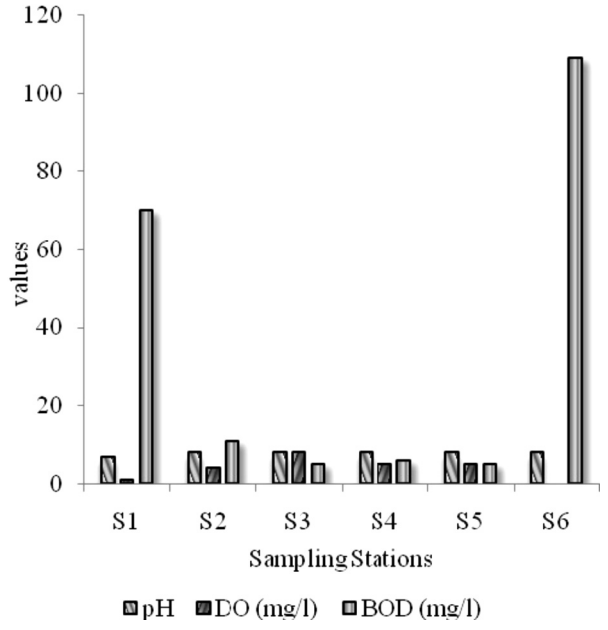

Figure 3: Concentration of pH, DO and BOD (year 2008).

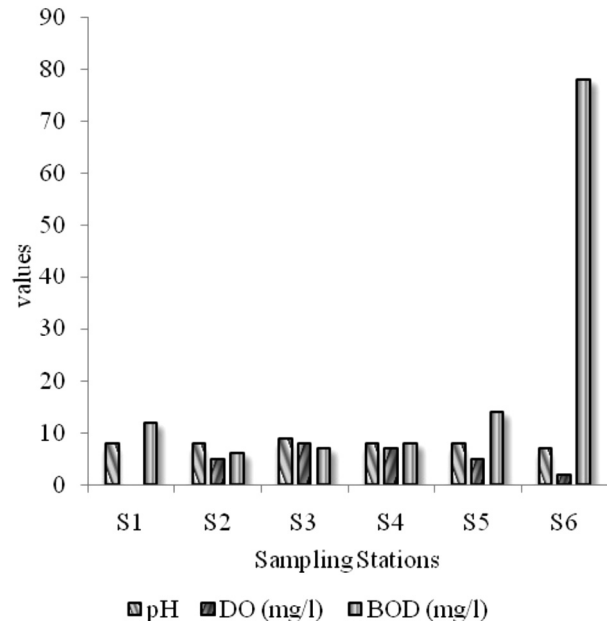

Figure 4: Concentration of pH, DO and BOD (year 2009).

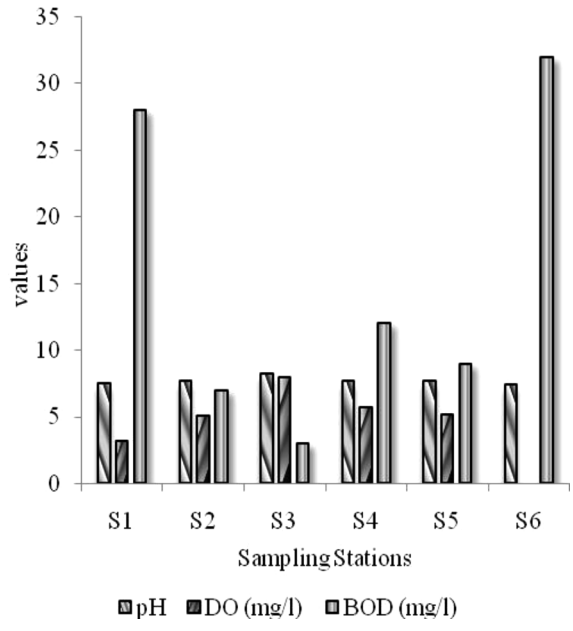

Figure 5: Concentration of pH, DO and BOD (year 2010).

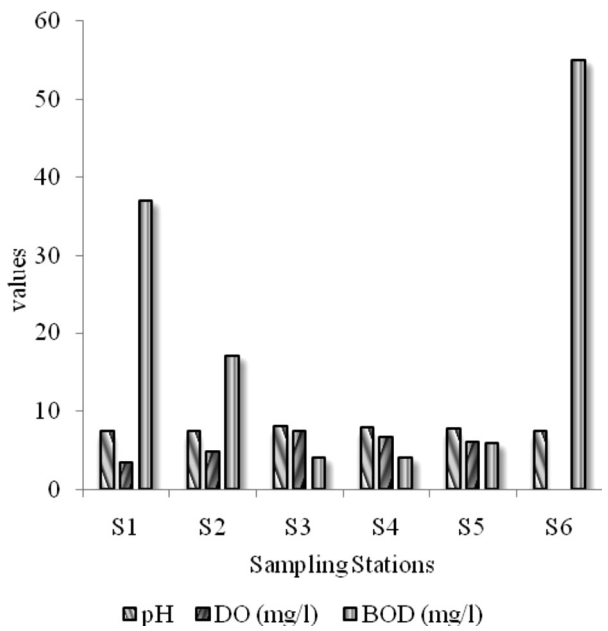

Figure 6: Concentration of pH, DO and BOD (year 2011).

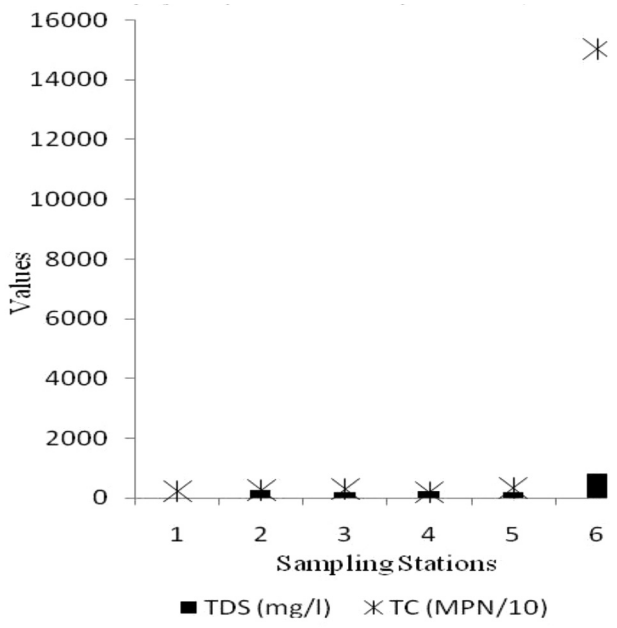

Figure 7: Concentration of TDS and TC (year 2008).

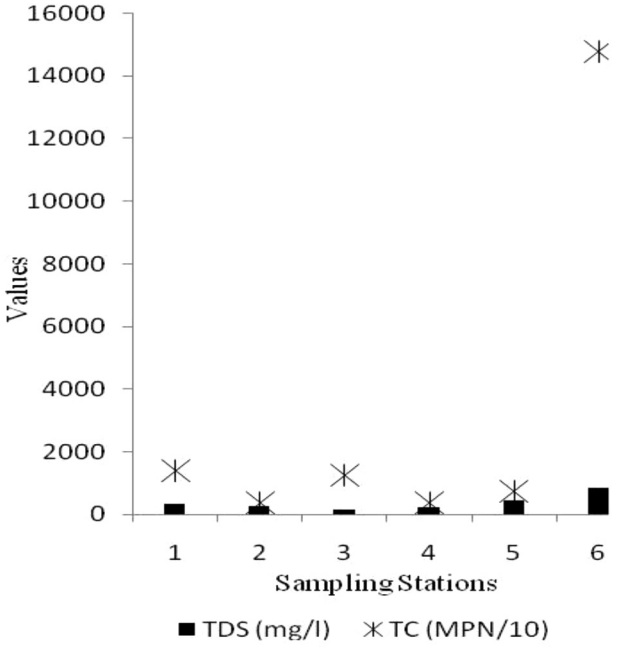

Figure 8: Concentration of TDS and TC (year 2009).

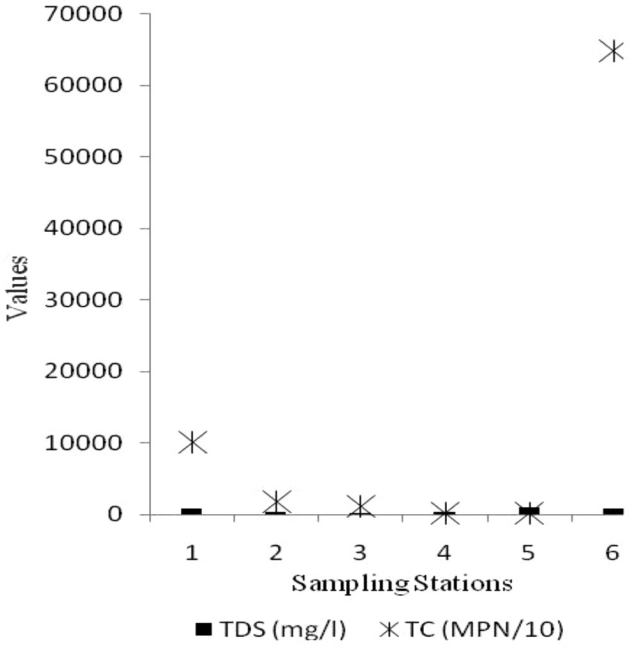

Figure 9: Concentration of TDS and TC (year 2010).

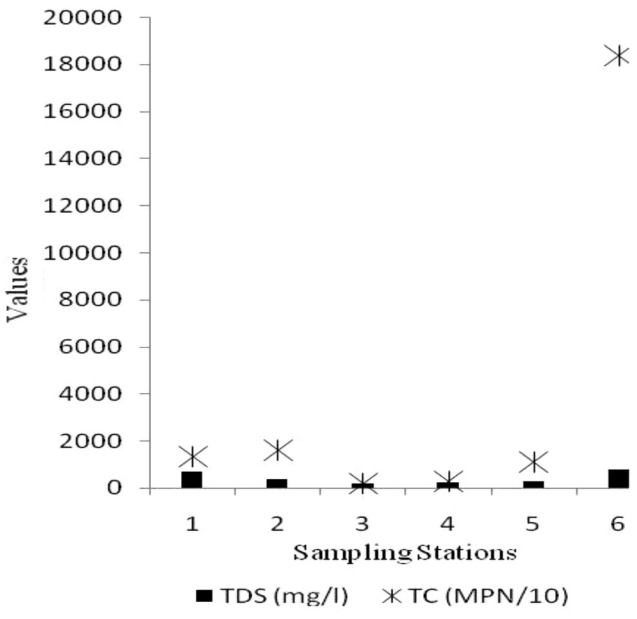

Figure 10: Concentration of TDS and TC (year 2011).

permissible limit except S3) indicating the presence of very weak basic salts.

We can see with increase in BOD value, the level of DO decreases. The permissible limit of BOD and DO is nil and 4 mg/l respectively.

Total dissolved solids (TDS) in water varied from 461.2 to 3040 mg/l at various locations. The higher values of TDS at sampling stations S1, S3 and S6 show high amount of salinity.

The TC count is much higher (at S1, S3, S5 and S6) than the standards. It is due to the contamination of effluent to the river. It can also be contaminated by the improper management of solid wastes (Kalyanaraman and Geetha, 2005).

Conclusions

From the above discussion, it may be concluded that the water of river Sabarmati within Ahmedabad city is getting contaminated with harmful impurities and not potable except some of the sampling stations as they do not exceed the permissible limits. To convert the existing water into potable water, certain water treatment should be given before supplying it as drinking water. The study also confirms that the water is suitable for agriculture on the basis of SAR (Chopra and Kanwar, 1999; Srivastava and Pathak, 2010; Srivastava and Pathak, 2011).

The higher values of BOD at S1 and S6 might be because of the contamination of these water bodies with the domestic wastewater disposal as well as industrial effluents.

Some initiatives are required to save Sabarmati: public awareness, proper treatment of both the industrial and domestic water as well as wastewater before discharging to river, proper solid waste management, control over the open defecation, creation of low cost sanitation system, introduction of decontaminator into the river and proper legislation.

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