

Surface Water Quality Assessment in Basara Village, Telangana State (India)

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Abstract—The purpose of this project is to assess the quality of one of the most important natural resource of India viz. Godavari River in Basara village and in Yamcha village of Telangana State, India. The presence of Gana Saraswati Temple on the banks of Godavari River and the impact on the quality of the water due to the devotees having regular bathing (as per the Hindu rituals) draws the attention for its quality assessment. The water quality was monitored for 5 sampling stations (on the basis of their importance) during the pre-monsoon season i.e. from March 2015 to May 2015. The results obtained through laboratory scale study showed that all the parameters are within the permissible limits as prescribed by the WHO and BIS standards. Statistical analysis was also done in-order to find the correlation between various parameters and it was observed that there was a strong positive correlation between EC-TDS (0.98), pH-CO₃²⁻ (0.98); whereas a negative correlation was observed between Ca²⁺-HCO₃²⁻ (-0.85), Cl⁻-HCO₃²⁻ (-0.86) and DO-COD (-0.75). Water quality Index (WQI) by Weighted Arithmetic Index was calculated for all the 5 sampling station. According to this method the WQI values varied from 25.61 to 31.59 which concluded that the quality of Godavari River during pre-monsoon season was found to be in good condition. It revealed that although the quality of Godavari river in the Basara and Yamcha region are within acceptable limits; it cannot be used for the drinking purpose without treatment, but it can be used for the domestic and household purpose.

1. INTRODUCTION

Water is the prime requirement for the mankind and is available abundantly in nature. It has been man's attempt from the time immemorial to utilize the available water resources, as a result of which, it has been exploited more than any other resources for the sustenance of life. The increasing population along with the associated developmental activity has played havoc with freshwater sources the world over and India is no exception. During last decades, it is observed that the intensive use of natural resource and increased human activities are posing great threat to groundwater quality [1] & [2]

Water quality parameters provide the basis for judging the sustainability for its designated uses and to improve the existing conditions. For optimal development and management for the beneficial uses, current information is needed which is provided by water quality programmers [3]. Unequal distribution of water on the surface of the earth

and fast declining availability of usable fresh water are the major concerns in terms of water quality and quantity [4].

The present study determines the various physico-chemical parameters of the Godavari river, which flows within through the Basara and Yamcha village of Telangana state, which provides a broad view for the utilization of the water with respect to its need or requirements.

The value of a water quality index scale is to impart information of trends in water quality in a non-technical manner and to help pinpoint surface water bodies which have altered significantly in quality and which, if necessary, can be investigated in greater detail. Reducing a large quantity of data to a single number index will allow more meaningful comparison to be made and integrate the effects of the various pollutions presents. Single number also can be used as education to country's younger generation as one of the method to prevent further surface-water and groundwater pollution due to mankind. According to Stambuk Giljanovic, WQI is a mathematical tool which has the ability to provide a single number for the large quantities of water quality data in a comprehensive manner [5]. Therefore, it is a simple tool for decision makers on the quality and possible uses of given water body [6]-[8]. Kannal and his subordinates, used water quality indices to evaluate spatial and temporal changes of the water quality in the Bagmati river basin (Nepal) for the period 1999–2003 and determined the serious negative effects of the city urban activity on the river water quality [8].

Yogendra and Puttaiah, studied an urban water in Gopishettykere of Shimoga town, Karnataka; at an interval of 30 days and analyses for 13 physico-chemical parameters (pH, EC, DO, TDS, TSS, Ca²⁺, Mg²⁺, Cl⁻, NO₃⁻, SO₄²⁻ and BOD) was carried out and the WQI values were calculated using Weighted Arithmetic Index method and it was observed that the calculated values were >100 for all the three seasons as a result the water is unfit for human consumption [9].

Under the Environmental Monitoring Programme on Water Quality in Kerala State, analyses of the water in the Periyar River basin and 34 groundwater samples around Periyar River

basin during different seasons was carried out from October 2005 to October 2007. The results of physico-chemical parameters of surface water exceeded the desirable limits of downstream during all the seasons. Pollution of Periyar River was due to anthropogenic activities was indicated by the WQI values and it was concluded that the samples at all other stations can be used for drinking only after proper treatment [10].

The objective of the present study is to assess the quality of Godavari river in Basara and Yamcha village, which is the prime source of water supply in this region.

Study Area

Gnana Saraswati Temple is a Hindu temple of Goddess Saraswati located on the banks of Godavari River at Basar, Telangana, India. Basar is a census town in the Adilabad district in the state of Telangana. Many pilgrims come to Basara to perform the "Akshara abhyasam" ceremony for the children before they start formal school education. Hence Basara is a pilgrim place and also one of the tourist spot. The Godavari river is a source of drinking water for the people residing in Basara as well as Yamcha Village.

5 water samples were collected for a 6 km long godavari river flowing in this region and the physico-chemical parameters for these samples were carried out in order to assess its quality seasonally.

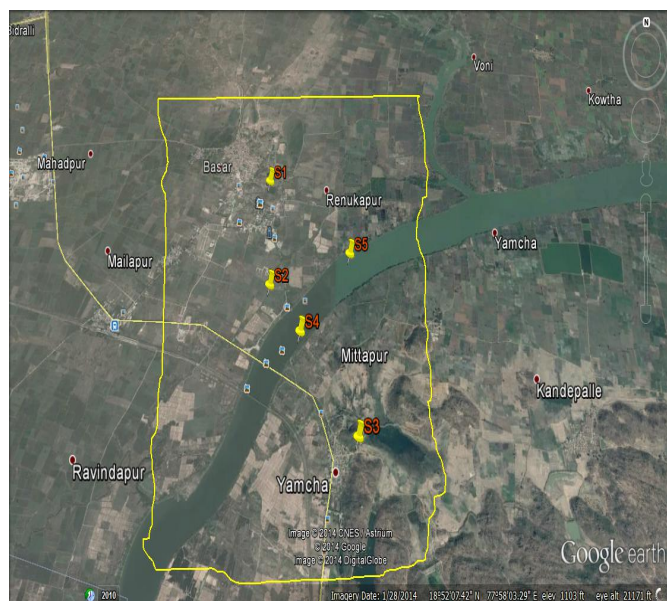


Fig. 1: Godavari River Boundary with the 5 sampling stations.

2. MATERIALS AND METHODS

13 parameters were analysed during the course of study. Standard methods are used to determine Alkalinity (with sulphuric acid), Hardness (with 0.01 M EDTA), Chlorides (with silver nitrate), Dissolve Oxygen (with sodium

thiosulphate), COD (closed refluxed), Calcium (with EDTA) [11] & [12]. pH and Electrical conductivity is determined using the pH and EC electrodes. Table 1 shows the methods employed for sample analysis of various parameters.

The water quality analysis results were compared with standard values recommended by World Health Organization (WHO) [13] and Bureau of Indian Standards (BIS) [14] for drinking purposes. Table 2 shows the physical and chemical standards for drinking water as per BIS, MUD, EPA and WHO.

Correlation matrix provides the information about the interdependency of the various parameters with each other; or it can be explained that the correlation matrix reflects the extent of a linear relationship between the two data sets. The value of correlation i.e. r lies between -1 to +1. A value closer to -1 or +1 indicates a strong negative correlation or a strong positive correlation between the variables.

Table 1: Parameters and methods employed for sample analysis

Sr. No.	Parameter	Method
1	Temperature	Thermometer
2	pH	pH meter
3	Electrical Conductivity (EC)	Conductometer
4	Total Alkalinity (TA)	Titrimetric
5	Total Hardness (TH)	Titrimetric
6	Chloride (Cl-)	Titrimetric
7	Fluoride	Colorimeter
8	Calcium (Ca ²⁺)	Titrimetric
9	Dissolved Oxygen (DO)	Titrimetric
10	Chemical Oxygen Demand (COD)	Titrimetric

The water quality index is calculated using weighted Arithmetic Index method and the quality rating (Q_i) corresponding to the i th parameter is a number reflecting the relative value of the parameter, which is calculated as shown:

$$Q_i = [(M_i - I_i) / (S_i - I_i)] \times 100$$

where M_i = estimated values of the parameters in the laboratory, I_i = Ideal values of the i th parameter (Ideal values are taken as zero except for pH=7, DO=14 and fluorides=1) and S_i = standard values of the i th parameter.

The unit weight (W_i) is calculated by a value inversely proportional to the recommended standards (S_i) of the corresponding parameter

$$W_i = k/S_i \text{ (where } k=1\text{)}$$

The overall WQI, based on WAI, is calculated by aggregating the quality rating (Q_i) with unit weight (W_i) linearly

$$WQI = Q_i \times W_i$$

Table 3 shows the interpretation of WAI values with the quality of water for public water supply. Parameters like pH, Alkalinity, DO, Hardness, Ca, Ma, Chlorides etc were

recognised as preliminary indication of quality as is used in calculating quality index for public water supply.

Table 2: Physical and Chemical Standards for Drinking Water

S. No.	Parameters	BIS 10500, 1991	MUD	EPA, 1979	WHO, 1984
1	pH	6.5-8.5	7-8.5	6.5-8.5	6.5-8.5
2	Temperature (OC)	N.M.	N.M.	N.M.	N.M.
3	Total Solids (mg/l)	500	500	500	N.M
4	Dissolved Oxygen (mg/l)	8	N.M	6	8
5	Chlorides (mg/l)	250	200	250	250
6	Total Alkalinity (mg/L)	200	N.M.	N.M.	250
7	Total Hardness (mg/l)	300	200	N.M	500
8	Electrical Conductivity (μ hos/cm)	750-2250	N.M	N.M	500
9	Fluorides	1.0	1.0	2.0	1.0
10	Calcium	75	75	N.M	75
11	Magnesium	30	30	N.M	30
12	Chemical Oxygen Demand	10	N.M	N.M	10

BIS: Bureau of Indian Standards; EPA: Environmental Protection Agency; MUD: Ministry of Urban Development; WHO: World Health Organisation, NM: Not Mentioned

Table 3: Water Quality according to WAI values

Value of WAI	Quality of water
0 – 25	Excellent
26 – 50	Good
51 – 75	Bad
76 – 100	Very bad
>100	Unfit

3. RESULTS AND DISCUSSION

Following results were obtained during the pre-monsoon (March, April and May) season of 2015.

From table 4 it is clear that all the 13 parameters, which were analysed during the course of study (pre-monsoon season) for the Godavari river in the Basara and Yamcha village, were within the permissible limits as per the WHO and BIS standards.

Table 4: Descriptive data of various parameters analysed for Godavari river during the pre monsoon season

Sampling Stations	S1	S2	S3	S4	S5
pH	7.94	8.46	8.28	8.05	7.75
EC	866.67	800	633.3	766.7	900
Alkalinity	270.4	234.2	283.7	272.1	265.7
Hardness	154.17	154	153.5	159	158.3

Cl-	73.56	85.35	74.07	89.21	84.68
TDS	554.67	512	405.3	490.7	576
Ca ²⁺	78.43	79.16	76.6	82.83	75.32
Mg ²⁺	18.41	18.19	18.68	18.51	20.17
CO ₃ ²⁻	1.95	5.65	4.46	2.6	1.23
HCO ₃ ²⁻	239.04	210.9	250.4	164.2	226.2
DO	7.17	6.72	7.38	7.29	7.02
BOD	2.56	2.95	3.39	2.42	2.96
COD	26.33	28.17	25.27	22.3	25.6

* All the parameters are in mg/L except pH and EC (μ S/cm)

Further the statistical analysis was carried out from the obtained data and the results are shown in the table 5.

Table 5: Correlation values obtained during pre-monsoon season

S. No.	Correlation between parameters	Correlation value (r)
1	Cl- - HCO ₃ ²⁻	- 0.86
2	Ca ²⁺ - HCO ₃ ²⁻	-0.85
3	pH- CO ₃ ²⁻	0.93
4	EC-TDS	0.98
5	DO-COD	-0.75

The correlation matrix is formed using Pearsons correlation formula and it was found that there is a strong positive correlation between EC-TDS (0.98), pH-CO₃²⁻ (0.93); whereas a negative correlation was observed between Ca²⁺ - HCO₃²⁻ (0.85), Cl-HCO₃²⁻ (-0.86) and DO-COD (-0.75).

WQI value using Weighted Arithmetic Index method was estimated and the following results were obtained as shown in table 3. The quality of the water was found to be good since the values ranges from 25.61 to 31.59; which concluded that the quality of water is good.

Table 6: WQI values calculated using Weighted Arithmetic Index Method

Sampling Station	WQI Value
S1	26.76
S2	31.59
S3	29.01
S4	27.46
S5	25.61

4. CONCLUSION

Water samples were collected during the summer season (pre-monsoon) on monthly basis during the year 2015. Five locations/sampling stations were considered from Godavari River basin which flows within the vicinity of Basara and Yamcha villages of Telangana State, India. Laboratory studies were carried out and it was observed that all the 13 parameters (pH, EC, Alkalinity, Hardness, Cl⁻, TDS, Ca²⁺, Mg²⁺, CO₃²⁻, HCO₃²⁻, DO, BOD, COD) which were analyzed are within the permissible limits as per the WHO and BIS standards.

Statistical analysis was performed and it was found out that the parameters like EC-TDS and pH-CO_3^{2-} had a strong correlation with each other whereas the parameters like Ca^{2+} - HCO_3^{2-} , Cl^- - HCO_3^{2-} and DO-COD had a negative correlation with each other.

Weighted arithmetic Index method was adopted to find out the WQI value and it was found out that the quality of the Godavari river is good and hence can be used for the domestic purpose but cannot be directly consumed for drinking without the minimal treatment.

Regular monitoring of the river may be useful for: (i) understanding the actual scenario of river water quality, (ii) determining the impacts of agricultural and anthropogenic activities on the surface runoff quality and (iii) planning and management of available surface water resources in Basara and Yamcha village.

The present work was carried out in a limited time frame with limited data. The work can be continued further with continuous monitoring of the water quality, water levels and other geological parameters which can help to carry out model studies and predict the water quality regime. Since the river taken up for the study is the source for drinking water, it is important that the water quality of the river is continuously monitored.

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