# Assessment of the Water Quality Index of water body at Pravarasangam, Maharashtra

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## Abstract

*The present study was intended to calculate water Quality Index (WQI) of surface water of Pravarasangam, in order to ascertain the quality of water assessed for public consumption and other purpose. Physicochemical parameters were monitored for the calculation of water quality index for rainy and winter seasons. Investigation has been based on different parameters namely pH, conductance, TDS, chlorides, nitrate, sulphate, phosphate,alkalinity, hardness, BOD and DO.*

**Keywords:** *River Prawara, Physico-Chemical parameters, water Quality Index.*

## 1. Introduction

The fresh water is of vital concern for mankind, since it is directly linked to human welfare. The surface water bodies, which are the most important sources of water for human activities are uniformly under severe environmental stress and are being threatened as a consequence of developmental activities. Pravarasangam is the one of the back water station of the largest earthen dam, Jiakwadi. It is historical place of Lord Shiva, situated at the conflict of Mula and Godavari River. This station is a holy place, hence throughout the year various human activities are taking place. The water from this station is used mainly for drinking purpose for the Newasa city and nearby other forty villages. Adequate amount of water is available at this station throughout year. It is with this background, the present work was undertaken between July2008 and January 2009.

Water quality index provides a single number that express overall water quality at a certain location and time, based on several water quality parameters. The objective of water quality index is to turn complex water quality data into information that is understandable and usable by the public. A single number cannot tell the whole story of water quality; there are many other water quality parameters that are not included in the index. However, a water quality index based on some very important parameters can provide a simple indicator of water quality. In general, water quality indices incorporate data from multiple water quality parameters into a mathematical equation that rates the health of a water body with number.

## 2. Study area

The Pravara river in Newasa, in Ahmednagar district is located in survey of India topological sheet number 47, 7/14 and lies between latitude 190 32′ to 190 37′ N and longitude 740 49′ to 750 1′E [1]. As the area falls in semi-arid zone, it receives moderate rain fall during the monsoon (average rain fall 56 cm) and have generally dry climate. But due to the availability of water from Mula left cannel, Bhandardara dam and back water from Jayakwadi dam (Nathsagar) plenty amount of water present at this station throughout year.

## 3. Materials and Methods

Water samples were collected twice every month during morning hours between 8 a.m. and 10 a.m. pH and dissolved oxygen were monitored at the sampling spot while conductivity, total dissolved solids, total alkalinity, total hardness, chlorides, nitrates, phosphate, and BOD were analysed in the laboratory according to APHA (2005) and Trivedy and Goel (1986) [2,3].

In this study, for the calculation of water quality index, eleven important parameters were chosen. The WQI has been calculated by using the standards of drinking water quality recommended by the Word Health Organisation (WHO) Bureau of Indian Standards (BSI) and Indian council for Medical Research (ICMR) [4, 5,6].

## Water Quality Index (WQI):

Water quality index, indicating the water quality in terms of index number, offers a useful representation of overall quality of water for public or for any intended use as well as in the pollution abatement programs and in water quality management. Horton (1965) defined water Quality Index (WQI) as a reflection of composite influence of individual quality characteristics [7]. The following steps of evaluation of WQI have been used from the point of view of the surface water for human consumption, and it is calculated by weight arithmetic index method (Brown et. al 1972) [8].

**Calculation of sub index or quality rating ($q_n$):**

Let there be `n` water quality parameters and quality rating or sub index (qn) corresponding to nth parameters is a number reflecting the relative value of this parameters in the polluted water with respective to its standard permissible value. The qn is calculated using following expression.

$$q_n = 100 [(V_n - V_{io}) / ( S_n - V_{io})]$$

Where,

$q_n$ =Quality rating for the nth water quality parameter.

$V_n$ = Estimated value of nth parameters at a given sampling station.

$S_n$ = Standard permissible value of the nth parameters.

$V_{io}$ = Ideal value of nth parameters in pure water. i.e. 7.0 for pH, 14.6 mg/l for DO and 0 for all other parameters.

**pH value calculation through water quality rating evaluation**:

Ideal value of pH is 7.0 where 8.5 is the permissible value of water (i.e. polluted water), therefore, quality for pH is calculated from the following relation.

$$q_{pH} = 100 [(V_{pH} - 7) / ( 8.5 – 7)]$$

Where $V_{pH}$ = observed value of pH.

**DO calculation through the water quality rating equation:**

$$Q_{DO} = 100 [(V_{DO} – 14.6 / (5 – 14.6)]$$

**Calculation of unit weight:**

$$W_n = K / S_n$$

Where,

$W_n$ = unit weight for the nth parameters, Sn = Standard value of for the nth parameters,

**K** = constant of proportionality

The overall water quality Index was calculated by aggregating the quality rating (qn) with the unit weight linearly.

$$WQI = \sum q_n W_n / \sum W_n$$

**Table 1: Water Quality rating for drinking water (Chaterjiee and Raziuddin 2002)**

| Sr. No | WQI level | Water quality rating | Possible Use of Water |
|---|---|---|---|
| 1. | 0-25 | Excellent | All-purpose like potable, industrial, agricultural, |
| 2. | 26-50 | Good | Domestic and agricultural |
| 3. | 51-75 | Poor | Agricultural, industrial |
| 4. | 76-100 | Very Poor | Agricultural |
| 5. | >100 | Unfit for drinking | Not much possible agricultural can be used only after proper treatment |

**Table 2: Drinking standard recommended by agencies and unit weights**

| Sr. No. | Parameters | Standards ($S_n$) | Recommended Agency | Unit weight ($W_n$) |
|---|---|---|---|---|
| 1. | Conductance | 300 | ICMR | 0.3710 |
| 2. | TDS | 500 | ICMR/ISI | 0.0037 |
| 3. | pH | 7-8.5 | ICMR | 0.2190 |
| 4. | Chlorides | 250 | ICMR | 0.0074 |
| 5. | Nitrates | 45 | ICMR | 0.0412 |
| 6. | Phosphate | 25 | ICMR | 0.0618 |
| 7. | Sulphate | 150 | ICMR | 0.0103 |
| 8. | Alkalinity | 120 | ICMR | 0.0155 |
| 9. | Hardness | 300 | WHO | 0.0051 |
| 10. | BOD | 5 | ICMR | 0.3723 |
| 11. | DO | 5 | ICMR | 0.3088 |

*** All the values are expressed in unit mg/L except conductance in µS/cm**

## 4. Result

**Table 3: Seasonal variation of the physico-chemical parameters of the water body**

| Sr. No. | Parameters | Rainy season | Winter season |
|---|---|---|---|
| 1. | Conductance | 373.4 | 299.78 |
| 2. | TDS | 244.3 | 196.75 |
| 3. | pH | 7.6 | 8.22 |
| 4. | Chlorides | 98.5 | 82.38 |
| 5. | Nitrates | 1.3 | 0.62 |
| 6. | Phosphate | 0.4 | 0.28 |
| 7. | Sulphate | 2.5 | 3.28 |
| 8. | Alkalinity | 37.3 | 49.09 |
| 9. | Hardness | 48.4 | 64.80 |
| 10. | BOD | 1.14 | 2.10 |
| 11. | DO | 7.72 | 8.27 |

**Table 4: Calculation of Water Quality index in Rainy season**

| Sr. No | Parameters | Observed Value | Standards (Sn) | Recommended Agency | Unit weight (Wn) | Quality Rating (qn) | Wnqn |
|---|---|---|---|---|---|---|---|
| 1. | Conductance in µS/cm | 373.4 | 300 | ICMR | 0.3710 | 124.467 | 46.177 |
| 2. | TDS | 244.3 | 500 | ICMR | 0.0037 | 48.860 | 0.181 |
| 3. | pH | 7.6 | 7-8.5 | ICMR | 0.2190 | 40.000 | 8.760 |
| 4. | Chlorides | 98.5 | 250 | ICMR | 0.0074 | 39.400 | 0.292 |
| 5. | Nitrates | 1.3 | 45 | ICMR | 0.0412 | 2.889 | 0.119 |
| 6. | Phosphate | 0.4 | 25 | USPH | 0.0618 | 1.600 | 0.099 |
| 7. | Sulphate | 2.5 | 150 | ICMR | 0.0103 | 1.667 | 0.017 |
| 8. | Alkalinity | 37.3 | 120 | ICMR | 0.0155 | 31.083 | 0.482 |
| 9. | Hardness | 48.4 | 300 | WHO | 0.0051 | 16.133 | 0.083 |
| 10. | BOD | 1.14 | 5 | ICMR | 0.3723 | 22.800 | 8.488 |
| 11. | DO | 7.72 | 5 | ICMR | 0.3088 | 71.667 | 22.131 |
| | | | | ∑ | **1.4161** | **400.566** | **86.828** |
| **Water Quality Index = $\sum W_n q_n / \sum W_n$ = 61.315** | | | | | | | |

**Table 5: Calculation of Water Quality index in in Winter season**

| NO | Parameters | Observed Value | Standards (Sn) | Recommended Agency | Unit weight (Wn) | Quality Rating (qn) | Wn qn |
|---|---|---|---|---|---|---|---|
| 1. | Conductance | 299.78 | 300 | WHO | 0.3710 | 99.93 | 37.073 |
| 2. | TDS | 196.75 | 500 | ICMR | 0.0037 | 39.35 | 0.146 |
| 3. | pH | 8.22 | 7-8.5 | ICMR | 0.2190 | 81.33 | 17.812 |
| 4. | Chlorides | 82.38 | 250 | ICMR | 0.0074 | 32.95 | 0.244 |
| 5. | Nitrates | 0.62 | 45 | ICMR | 0.0412 | 1.38 | 0.057 |
| 6. | Phosphate | 0.28 | 25 | USPH | 0.0618 | 1.12 | 0.069 |
| 7. | Sulphate | 3.28 | 150 | ICMR | 0.0103 | 2.19 | 0.023 |
| 8. | Alkalinity | 49.09 | 120 | ICMR | 0.0155 | 40.91 | 0.634 |
| 9. | Hardness | 64.80 | 300 | WHO | 0.0051 | 21.60 | 0.111 |
| 10. | BOD | 2.10 | 5 | ICMR | 0.3723 | 42.00 | 15.637 |
| 11. | DO | 8.27 | 5 | ICMR | 0.3088 | 65.94 | 20.362 |
| | | | | ∑ | **1.4161** | **428.69** | **92.166** |
| **Water Quality Index = $\sum W_n q_n / \sum W_n$ = 65.080** | | | | | | | |

## 5. Discussion

Water quality index of the present waterbody is established from important various physicochemical parameters indifferent seasons. The values of various physicochemical parameters for calculation of water quality index are presented in the Table 3.

The water quality index obtained for water body in different season of study period i.e. rainy season and winter season are **61.315** and **65.08** respectively, which indicates slightly poor quality of water [9].

The above water quality is also supported by the following physicochemical parameters variations observed during the different seasons of the study. The conductance of water body varies between 299.78 -373.4 µS/cm. The higher values of conductance were observed during rainy season, the higher values of conductance might be due to the addition of different nutrients, and agricultural

runoff in the main stream [10]. The TDS values are in the range 196.75- 244.3mg/L are lower than the prescribed limits of ICMR and ISI i.e. 500mg/l. The pH of the water indicates as an alkaline nature it varies between 7.6 and 8.22. The recommended value of it by ISI is 6.5 to 8.5 and by ICMR 7.0 – 8.5. The chloride concentration results in salty taste of water. Some times higher concentration of it is responsible for laxative effect to the human beings. The concentration of chloride varied between 82.38 – 98.50 mg/L which are well below the prescribed limits of WHO. The nitrates are the end product of the decomposition of organic waste present in the fully oxidized water and harmful above 45 mg/L .In the present study nitrate in the surface water are well below the permissible limits. The seasonal average statistic shows that maximum phosphate value was seen in rainy season i.e. 0.4 mg/L while minimum in winter season i.e. 0.28 mg/L [11]. These values were very well below the prescribed limits of USPH. The sulphate may have laxative effect if magnesium ion is present at an equivalent concentration [9]. In the present study sulphate concentration is held well below permissible limits. The value of sulphate concentration ranged within 2.5- 3.28 mg/L. The alkalinity itself is not harmful to the human beings but desirable limits to 120 mg/L are always required for domestic supply of water. The total alkalinity values were within the 37.3 – 49.09 mg/L. The hardness values were recorded as 48.4 – 64.8 mg/L, higher value of hardness were observed during winter which may be due to the low water level, this values are well below the desired limits of WHO (< 300mg/L) dissolved oxygen varied from 7.72 – 8.2 mg/L .The BOD values are 1.14 - 2.10 mg/L which very well below the prescribed limits indicates unpolluted water.

## 6. conclusion

Application of the WQI is a useful method in assessing the water quality of the surface water. In the present study application of water quality index gives comparative evaluation of water quality in the different season. The present result shows that WQI in the rainy season are lesser than winter season. Average WQI i.e.63.1975 shows that in both seasons these values are in between 50 and 75 indicates poor quality water, suitable for agricultural and industrial use and is suitable for drinking purpose after suitable treatment only.

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## References

1] Census of India 1991, District Census Handbook, Ahmednagar (Series-14, Part XII-A and B). 114-116p.
2] APHA2005, standard Methods for the examination of water and west water.
3] Trivedy R.K. and Goel P.K.1986.Chemical and Biological Methods for water pollution studies. Env. Pub. India.
4] WHO1992 International standards for Drinking Water. Word Health Organization, Geneva, Switzerland.
5] BIS 1983 Standards for water for drinking and other purpose, Bureau of Indian standards, New Dehli.
6] ICMR1975, Manuual of Standards of Quality for Drinking Supplies. Indian Councile of medical Research,New Delhi.
7] Haorton,R.K., 1965. An index number system for rating water quality. Journal of Water Pollution.Cont.Fed.,3:300-305.
8] Broun, R.M. Mc Chalieland, N.J., Deininger, R.A., and O'Lonnor, M.F. 1972. A Water Quality Index Crossing the psychological barrier. Jenkis, S.H. (ed).Proc. Int. conf. on water pollution Res., Jerusalem, 6:187 – 1971993 Analysis of water and waste water, Bureau of Indian Standards, New Dehli.
9] Chaterjiee,C. and Raziuddin,M.2002. Determination of water quality index of a degraded river in Asansol Industrial area, Raniganj, Burdwan, West Bengal.Nature, Environment and pollution Technology,1(2): 181-189.
10] Gupta, A. K. and Singh, S. K. 2003 Changing wetland due to discharge of effluent from small-scale industries around Varuna River Corridor. Eco. Env. And Cons., 9(2): 209-211(7*)
11] Dhembare A. J. (2007), studies on physico chemical parameters of Mula Dam water, Rahuri, Ahmednagar, India. Journal Short Communication 26 (2): 259-261