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Original Research Paper

# Hydrobiological Status of A Freshwater Body, Rural Area of Ahmedabad, Gujarat

Zoology

**KEYWORDS :** Ghuma Lake, WQI and Algal genus pollution index

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## ABSTRACT

*The present study was intended to calculate Water Quality Index (WQI) of a rural freshwater body in Ghuma village, in order to ascertain the quality of water for public consumption, recreation and other purposes. This paper deals with the study on the influence of environmental parameters on the water quality of water body. There are several ways to assess the quality of water deemed fit for drinking, irrigation and industrial use. Water Quality Index, indicating the water quality in terms of index number, offers a useful presentation of overall quality of water for public or for any intended use as well as in the pollution abatement programmes and in water quality management. In this study Water Quality Index was determined on the basis of various physico-chemical parameters.Palmer stated that composite rating of algae, tolerating organic pollution and developed an index to establish the status of the aquatic body. In this method to determine the level of organic pollution by studying the algae present in a sample of water*

## INTRODUCTION:

The freshwater is of vital concern for mankind. The surface water bodies are the most important sources of water for human activities are unfortunately under a severe environmental stress and are being threatened as consequence of developmental activities. Ghuma Lake is natural water body and is located on the western part of Ghuma village. 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 useful for public. 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.

## STUDY AREA:

The Ghuma Lake is a natural lake and is located on the western part of Ghuma village. The sewage waste of Ghuma village is directly discharge into this lake. The People of village also use this lake to wash their cloths, take bath, sanitation, etc. The cattle of the villagers also take bath in this lake. The Lake covers an area of 84479sq.m. Peripheral area of the lake is 466.22 m. and depth is 21 feet. Its exact geographical location is 230 01′ 57.32″ N Latitude and 720 26′ 56.15″ E Longitude, and 140 feet above sea level.

## MATERIALS AND METHODS:

The water sample from the water body were collected early in the morning at an interval of 30 days and analyzed for 12 physico-chemical parameters by following the established procedure. During study period WQI has been calculated by using the standards of drinking water quality recommended by the World Health Organization (WHO, 1992 and 2003), Bureau of Indian Standards (BIS, 1993 and 2003) and Indian Council of Medical Research (ICMR, 1975). The weighted arithmetic index method (Brown etal., 1972) has been used for the calculation of WQI of the water body. Further, quality rating or sub index (qn) was calculated by following expression.

**qn = 100[Vn– V10] / [Sn – V10]**

Where:

**qn** = Quality rating for the nth water quality parameter,

The overall Water Quality Index was calculated by aggregating the quality rating with the unit weight linearly.

**WQI = ΣqnWn/ ΣWn**

**Table 1.Water Quality Index (WQI) and status of water quality (Chatterji and and Thakor,2011 and Kotadiya et. al.,2014).**

| Table 1.Water Quality Index (WQI) and status of water quality. | |
|---|---|
| Water Quality Index Level | 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 |

Table 2. Drinking water standards recommending agencies and unit weights.

| SR. NO. | PARAMETERS | STANDERED VALUES | RECOMMENEDED AGENCY | DESIRABLE UNIT WEIGHT |
|---|---|---|---|---|
| 1 | pH | 6.5-8.5 | ICMR/BIS | 0.219 |
| 2 | EC | 300 | ICMR | 0.371 |
| 3 | TDS | 500 | ICMR/BIS | 0.0037 |
| 4 | Alkalinity | 120 | ICMR | 0.0155 |
| 5 | Total hardness | 300 | ICMR/BIS | 0.0062 |
| 6 | Mg hardness | 30 | ICMR/BIS | 0.061 |
| 7 | Ca hardness | 75 | ICMR/BIS | 0.025 |
| 8 | Nitrate | 45 | ICMR/BIS | 0.0412 |
| 9 | DO | 5 | ICMR/BIS | 0.3723 |
| 10 | BOD | 5 | ICMR | 0.3723 |
| 11 | Sulphate | 150 | ICMR/BIS | 0.01236 |
| 12 | Chloride | 250 | ICMR | 0.0074 |
| All values except pH and Electrical Conductivity are in mg./L | | | | |

*Note: Regional Director, Central Ground Water Board, Ministry of Water Resources, Kedaram, Kesavadasapuram, Trivandrum - 695 004

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The water samples for phytoplankton analysis were collected from Ghuma lake for a period of 12 months. The sample was preserved in 4 % formalin. The methods for the examination of water as prescribed by American Public Health Association, (APHA-1995), ICMR, (1975), Indian standards specifications for drinking water BIS (2003). Brown, et, al. (1972).

Chaterjee et, al., (2002). International standards for drinking water, World Health Organisation, Geneva, (WHO-2005).

The standard method suggested in APHA, (1995), Fresh Water Biology by Edmondson, W. T., (1959) and Algae of the western great Lakes areas by Prescott G.W., (1970) used for assessing water quality includes collection, counting and identification of phytoplankton. Plankton net number 25 of mesh size 20 μm was used for collecting samples. 50 liters of water was measured in a graduated bucket and filtered through the net and concentrated in a 100 ml bottle. Samples were collected as close to the water surface as possible in the morning hours. The samples were labeled with the date, time, and study area i.e. name of Lake and the volume measured and pasted on the containers. Plankton is preserved by using 4% formalin. The sample was allowed to settle for 24-48 hours and was further concentrated to approximately 30 ml by decanting. Sedgwick Rafter counting cell is used to count the plankton. A trinocular microscope is used to count the plankton with different eyepieces such as 10X and 40X.

Palmer reviewed a composite rating of algae, tolerating organic pollution and developed an index to establish the status of the aquatic body. In this method to determine the level of organic pollution by studying the algae present in a sample of water. If there are 5 or more cells of a particular kind of algae on a slide, the alga must be identified and recorded. The index numbers of the algae are then added. Any algae that are not listed have a pollution factor of zero. A pollution index factor of 1 through 5 has been assigned to each of the 20 types of algae that are most tolerant to organic pollution. Types of algae most tolerant of organic pollution were assigned a factor of 5. Less tolerant types were assigned a lower number. If the pollution index score is 20 or more, the score is evidence of high organic pollution. A score of 15-19 indicates probable organic pollution. Lower scores usually indicate less organic pollution, but they may also occur if something is interfering with algae growth (Table 3 and 4).

Table 3. Algal genus pollution index (Palmer 1969)

| Algal genus | Pollution index | Algal genus | Pollution index |
|---|---|---|---|
| Anacystis | 1 | Micractinium | 1 |
| Ankistrodesmus | 2 | Navicula | 3 |
| Chlomydomonas | 4 | Nitzschia | 3 |
| Chlorella | 3 | Oscillatoria | 5 |
| Clostrium | 1 | Pandorina | 1 |
| Cyclotella | 1 | Phacus | 2 |
| Euglena | 5 | Phormidium | 1 |
| Gomphonema | 1 | Scenedesmus | 4 |
| Lepocinclis | 1 | Stigeoclonium | 2 |
| Melosira | 1 | Synedra | 2 |

Table 4. Palmer pollution index score

| Pollution index score | pollution status |
|---|---|
| 20 or more | High organic pollution |
| 15 - 19 | Probable organic pollution |
| Less than 15 | Less organic pollution |

**RESULT AND DISCUSSION:**

Table 5. Seasonal variation in the physico-chemical parameters of Ghuma lake

| SR.NO. | PARAMETERS | MONSOON SEASON | WINTER SEASON | SUMMER SEASON |
|---|---|---|---|---|
| 1 | pH | 7.6 | 7.88 | 8.25 |
| 2 | EC | 1.6 | 1.43 | 2.4 |
| 3 | TDS | 825 | 1017.5 | 1257.5 |
| 4 | Alkalinity | 255 | 297.5 | 310 |
| 5 | Total hardness | 250 | 272.5 | 290 |
| 6 | Mg hardness | 30.5 | 27.47 | 29.89 |
| 7 | Ca hardness | 50 | 65.5 | 66 |
| 8 | Nitrate | 0.74 | 0.74 | 0.76 |
| 9 | DO | 6.29 | 3.25 | 4.67 |
| 10 | BOD | 2.75 | 2.5 | 3.5 |
| 11 | Sulphate | 38.66 | 55.4 | 58.18 |
| 12 | Chloride | 196.25 | 263.75 | 338.75 |
| **WaterQuality Index** | | **49.61** | **59.52** | **65.21** |

Table 6. Calculation of Water Quality Index in monsoon season of Ghuma lake

| Sr. No. | PARAMETERS | OBSERVED VALUE **(Vn)** | STANDERED VALUES **(Sn)** | IDEAL VALUE**(V10)** | UNIT WEIGHT**(Wn)** | QUALIYT RATING **(Qn)** | **WnQn** |
|---|---|---|---|---|---|---|---|
| 1 | pH | 7.6 | 6.5-8.5 | 7 | 0.219 | 58.67 | 12.85 |
| 2 | EC | 1.6 | 300 | 0 | 0.371 | 0.48 | 0.18 |
| 3 | TDS | 825 | 500 | 0 | 0.0037 | 203.50 | 0.75 |
| 4 | Alkalinity | 255 | 120 | 0 | 0.0155 | 247.92 | 3.84 |
| 5 | Total hardness | 250 | 300 | 0 | 0.0062 | 90.83 | 0.56 |
| 6 | Mg hardness | 30.5 | 30 | 0 | 0.061 | 91.57 | 5.59 |
| 7 | Ca hardness | 50 | 75 | 0 | 0.025 | 87.33 | 2.18 |
| 8 | Nitrate | 0.74 | 45 | 0 | 0.0412 | 1.64 | 0.07 |
| 9 | DO | 6.29 | 5 | 14.6 | 0.3723 | 118.23 | 44.02 |
| 10 | BOD | 2.75 | 5 | 0 | 0.3723 | 50.00 | 18.62 |
| 11 | Sulphate | 38.66 | 150 | 0 | 0.01236 | 36.93 | 0.46 |
| 12 | Chloride | 196.25 | 250 | 0 | 0.0074 | 105.50 | 0.78 |
| | | | | | **∑Wn= 1.51** | **∑Qn= 917.18** | **∑WnQn= 74.918** |
| **WaterQuality Index = ∑WnQn/Wn = 49.61** | | | | | | | |

Table 7. Calculation of Water Quality Index in winter season of Ghuma lake

| SR. NO. | PARAMETERS | OBSERVED VALUE **(Vn)** | STANDERED VALUES**(Sn)** | IDEAL VALUE**(V10)** | UNIT WEIGHT**(Wn)** | QUALIYT RATING **(Qn)** | **WnQn** |
|---|---|---|---|---|---|---|---|
| 1 | pH | 7.88 | 6.5-8.5 | 7 | 0.219 | 58.67 | 12.85 |
| 2 | EC | 1.43 | 300 | 0 | 0.371 | 0.48 | 0.18 |
| 3 | TDS | 1017.5 | 500 | 0 | 0.0037 | 203.50 | 0.75 |
| 4 | Alkalinity | 297.5 | 120 | 0 | 0.0155 | 247.92 | 3.84 |
| 5 | Total hardness | 272.5 | 300 | 0 | 0.0062 | 90.83 | 0.56 |
| 6 | Mg hardness | 27.47 | 30 | 0 | 0.061 | 91.57 | 5.59 |
| 7 | Ca hardness | 65.5 | 75 | 0 | 0.025 | 87.33 | 2.18 |
| 8 | Nitrate | 0.74 | 45 | 0 | 0.0412 | 1.64 | 0.07 |
| 9 | DO | 3.25 | 5 | 14.6 | 0.3723 | 118.23 | 44.02 |
| 10 | BOD | 2.5 | 5 | 0 | 0.3723 | 50.00 | 18.62 |
| 11 | Sulphate | 55.4 | 150 | 0 | 0.01236 | 36.93 | 0.46 |
| 12 | Chloride | 263.75 | 250 | 0 | 0.0074 | 105.50 | 0.78 |
| | | | | | **∑Wn= 1.51** | **∑Qn=1092** | **∑WnQn= 89.89** |
| **WaterQuality Index = ∑WnQn/Wn = 59.52** | | | | | | | |

Table 8. Calculation of Water Quality Index in summer season of Ghuma lake

| SR. NO. | PARAMETERS | OBSERVED VALUE **(Vn)** | STANDERED VALUES **(Sn)** | IDEAL VALUE**(V10)** | UNIT WEIGHT**(Wn)** | QUALIYT RATING **(Qn)** | **WnQn** |
|---|---|---|---|---|---|---|---|
| 1 | pH | 8.25 | 6.5-8.5 | 7 | 0.219 | 83.33 | 18.25 |
| 2 | EC | 2.4 | 300 | 0 | 0.371 | 0.80 | 0.30 |
| 3 | TDS | 1257.5 | 500 | 0 | 0.0037 | 251.50 | 0.93 |
| 4 | Alkalinity | 310 | 120 | 0 | 0.0155 | 258.33 | 4.00 |
| 5 | Total hardness | 290 | 300 | 0 | 0.0062 | 96.67 | 0.60 |
| 6 | Mg hardness | 29.89 | 30 | 0 | 0.061 | 99.63 | 6.08 |
| 7 | Ca hardness | 66 | 75 | 0 | 0.025 | 88.00 | 2.2 |
| 8 | Nitrate | 0.76 | 45 | 0 | 0.0412 | 1.69 | 0.07 |
| 9 | DO | 4.67 | 5 | 14.6 | 0.3723 | 103.44 | 38.51 |
| 10 | BOD | 3.5 | 5 | 0 | 0.3723 | 70.00 | 26.06 |
| 11 | Sulphate | 58.18 | 150 | 0 | 0.01236 | 38.79 | 0.48 |
| 12 | Chloride | 338.75 | 250 | 0 | 0.0074 | 135.50 | 1.00 |
| | | | | | **∑Wn= 1.51** | **∑Qn= 1227.68** | **∑WnQn= 98.48** |
| **WaterQuality Index = ∑WnQn/Wn = 65.21** | | | | | | | |
| **Overall WaterQuality Index = 58.11** | | | | | | | |

Water quality Index of the present water body is established from important various physicochemical parameters in different seasons. The values of various physicochemical parameters for calculation of water quality index are presented in Table 3. Season wise Water Quality Index calculations are depicted in the Table 4, 5 and 6. The Water Quality Index obtained for the water body in different seasons of study period i.e., rainy season, winter season and summer season are 49.61, 59.52and 65.21 respectively, which indicate the poor quality of water (Chatterji and Raziuddin 2002 and Solanki and Karlikar, 2011).

This water quality rating study clearly shows that, the status of the water body is not suitable for drinking before its purification. It is also observed that the pollution load is relatively high during summer season when compared to the winter and rainy seasons.

The above water quality is also supported by the following physicochemical parameters variations observed during the different seasons of the study. Among all the physicochemical parameters selected for the Water Quality Index calculations, pH is an important parameter which determines the suitability of water for various purposes. In the present study pH range was between 7.6 to 8.25. However, when the average values for three seasons are taken into account the water body was found to be slightly alkaline. Ambasht (1971), Petre (1975), Shardendu and Ambasht (1988), Swarnalatha and Narasingrao (1993), Sinha (1995) and Verma*et al.(2010) have also made similar observations in their studies on different water bodies. Electrical Conductivity was very low and total dissolved solids were found to be very high. Season wise it is found to be high during summer season.*

Sulphates are found in natural water. Water containing high concentration of sulphate (more than 250 ppm) has laxative effect (in fact in earlier times MgSO4 known as Epsom salt was prescribed as a purgative medicine), which is enhanced when sulphate is consumed along with magnesium. Formation of SO4 depends on sulfur cycle in nature, which is both sedimentary and gaseous in nature. SO4 can be form through bacterial activity present in water(Verma, et al., 2011 and Solanki, 2012). Sulphate is within the desirable limits during present study.

Chloride is one of the most important parameter in assessing the water quality. Munawar (1970) is of the opinion that higher concentrations of chlorides indicate higher degree of organic pollution. In the present study the concentration of chloride fluctuated between 196.25 mg/L to 338.75 mg/L. seasonally, chloride was found to be high during summer season and low during rainy season. The chloride content was generally highest in summer. It starts rising from monsoon to summer. Chloride content has been found increasing post-monsoon through winter to summer, being lowest in the post-monsoon and highest in

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summer in most of the ponds. The reason for this can be attributed to the soil at bottom and climatic conditions prevailing in the area. Chlorides being water-soluble leach down on accumulation of rainwater in pond and hence the low values during monsoon and post-monsoon period. Once the monsoon is over and gradual shrinkage of the water body due to the evaporation, which accelerates with the rise of temperature and as a result, chloride concentration increases (Solanki, 2012). A similar observation has been made by Shastry et. al., (1970) Sinha (1995).

Much of the Dissolved oxygen in water comes from the atmosphere due to the wind (air) action. Algae and macrophytes aquatic plants also release oxygen to water through photosynthesis. The oxygen content of natural water varies with temperature, salinity, turbulence, respiration and photosynthetic activity of algae and higher plants and the atmospheric pressure. DO values were higher in those ponds where there was good aquatic life (Solanki, 2012). The concentration of dissolved oxygen regulates the distribution of flora and fauna. The present investigation indicated that the concentration of dissolved oxygen fluctuated between 4.67mg/L and 6.29mg/Lseasonally; the concentration of dissolved oxygen was more during monsoon and least during summer. The dissolved oxygen (DO) is some time referred to as measure of the pulse of an aquatic ecosystem (Pandit and Solanki 2004). The optimum range of dissolved oxygen in natural waters is 4 to 6 mg/L (Jayasree, 2002). The maximum value of dissolve oxygen was recorded during monsoon season, similar observations observed by Vijayan, (1991).

Bio-chemical oxygen demand is a parameter to assess the organic load in a water body. The increased levels of BOD indicated the nature of chemical pollution.BOD Variations were observed – maximum being in polluted waters and minimum in pollution free waters (Solanki, 2012).Many researchers have recorded higher BOD values in polluted water. The average BOD was 2.75 mg/L during rainy season, 2.50 mg/L during winter season and 3.5 mg/L during summer season. The BOD values obtained in the present study are within the ICMR standards. Seasonally, it was high during summer (Chatterjee, 1992).

Table 9. Palmer algal genus pollution index for Ghuma lake

| Algal genus | Pollution index | Monsoon | Winter | Summer |
|---|---|---|---|---|
| Anacystis | 1 | - | - | - |
| Ankistrodesmus | 2 | - | - | - |
| Chlomydomonas | 4 | - | - | - |
| Chlorella | 3 | - | - | - |
| Clostrium | 1 | - | - | - |
| Cyclotella | 1 | - | - | 1 |
| Euglena | 5 | 5 | 5 | 5 |
| Gomphonema | 1 | - | 1 | 1 |
| Lepocinclis | 1 | - | - | - |
| Micractinium | 1 | - | - | - |
| Navicula | 3 | 3 | 3 | 3 |
| Nitzschia | 3 | 3 | 3 | 3 |
| Oscillatoria | 5 | 5 | 5 | - |
| Pandorina | 1 | - | - | - |
| Phacus | 2 | - | - | - |
| Phormidium | 1 | - | - | - |
| Scenedesmus | 4 | - | - | 4 |
| Stigeoclonium | 2 | - | - | - |
| Synedra | 2 | - | - | - |
| Palmer algal genus pollution index value of Ghuma lake | | 16 | 17 | 17 |
| Over all Palmer algal genus pollution index value of Ghuma lake | | 16.66 | | |

The use of algae as biological indicators of pollution has been studied by rating pollution tolerant algae in the Ghuma lake based on the report of Palmer, (1959). Total of 608 genera count/ml of algae were recorded from Ghuma lake. During monsoon season algal pollution index was 16, in winter season algal pollution index was 19, summer season algal pollution index was 17 and over all algal pollution index was 16.66 (Table 9). The algae from Ghuma lake were indicated the organic pollution shows the dominance of *Scenedesmus sp.*, *Navicula sp.*, *Nitzschia sp.*, *Euglena sp.* etc throughout the study (Ayodhya, 2013), which considered to be indicators of organic pollution. The similar observations were encountered by Jafari and Gunale, (2006); Trivedi, (1988), Upadhyay et. al., (2013).

**CONCLUTION:**

Some of the samples have pH, EC, Total hardness, Magnesium, Calcium, Sulphate, Nitrate, DO, and BOD values in the permissible limits and TDS, Alkalinity and Chloride values exceeding the permissible limits as prescribed by Indian standards. However, the WQI values in the present investigation were reported 49.61 in monsoon season 59.52 in winter season 58.11 in summer season and overall WQI value was 58.11.Above results were less than 75 (Water Quality Index Level) for different season indicating that the water quality is poor and not totally safe for human consumption.

Season wise and over all pollution index showed that probable organic pollution in Ghuma lake (Table 4 and 9). Palmer, (1969) suggested that algae are reliable indicators of water pollution as it was true in present study. These pollution tolerant algae can be used for remediation of domestic wastewater.

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