

## Water Quality Status Of Fresh Water Of Bhakuchi Wadi From Sangli District Of Maharashtra (India)

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### Abstract:

The study represents on influence of environmental parameters on water quality at Bhakuchi wadi reservoir in Khanapur tahsil of Sangli district on the basis of water quality (WQI). WQI was determined on the basis of various parameters like pH, dissolved oxygen, total alkalinity, total hardness, calcium, magnesium, chlorides, total dissolved solids (TDS) and biological oxygen demand (BOD) for which no earlier reports are available on this water body.

During this investigation, it was observed that some parameters are within the range prescribed by WHO, ICMR, BIS etc. But some parameters are beyond the permissible limit.

Key Words: Bhakuchi wadi reservoir, WQI, Sangli district, Maharashtra.

### Introduction:

**F**resh water has become a scarce commodity due to over exploitation and pollution of water. Increasing population and its necessities has lead to the deterioration of surface and subsurface water.

Water is the prime natural resource, a basic human need and a precious national asset. The quality of water is of vital concern for mankind since it is directly linked with human welfare. Water is utilized for domestic purpose, for industrial applications, agriculture purpose, as well as for inland fishery.

Water and life are two sides of the same coin. Life initiates and grows in the lap of water. Water is very vital to all forms of lives from very small organisms to very complex systems of plants, animals and human being. The purity of water varies from place to place in nature.

Water Quality Index (WQI) is one of the most effective tools to communicate information on the quality of water to concerned citizens and policy makers (WHO 1993, APHA 1992, ICMR 1975).

The WQI evaluates the values to each water quality parameter relative to its objective value. WQI is based on some important parameters that can provide a simple indicator of water quality. It gives the public a general idea of the possible problems with water in a particular region. Nine parameters were taken for WQI calculations namely, pH, dissolved oxygen, total alkalinity, total hardness,

calcium, magnesium, chlorides, total dissolved solids and biological oxygen demand. The water quality index is unit less single dimensional number between 0 and 100.

### Material And Methods:

#### Study Area:

The Bhakuchi wadi is small village located at northern part of Khanapur tahsil and northern part of district 70 km away from district place. The village is known for its minor reservoir. In 1988-91 Irrigation Department has constructed earthen dam riveted with stones. The water is used for irrigation also for washing, bathing and fishing activities. The reservoir is much influenced by human activities and weeds.

The total catchment area is 261.24 sq. miles, the total capacity of storage is 680.33 Mcft and dead storage is 59.96 Mcft. Length of dam including slipway is 150 meter having clear overflow type of slipway. The height of dam is 19.70 meter and is of earthen type. The submergence area is 108.80 hectare. The bottom of reservoir is rocky. Hence reservoir shows very less macrophytes.

During rainy season i.e. from mid June, July, August and September the farmers allow their buffalows grazing on lush green grasses in catchment area. Very less macrophyte occur in the reservoir.

The reservoir stores rain water received from adjoining catchment area and is much influenced by anthropogenic activities.

The sampling sites were selected by considering the inflow, outflow and anthropogenic

activities. Three sampling sites for each reservoir were selected for monthly analysis. The water samples were collected approximately 10–15 meters from border line of each wetland in pre-cleaned five liter plastic cans and immediately brought to the laboratory for various physico-chemical analysis. Therefore, sampling sites were constant through out the annum.

The calculation of WQI was made using weighted arithmetic index method. (Brown *et al.*, 1970 and 1972) in follows.

**Water Quality Index:**

In lakes the pollution increases through surface run off and precipitation of chemical pollutants of industry, domestic and agriculture. Anthropogenic activities are one of the important factors of pollution. Horton (1965) proposed that first WQI and classification of WQI by considering various water bodies.

For calculations of WQI, selection of parameters has great importance which widens the quality index. Nine physico chemical parameters namely pH, dissolved oxygen, total alkalinity, total hardness, calcium, magnesium, chlorides, total dissolved solids and biological oxygen demand were used to calculate WQI.

**Calculations of quality rating (q<sub>n</sub>):**

Let there be n, water quality parameters and quality rating (q<sub>n</sub>) corresponding to n<sup>th</sup> parameter is a number reflecting the relative value of this parameter in the polluted water with respect to its standard permissible value. The q<sub>n</sub> is calculated by using the following expression-

$$Q_n = 100 (V_n - V_{10}) / (S_n - V_{10})$$

Where,

Q<sub>n</sub>= Quality rating for the n<sup>th</sup> water quality parameter.

V<sub>n</sub>= estimated value of n<sup>th</sup> parameter at a given sampling stations.

S<sub>n</sub> = standard permissible value of n<sup>th</sup> parameter

V<sub>10</sub>= ideal value of n<sup>th</sup> parameter in pure water.

All the ideal values n<sup>th</sup> parameter (V<sub>10</sub>) are taken as zero for the drinking water except for pH = 7.0 and dissolved oxygen = 14.6 mg/L.

**Calculation of quality rating for pH:**

For, pH, ideal value is 7.0 (neutral water) and permissible value is 8.20. Therefore, quality rating for pH is calculated from following relation,

$$q_{pH} = 100 [ (V_{pH} - 7.0 ) / (8.20 - 7.0) ]$$

Where, V<sub>pH</sub> = observed value of pH.

**Calculation of quality rating for dissolved oxygen:**

The ideal value is for dissolved oxygen is 14.6 mg/L. and standard permissible value for drinking water is 5 mg/L. Therefore, quality rating is calculated from following relation,

$$q_{DO} = 100 [ (V_{DO} - 14.6) / (5 - 14.6) ]$$

Where, V<sub>DO</sub> = measured value of dissolved oxygen.

**Calculation of unit weight (W<sub>n</sub>):**

The unit weights (W<sub>n</sub>) for various water quality parameters are inversely proportional to the recommended standards for the corresponding parameters.

$$W_n = K / S_n$$

Where, W<sub>n</sub>= unit weight for n<sup>th</sup> parameters,

S<sub>n</sub> = standard value n<sup>th</sup> parameters.

K= constant for proportionality

**Calculation of WQI:**

WQI is calculated from the following equation

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

**Result And Discussion:**

The average values of Bhakuchi wadi reservoir of various parameters are used for WQI calculations and depicted in Table 1.

The average value of pH was 8.33. The values pH remained alkaline throughout the study period. But the annual fluctuations were negligible, indicating good buffering capacity. According to WHO (1993) the desirable pH of drinking water is 7.0 to 8.5. The water pH ranging between 6.5 to 9.0 at daybreak is most suitable for better aquaculture (Jhingran 1982). In the present work the highest values of pH during summer may possibly due to removal of sufficient amount of CO<sub>2</sub> by photosynthetic process of the aquatic system. (Solanki *et al.* 2005, Kaur *et al.* (1997).

It is interesting here to note that, dissolved oxygen was rises appreciably during summer and decreases in monsoon months. However, very little variation is observed during summer and monsoon.

The amount of dissolved oxygen in Bhakuchi wadi was 5.23 mg/L. The minimum dissolved oxygen limit for fish growth is 4.0 mg/L (Jhingran 1982). According to APHA (1985) the lowest dissolved oxygen for maintaining fish in healthy condition is 5.0 mg/L and the critical value is

3.0 mg/L. In present study the range of dissolved oxygen is found optimum for fish growth. Relatively higher values of dissolved oxygen during summer probably as a result of photosynthetic activity (Solanki *et.al.*2007). Similar type of observation made by Khare *et. al.* (2007).

The range of total alkalinity varied from 114 mg/L to 252 with average value 306.67 mg/L at Bhakuchi wadi. During rains total alkalinity declines while, rises up to summer season. Many workers have observed similar pattern of variation in total alkalinity which support present findings (Shrivastava (2005), Hujare (2008), Sukhija (2007), Sharma and Jain (2000), Chatterjee and De (2008).

Hardness values were recorded within 106 mg/L to 336 mg/L with mean 306.67 mg/L at Bhakuchi wadi. Definite pattern of seasonal variation was noticed i. e. maximum during summer and minimum was noticed during winter. Hujare and Mule (2008) and Pundhir and Rana (2002) have also noticed maximum hardness in summer and minimum in winter. Alaka Patil (2011) has noticed definite pattern of seasonal variation was noticed for Bhambarde and Lengre reservoirs in Khanapur tahsil of Sangli district.

At Bhakuchi wadi calcium content ranged between 41.21 mg/L to 58.26 mg/L. Calcium content was found minimum during winter and maximize in summer, this view has also been supported by the findings of Awasti and Tiwari (2004). Subhashini and Saradhamani (2005) have recorded similar pattern of change in calcium content.

The concentration of magnesium in Bhakuchi wadi reservoir varied from 30.12 mg/L to 35.07 mg/L. Maximum magnesium content was observed in summer season. The concentration of magnesium was minimum than concentration of calcium possibly due to lesser occurrence of magnesium minerals in bottom strata of reservoir.

According to WHO (1993) and BIS (1991) the permissible limit for magnesium content in drinking water is 50 mg/L. The present results of reservoir were within the permissible limit. Sobha and Harilal (2005) have recorded similar observation at Ampalthara. Similar pattern of changes were also recorded by Khare *et. al.* (2007), Subhashini and Saradhamani (2005)

The average value of chloride for Bhakuchi wadi was 33.15 mg/L. In present investigation, chloride values in reservoir were found increased during summer and decreased in winter. According to WHO (1993) and BIS (1991) permissible limit of chloride is 200 mg/L for drinking water. Therefore, it is noted that the water is fit for drinking. The chloride concentration reached maximum during summer, as the level of reservoir attained low level. However, this may be one of the reasons the values decreased steadily through monsoon and reached minimum in winter due to dilution. Similar condition was observed by Anand and Sharma (2000), Sharma and Jain (2000), Vijay Kumar *et.al.* (2005) and Khare *et.al.* (2007).

The amount of total dissolved solids detected from water sample at Bhakuchi wadi were 212 mg/L to 526 mg/L. There was steep fall in total dissolved solids values during winter season, while content increases during summer. Rincy and Tessy (2010) and Shrivastava and Alam (2007) have observed higher concentration of total dissolved solids during pre-monsoon season. Sukhija (2007) has recorded minimum total dissolved solids values during December.

Biological Oxygen Demand at Bhakuchi wadi reservoir was 2.63 mg/L. Minimum BOD values were observed during December and maximum during May. Similar fluctuations in BOD values were reported by Subhashini and Saradhamani (2005), Vijay Kumar *et. al.* (2005), and Chatterjee and De (2008). WHO (1993) specify that the drinking water should be devoid of BOD. Accordingly the present values for the reservoir suggested the contaminating status. It may be due to human and cattle activities in and around the reservoir. Singh and Gupta (2004), Raghuwanshi (2005), Sudeep *et.al.* (2008) and Agrawal *et. al.* (2004) explained that, the highest values of BOD during summer were attributed to biological activity, due to high organic decomposition during summer. In winter, microbial activity lowers hence values of BOD decreases.

#### **Conclusion:**

During rainy season WQI was 82.27, at winter season 73.57 and at summer season 84.77 at Bhakuchi wadi. According to Bhargava (1989)

Classification of WQI, the water of Bhakuchi wadi reservoir is in permissible category during all seasons. As per Classification of Abbasi (2002) this reservoir water is good to excellent indicating pollution less water for local inhabitants. Similar pattern of water quality was reported in Atpadi reservoir by Patil Alaka (2013).

<b>65 to 89</b>	Permissible	50-63	Good	B
<b>39 to 64</b>	Marginally Suitable	38-50	Bad	C
<b>11 to 34</b>	Inadequate for use	38	Very Bad	D,E
<b>0&lt;</b>	Totally unsuitable			

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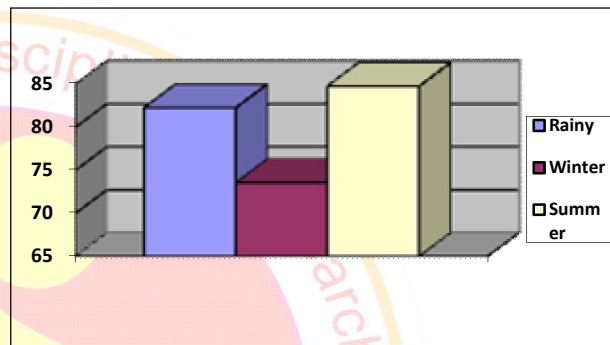
Table 1. WQI Calculation of Bhakuchi wadi reservoir by considering mean values of year Aug. 2016 to July 2017.

Sr. No.	Parameters	Standard Values (Sn)	1/Sn	Unit weight (Wn)	Observed Values	Quality rating (qn)
1	pH	7	0.1429	0.236	8.33	87.333
2	DO	5	0.2000	0.330	5.23	97.889
3	Total Alkali	120	0.0083	0.014	163.17	135.975
4	Total Hard.	500	0.0020	0.003	201.33	40.266
5	Calcium	75	0.0133	0.022	47.39	63.187
6	Magnesium	30	0.0333	0.055	32.4	108.000
7	Chlorides	250	0.0040	0.007	33.15	13.260
8	TDS	500	0.0020	0.003	306.67	61.334
9	BOD	5	0.2000	0.330	2.63	52.600
<b>WQI = 79.90</b>						

• Except pH all values are expressed as mg/L

Table 2. WQI as per Bhargava (1989)		Table 3. WQI as per Abbasi S. A. (2002)		
WQI Values	Classification	WQI	Description	Class
90>	Excellent	63-100	Good to Excellent	A

Fig. 1 Seasonal WQI of Bhakuchi wadi reservoir during Aug. 2017 to July 2018



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