WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 11, Issue 9, 975-984. Research Article ISSN 2277– 7105

WQI STATUS OF FRESH WATER OF NIMBAVDE RESERVOIR FROM SANGLI DISTRICT OF MAHARASHTRA (INDIA)

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Article Received on
10 May 2022,

Revised on 31 May 2022,
Accepted on 21 June 2022

DOI: 10.20959/wjpr20229-24710

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ABSTRACT

This investigation represents on influence of environmental parameters on water quality at Nimbavde reservoir in Atpadi 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 World Health Organization, Indian Council of Medical Research, Bureau Indian Standard etc. This Nimbavde reservoir water is good to excellent indicating pollution less water for local inhabitants.

KEYWORDS: *Nimbavde reservoir, WQI, Sangli district, Maharashtra.*

INTRODUCTION

Increasing population and the necessities has led to the deterioration of surface and subsurface water of reservoir. Fresh water has become a scarce commodity due to over exploitation and pollution of water now a days.

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.

MATERIALS AND METHODS

Study Area

The Atpadi is a tahsil place and it is 105 km away from district place. Nimbavade is well known minor irrigation reservoir. In the period 1981-1988 Irrigation Department has constructed earthen Dam riveted with stones. The purpose of construction of reservoir is irrigation, but it is neglected for many years. Recently it is used for irrigation, for human activities and for fish culture. The reservoir is much influenced by human activities and weeds.

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

The Average rainfall in this area is 29.56 inches. The total catchment area is 109.49 sq. km, the total capacity of storage is 11 Mcft and dead storage is 35.35 Mcft. Length of dam including slipway is 887.50 meter having clear overflow type of slipway. The height of dam is 16.31 meter and is of earthen type. The submergence area is 66 hectares. Water spread is 533 hectares. 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 buffallows grazing on lush green grasses in catchment area. Very less macrophyte occur in the reservoir.

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 reservoir in pre-cleaned five-liter plastic cans and immediately brought to the laboratory for various physico-chemical analysis. Therefore, sampling sites were constant throughout the annum.

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

Let there be n, water quality parameters and quality rating (q_n) corresponding to n^{th} parameter is a number reflecting the relative value of this parameter in the polluted water with respect to its standard permissible value. The q_n is calculated by using the following expression.

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

Where,

Q_n= Quality rating for the n^{th} water quality parameter.

V_n= estimated value of n^{th} parameter at a given sampling stations.

S_n = standard permissible value of n^{th} parameter

V_{10}= ideal value of n^{th} parameter in pure water.

All the ideal values n^{th} parameter (V_{10}) 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_{pH} = 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_{DO} = measured value of dissolved oxygen.

Calculation of unit weight (W_n)

The unit weights (W_n) for various water quality parameters are inversely proportional to the recommended standards for the corresponding parameters.

$W_n = K \backslash S_n$

Where, W_n= unit weight for n^{th} parameters,

S_n = standard value n^{th} parameters.

K= constant for proportionality

Calculation of WQI

WQI is calculated from the following equation

$WQI = \sum q_n w_n / \sum w_n$

RESULTS AND DISSCUSSION

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

Table 1: WQI Calculation of Nimbavde reservoir by considering mean values of year Aug 2019 to July 2020.

Sr. No.	Parameters	Standard Values (Sn)	1/Sn	Unit weight (Wn)	Observed Values	Quality rating (qn)
1.	pH	7	0.143	0.236	8.43	87.333

2.	DO	5	0.200	0.330	6.43	97.889
3.	Total Alkali.	120	0.008	0.014	308.92	257.433
4.	Total Hard.	500	0.002	0.003	270.33	54.066
5.	Calcium	75	0.013	0.022	45.68	60.907
6.	Magnesium	30	0.033	0.055	20.25	67.500
7.	Chlorides	250	0.004	0.007	44.22	17.688
8.	TDS	500	0.002	0.003	395.92	79.184
9.	BOD	5	0.200	0.330	3	60.000
WQI = 81.86						

- Except pH all values are expressed as mg/L

The average value of pH was 8.43. 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_2 by photosynthetic process of the aquatic system. (Solanki *et. al.*2005, Kaur *et. a*l. (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 Nimbavde was 6.43 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 230.5 mg/L to 417.75 with average value 308.92 mg/L. 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 221 mg/L to 321 mg/L with mean 306.67 mg/L at Nimbavde. 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 Nimbavde calcium content ranged between 29.54 mg/L to 51.83 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 Nimbavde reservoir varied from 18.43 mg/L to 24.01mg/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 Nimbavde was 44.22 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 Nimbavde were 257.93 mg/L to 501.53 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 Nimbavde reservoir was 3 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 Biological Oxygen Demand. 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.

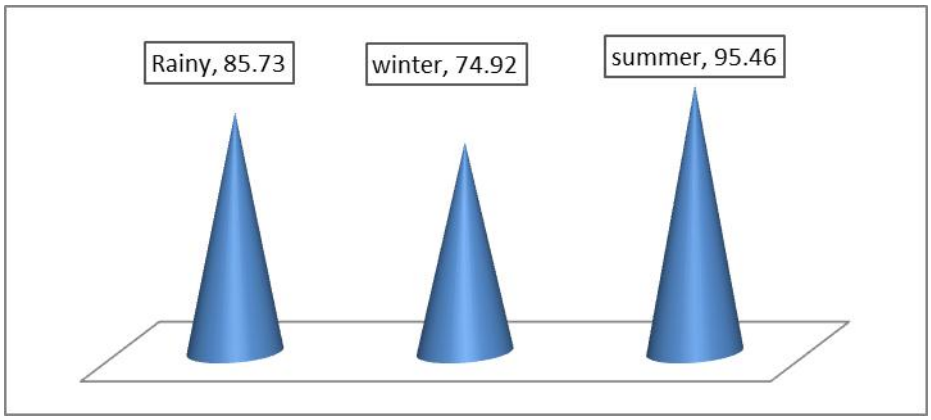

Fig. 1: Seasonal WQI of Nimbavde reservoir during Aug. 2019 to July 2020.

Table 2: WQI as per Bhargava (1989).

WQI Values	Classification
90>	Excellent
65 to 89	Permissible
39 to 64	Marginally Suitable
11 to 34	Inadequate for use
0<	Totally unsuitable

Table 3: WQI as per Abbasi S. A. (2002)

WQI	Description	Class
63-100	Good to Excellent	A
50-63	Good	B
38-50	Bad	C
38	Very Bad	D, E

CONCLUSION

During rainy season WQI was 85.73, at winter season 74.92 and at summer season 95.46 at Nimbavde. (Figure 1) According to Bhargava (1989) (Table 2) Classification of WQI, the water of Nimbavde reservoir is in permissible to excellent category during all seasons. As per Classification of Abbasi (2002) (Table 3) 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).

ACKNOWLEDGEMENT

Author is thankful to Dr. M. S. Hujare, Principal, P.D.V.P. Mahavidyalaya, Tasgaon, and Dist Sangli (MS) for encouragement and providing necessary facilities to carry out the work.

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