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Determination of Water Quality Index of Three Different Water Bodies in Amravati City

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Abstract: Water is the main constituent of Earth's streams, lakes, oceans and fluid of most living organisms. Water quality is important because it directly affects health of not only human being as well as animals. Water quality monitoring is directly and indirectly related with chemistry, biology, statistics and also economics. This paper describes water quality index (WQI) of three different water bodies in Amravati city. These lakes are beautiful which invokes a natural attraction but there is need to develop these places from water quality point of view. Water quality index provides a single number that express overall water quality at certain location. The water quality index incorporates data from multiple water quality parameters into a mathematical equation that rates the health of water body with number. This study is also intended to check the pollution load of water bodies and to assess the usability of water therein for drinking, recreation and other uses if needed in future. The objective of study is monitoring the quality of surface water in order to protect our waterways from pollution.

Keywords: Water Quality Index (WQI), Water bodies, Monitoring, Surface Water, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD)

1. Introduction

Fresh and drinkable water is the need of present era for all human being as well as animals. No living thing can be alive without fresh water. Water bodies like river and lakes are interconnected with atmosphere. These water bodies play an important role not only in hydrological cycle but also in human welfare. Natural water bodies like rivers are subjected to pollution comprising of organic and inorganic constituent. This natural resource is being polluted by indiscriminate disposal of sewage, industrial waste and human activities which affect quality of river water[1]. The ever growing population exerts a great pressure on this resource.Where the very survival of man has become endangered. The concern for protecting the quality and overuse of earth's natural resources has been increasing in recent years all over the world[2].

The Water Quality Index (WQI) was first developed by Horton in the early 1970s, is basically a mathematical means of calculating a single value from multiple test results. The index result represents the level of water quality in a given water basin, such as lake, river or stream[3]. Water quality index is the number which gives an indication of the health of the water bodies at various points and can be used to keep a track of water quality over a period of time. To calculate the water quality index various physico–chemical parameters should be studied in detail and then their experimental values are substituted in the mathematical expression[4].

This study includes the Water Quality Index of three different water bodies in Amravati city. For this three lakes from Amravati city viz .Kondeshwar, Chhatri and Wadali were selected for the study. Chhatri lake was built in 1888 and is a reservoir which supplies drinking water to residence of Amravati city. It is situated 1 km from Dastur Nagar Square. Kondeshwar is a beautiful lake which invokes a natural attraction but there is need to develop this place from water quality point of view. Wadali lake is one of the popular reservoir is situated on Chandur Railway road towards east of Amravati. The objective of study is to check the suitability of water of Chhatri lake, Wadali lake and Kondeshwar lake for drinking purpose and to analyze changes in water quality over the time.

2. Material and Methods

2.1 Selection of water bodies

Amravati city which is also known as"Ambanagari" is the 8th most populous metropolitan area in the state. Amravati is located at 20.93degrees N77.75 degrees S. It has an average elevation of 343 meters. It lies 156 km west of Nagpur and serves as the administrative centre of Amravati district. There are two lakes in the eastern part of the city, Chhatri lake and Wadali lake. The Maltekdi hill is inside the city and is 60 meters high.

Figure 1: Location of Kondeshwar Lake, Wadali Lake

Wadali talao is a lake built in the Chandur rail road which is 3 km away from the Amravati city.This place offers scenic beauty along with photographic location and boating experience. The main purpose for the construction of the lake was to supply the fresh water to the residents of the city and also for some irrigation purposes. This lake is fastly growing as the good tourist's destination in the region due to its majestic features. Chhatri lake was built in 1888 and is a reservoir, which supplies drinking water to the residents of Amravati city, situated on the Malkhed railway road, 1 km from Dastur nagar square. This lake is visited by tourists in large numbers due to the small garden and boating facility available at the site. Kondeshwar lake is nearly about 6 km away from Badnera. The water in the Kondeshwar lake can be used for the drinking purpose if treated well. Even if its area is small, its water can be used sufficiently for the holy purposes. The temple and lake are located on a rocky terrain.

2.2 Sampling

Samples were collected from Chatri, Wadali and Kondeshwar lake as per the standard procedures. The various Physico– chemical parameters like pH, Alkalinity, Total dissolved solids, Electrical Conductivity, Chloride, Total hardness, Dissolveed Oxygen (DO), Biochemical Oxygen Demand (BOD) were analyzed and the results were compared with the WHO and ISI standards. Chemicals used for analysis were of AR grade. Glass distilled water was used for the preparation of the reagents. pH and Electrical Conductivity were determined using Digital pH–meter, Conductometer respectively. Temperature of the samples was noted at their sampling points. Standards methods were employed for the determination of the various parameters. The experimental results obtained were then compared with WHO and ISI standards are listed.

2.3 Weighted Arithmetic Water Quality Index Method

Weighted Arithmetic Water Quality Index method is the most common method which is used for determination of water quality index. It has its own advantages. It gives the suitability for both ground water and surface water. This method requires less number of parameters in comparison to all water quality parameters for particular use. We have used this method because of its suitability. Weighted arithmetic water quality index method classified the water quality according to the degree of purity by using the most commonly measured water quality variables. The method has been widely used by the various scientists and the calculation of WQI is made by using the following equation:

$$WQI = \sum QiWi / \sum Wi$$

Where, Qi= quality rating, Wi= Unit weight The quality rating scale (Qi) for each parameter is calculated by using the expression:

$$Qi = 100[(Vi - Vo/Si - Vo)]$$

V_i is estimated concentration of i^{th} parameter in the analyzed water,
V_o is the ideal value of this parameter in pure water
V_o = 0 (except for pH and DO; pH =7.0 and DO = 14.6 mg/l)
S_i is recommended standard value of i^{th} parameter
The unit weight (W_i) for each water quality parameter is calculated by using the following formula

$$Wi = K/Si$$

Where,

K = proportionality constant and can be calculated by using the following equation

$$K = \frac{1}{\sum(1/Si)}$$

3. Result and Discussion

The various physio-chemical parameters i.e. Temperature, pH ,electrical conductivity, total dissolved solids, total suspended solids, Chloride content, total hardness, dissolved oxygen, biochemical oxygen demand to calculate Water Quality Index for four different trials at the interval of 10 days for Kondeshwar lake, Wadali lake and Chhatri lake are as follows

Table 1: Water Quality Index, status and grading of water quality (Brown et al., 1972)

Water Quality Index Value	Rating of Water Quality	Grading
0-25	Excellent water Quality	A
26-50	Good water Quality	B
51-75	Poor water Quality	C
76-100	Very Poor water Quality	D
Above 100	Unsuitable for drinking and fish culture	E

Table 2: Drinking water standards recommending agencies and unit weights

Sr. No.	Parameters	Standards	Recommended agency	Unit weight
1	pH	6.5-8.5	ICMR/BIS	0.219
2	Electrical Conductivity	300	ICMR	0.371
3	Total Dissolved Solids	500	ICMR/BIS	0.0037
4	Total Suspended Solids	500	WHO	0.0037
5	Total Hardness	300	ICMR/BIS	0.0062
6	Chlorides	250	ICMR	0.0074
7	Dissolved Oxygen	5	ICMR/BIS	0.3723
8	Biological Oxygen Demand	5	ICMR	0.3723
9	Turbidity	5	ICMR	0.04

Table 3: Water Quality Index of Kondeshwar Lake

Sr. No.	Parameters	Observed Values	Standards Values	Unit Weight	Quality Rating	Wi*qn
		Vn	Sn	Wi	qn	
1	pH	8.195	6.5-8.5	0.219	79.66	17.44
2	Electrical Conductivity	527.75	300	0.371	175.91	65.26
3	Total Dissolved Solids	306.25	500	0.0037	61.25	0.226
4	Total Suspended Solids	0.015	500	0.0037	0.003	1.00E-05
5	Chloride Content	28.65	250	0.0074	11.46	0.084
6	Total Hardness	3.84	300	0.0062	1.28	0.008
7	Dissolved Oxygen	1.2	5	0.3723	139.58	51.965
8	Bio-chemical Oxygen Demand	64.25	5	0.3723	1285	478.405
WQI of Kondeshwar Lake = 452.496				Σ Wi=1.3556		Σ Wi*qn=613.404

Table 4: Water Quality Index of Wadali Lake

Sr. No.	Parameters	Observed Values	Standard Values	Unit Weight	Quality rating	Wi*qn
		Vn	Sn	Wi	qn	
1	pH	8.612	6.5-8.5	0.219	107.46	23.53
2	Electrical conductivity	426.5	300	0.371	142.16	52.74
3	Total dissolved solids	246	500	0.0037	49.2	0.182
4	Total suspended solids	0.02	500	0.0037	0.004	1.00E-10
5	Chloride content	36.595	250	0.0074	14.478	0.107
6	Total hardness	3.19	300	0.0062	1.036	0.0064
7	Dissolved oxygen	1.1	5	0.3723	140.625	52.35
8	Biochemical oxygen demand	70.25	5	0.3723	1405	523.08
WQI of Wadali Lake = 480.97				Σ Wi=1.3556		Σ Wi*qn=652.010

Table 5: Water Quality Index of Chhatri Lake

Sr. No.	Parameters	Observed Values	Standards Values	Unit Weight	Quality rating	Wi*qn
		Vn	Sn	Wi	qn	
1	pH	8.602	6.5-8.5	0.219	106.8	23.38
2	Electrical conductivity	467.25	300	0.371	155.75	57.783
3	Total dissolved solids	260.5	500	0.0037	52.1	0.1927
4	Total suspended solids	0.041	500	0.0037	0.0082	3.00E-10
5	Chloride content	31.195	250	0.0074	12.478	0.0923
6	Total hardness	2.75	300	0.0062	0.916	0.00567
7	Dissolved oxygen	1	5	0.3723	141.66	52.74
8	Biochemical oxygen demand	51.75	5	0.3723	1035	385.33
WQI of Chhatri Lake = 383.25				Σ Wi=1.355		Σ Wi*qn=519.536

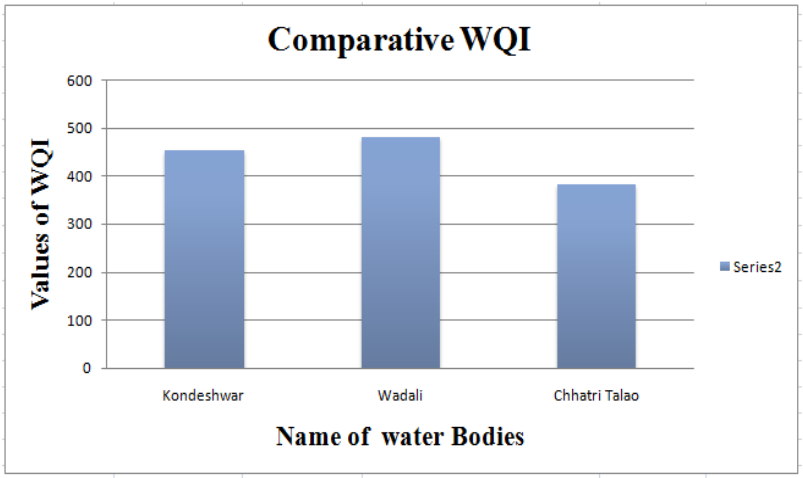

Figure 3: Water Quality Index of three different water bodies

4. Conclusion

The Water Quality Index by using Weighted Arithmetic Method are found to be 452.49 for Kondeshwar lake, 480.97 for Wadali lake and 383.25 for Chhatri Lake. Water quality index for all the three water bodies exceeds 100; therefore the quality of water from these water bodies is poor and not suitable for drinking and fishing purpose. Pollution load is also high for all the three water bodies and they need to be protected from Perils of contamination.

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