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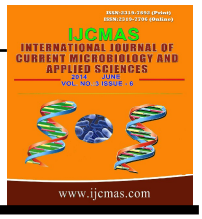

Original Research Article

Determination of water quality index of Palnekond reservoir in Sawantwadi Taluka, Sindhudurg

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A B S T R A C T

Keywords

Physico-chemical parameters, water quality index, Palnekond Reservoir.

Importance of water for the living being cannot be neglected, with this prospect in mind and the impact of the reservoir from the ecological point, the present investigation was carried out Reservoir in Sawantwadi taluka for the period of one year from March 2013- February 2014. The present study was undertaken to calculate Water Quality Index (WOI) of Palnekond reservoir to assess the impact of human and agricultural activities on the said waterbody. In this investigation, WQI was determined on the basis of the physico-chemical parameters like pH, total alkalinity, dissolved oxygen, biological oxygen demand, total hardness, calcium hardness, magnesium hardness, chlorides and sulphates.

Introduction

Fresh water is of vital concern for mankind. According to Lamikanra (1999) water of good drinking quality is of basic importance to human physiology and man's continued existence depends very much on its availability. Tebutt, (1983) stated that before water can be described as potable, it has to comply with certain physical, chemical and microbiological standards, which are designed to ensure that the water is palatable and safer for drinking. Hence with this prospect, present study was conducted to assess Water Quality Index using different physico-chemical parameters of Palnekond Resevoir in Sawantwadi Tehsil.

Sawantwadi (15°56'57"N, 73°49'2"E) is one of the most important and heavily populated Taluka in Sindhudurg District of Maharashtra State. It is well known for its wooden toys and is also becoming a major tourist attraction spot. Sawantwadi town as a municipal entity, spans an area of 132.45km with total population 47,921 according to census during 2011.

Sawantwadi receives average rainfall upto 4,000mm during the period from June to September. Palnekond reservoir which is located at south of village Kunkeri, 5km away from main city is one of the major source of water which is utilized for water supply by Sawantwadi Muncipal Corporation. A dam is constructed on the Palnekond Reservoir. The knowledge of reservoir ecosystem is of considerable value in assessing the ecological nature of

the reservoir which can be studied by the assessment of the physico- chemical characters of the Reservoir water. The present findings may serve scientific community and government as a database for future innovations.

Materials and Methods

The water samples were collected monthly for a period of one year from March 2013 to February 2014. Sampling was carried out by using one liter acid leached polythene bottle. Sample collection was done during morning hours between 7.00 am to 10.00 am and brought to laboratory for further analysis.

The parameters like water, hydrogen ion concentration was estimated on the spot. Sample for Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD) estimation was collected in BOD bottles and DO was fixed on spot while other parameters were estimated in the laboratory as per standard methods prescribed by Trivedy and Goel (1986), APHA (1992), Kodarkar *et al* (1998).

In this study, for the calculation of water quality index, nine different physico-chemical parameters were chosen. The WQI has been calculated by using the standards of drinking water quality recommended by the World Health Organization (WHO), Bureau of Indian Standards (BIS) and Indian Council for Medical Research (ICMR). Further, quality rating or sub index (q_n) was calculated using the following expression.

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

(Let there be **n** water quality parameters and quality rating or sub index (q_n) corresponding to $\mathbf{n^{th}}$ parameter is a number reflecting the relative value of this parameter in the polliuted water with respect to its standard permissible value.)

(q_n) = Quality rating for the $\mathbf{n^{th}}$ water quality parameter.

V_n = Estimated value of the $\mathbf{n^{th}}$ parameter at a given sampling station.

S_n = Standard permissible value of the $\mathbf{n^{th}}$ parameter.

V_{io} = Ideal value of $\mathbf{n^{th}}$ parameter in pure water.

(i.e., 0 for all other parameters except the parameter pH and Dissolved oxygen 7.0 and 14.6 mg/l respectively.)

Unit weight was calculated by a value inversely proportional to the recommended standard value $\mathbf{S_n}$ of the corresponding parameter.

$$\mathbf{W_n = K/S_n}$$

$\mathbf{W_n}$ = unit weight for the $\mathbf{n^{th}}$ parameters.

$\mathbf{S_n}$ = Standard value for $\mathbf{n^{th}}$ parameters.

K = Constant for proportionality.

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

$$\mathbf{WQI = \Sigma q_n W_n / \Sigma W_n}$$

Results and Discussion

Water Quality Index of the Palnekond Reservoir was calculated using nine different physico-chemical parameters for the year during March 2013 – February 2014. Monthwise WQI calculations are given in the tables 3.1-3.12.

Table.1 Water Quality Index (WQI) and status of water quality (Chaterjee and Raziuddin, 2002)

Water quality index	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 (All values except pH are in mg/lit.)

Sr. No.	Parameters	Standards	Recommended agency	Unit Weight
1	pH	6.5-8.5	ICMR/BIS	0.2190
2	Total Alkalinity	120	ICMR	0.0155
3	Dissolved Oxygen	5.00	ICMR/BIS	0.3723
4	Biological Oxygen Demand	5.00	ICMR	0.3723
5	Total Hardness	300	ICMR/BIS	0.0062
6	Calcium Hardness	75	ICMR/BIS	0.025
7	Magnesium Hardness	30	ICMR/BIS	0.061
8	Chlorides	250	ICMR	0.0074
9	Sulphates	150	ICMR/BIS	0.01236

Table.3.1 Physico-chemical variation of the water body during March, 2013

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	7.3	6.5-8.5	0.2190	20	4.38
2	Total alkalinity	51	120	0.0155	42.5	0.6587
3	Dissolved oxygen	6.23	5.00	0.3723	124.6	46.388
4	Biological oxygen demand	1.73	5.00	0.3723	34.6	12.881
5	Total hardness	28	300	0.0062	9.33	0.0578
6	Calcium hardness	11.7	75	0.025	15.6	0.39
7	Magnesium hardness	2.31	30	0.061	7.7	0.469
8	Chlorides	40.11	250	0.0074	16.044	0.118
9	Sulphates	0.75	150	0.01236	0.5	0.006
				ΣW_n= 1.09106		**Σq_nW_n= 65.3511**
Water Quality Index = $\Sigma q_n W_n / \Sigma W_n$ = 59.896						

Table.3.2 Physico-chemical variation of the water body during April, 2013

Sr. No.	**Parameters**	**Observed values (V_n)**	**Standard values (S_n)**	**Unit weight (W_n)**	**Quality rating (q_n)**	**q_nW_n**
1	pH	7.1	6.5-8.5	0.2190	20	4.38
2	Total alkalinity	53	120	0.0155	44.16	0.684
3	Dissolved oxygen	6.07	5.00	0.3723	121.4	45.197
4	Biological oxygen demand	1.81	5.00	0.3723	36.2	13.477
5	Total hardness	36	300	0.0062	12	0.0744
6	Calcium hardness	11.6	75	0.025	15.46	0.3865
7	Magnesium hardness	2.22	30	0.061	7.4	0.4514
8	Chlorides	43.14	250	0.0074	17.25	0.1276
9	Sulphates	0.66	150	0.01236	0.44	0.0054
				ΣW_n= 1.09106		**Σq_nW_n= 64.783**
Water Quality Index = **$\Sigma q_n W_n / \Sigma W_n$** = 59.376						

Table.3.3 Physico-chemical variation of the water body during May, 2013

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	7.0	6.5-8.5	0.2190	0.0	0.0
2	Total alkalinity	52	120	0.0155	43.33	0.671
3	Dissolved oxygen	6.06	5.00	0.3723	121.2	45.122
4	Biological oxygen demand	0.02	5.00	0.3723	0.4	0.148
5	Total hardness	41	300	0.0062	13.66	0.084
6	Calcium hardness	12.1	75	0.025	16.13	0.403
7	Magnesium hardness	5.10	30	0.061	17	1.037
8	Chlorides	45.07	250	0.0074	18.02	0.133
9	Sulphates	0.60	150	0.01236	0.4	0.004
				ΣW_n= 1.09106		**Σq_nW_n= 47.605**
Water Quality Index = **$\Sigma q_n W_n / \Sigma W_n$** = 43.631						

Table.3.4 Physico-chemical variation of the water body during June, 2013

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	7.5	6.5-8.5	0.2190	33.33	7.299
2	Total alkalinity	58	120	0.0155	48.33	0.749
3	Dissolved oxygen	6.42	5.00	0.3723	128.4	47.803
4	Biological oxygen demand	3.61	5.00	0.3723	72.2	26.880
5	Total hardness	43	300	0.0062	14.33	0.088
6	Calcium hardness	12.4	75	0.025	16.53	0.413
7	Magnesium hardness	4.16	30	0.061	13.86	0.845
8	Chlorides	43.75	250	0.0074	17.5	0.129
9	Sulphates	0.51	150	0.01236	0.34	0.004
				ΣW_n= 1.09106		**$\Sigma q_n W_n$= 84.212**
Water Quality Index = **$\Sigma q_n W_n / \Sigma W_n$** = 77.184						

Table.3.5 Physico-chemical variation of the water body during July, 2013

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	7.4	6.5-8.5	0.2190	26.66	5.838
2	Total alkalinity	59	120	0.0155	49.16	0.761
3	Dissolved oxygen	7.33	5.00	0.3723	146.6	54.57
4	Biological oxygen demand	3.00	5.00	0.3723	60	22.338
5	Total hardness	41	300	0.0062	13.66	0.084
6	Calcium hardness	12.9	75	0.025	17.2	0.43
7	Magnesium hardness	4.26	30	0.061	14.2	0.866
8	Chlorides	36.14	250	0.0074	0.144	0.001
9	Sulphates	0.50	150	0.01236	0.333	0.004
				ΣW_n= 1.09106		**$\Sigma q_n W_n$= 84.892**
Water Quality Index = **$\Sigma q_n W_n / \Sigma W_n$** = 77.806						

Table.3.6 Physico-chemical variation of the water body during August, 2013

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	7.2	6.5-8.5	0.2190	13.33	2.919
2	Total alkalinity	60	120	0.0155	50	0.775
3	Dissolved oxygen	7.72	5.00	0.3723	154.4	57.483
4	Biological oxygen demand	2.95	5.00	0.3723	59	21.965
5	Total hardness	47	300	0.0062	15.66	0.097
6	Calcium hardness	12.6	75	0.025	16.8	0.42
7	Magnesium hardness	4.71	30	0.061	15.7	0.957
8	Chlorides	36.72	250	0.0074	14.68	0.108
9	Sulphates	0.44	150	0.01236	0.29	0.003
				ΣW_n= 1.09106		**Σq_nW_n= 84.892**
Water Quality Index = **$\Sigma q_n W_n / \Sigma W_n$** = 77.806						

Table.3.7 Physico-chemical variation of the water body during September, 2013

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	7.4	6.5-8.5	0.2190	26.666	5.838
2	Total alkalinity	53	120	0.0155	44.16	0.684
3	Dissolved oxygen	7.93	5.00	0.3723	158.6	59.046
4	Biological oxygen demand	2.52	5.00	0.3723	50.4	18.763
5	Total hardness	42	300	0.0062	14	0.0868
6	Calcium hardness	12.5	75	0.025	16.66	0.416
7	Magnesium hardness	4.52	30	0.061	15.066	0.919
8	Chlorides	38.24	250	0.0074	15.296	0.113
9	Sulphates	0.45	150	0.01236	0.3	0.003
				ΣW_n= 1.09106		**Σq_nW_n= 85.868**
Water Quality Index = **$\Sigma q_n W_n / \Sigma W_n$** = 78.701						

Table.3.8 Physico-chemical variation of the water body during October, 2013.

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	7.3	6.5-8.5	0.2190	20	4.38
2	Total alkalinity	56	120	0.0155	46.66	0.723
3	Dissolved oxygen	8.02	5.00	0.3723	160.4	59.71
4	Biological oxygen demand	1.21	5.00	0.3723	24.2	9.009
5	Total hardness	40	300	0.0062	13.33	0.082
6	Calcium hardness	12.8	75	0.025	17.066	0.426
7	Magnesium hardness	6.56	30	0.061	21.866	1.333
8	Chlorides	39.96	250	0.0074	15.984	0.118
9	Sulphates	0.48	150	0.01236	0.32	0.003
				ΣW_n= 1.09106		**Σq_nW_n= 75.784**
Water Quality Index = **$\Sigma q_n W_n / \Sigma W_n$** = 69.459						

Table 3.9 Physico-chemical variation of the water body during November, 2013

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	8.1	6.5-8.5	0.2190	73.33	16.059
2	Total alkalinity	54	120	0.0155	45	0.697
3	Dissolved oxygen	9.26	5.00	0.3723	185.2	68.949
4	Biological oxygen demand	1.20	5.00	0.3723	24	8.935
5	Total hardness	41	300	0.0062	13.66	0.084
6	Calcium hardness	12.5	75	0.025	16.66	0.416
7	Magnesium hardness	6.23	30	0.061	20.76	1.266
8	Chlorides	37.17	250	0.0074	14.868	0.110
9	Sulphates	0.55	150	0.01236	0.366	0.004
				ΣW_n= 1.09106		**Σq_nW_n= 96.520**
Water Quality Index = **$\Sigma q_n W_n / \Sigma W_n$** = 88.464						

Table.3.10 Physico-chemical variation of the water body during December, 2013

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	8.8	6.5-8.5	0.2190	120	26.28
2	Total alkalinity	52	120	0.0155	43.33	6.716
3	Dissolved oxygen	8.24	5.00	0.3723	164.8	61.355
4	Biological oxygen demand	0.80	5.00	0.3723	16	5.956
5	Total hardness	38	300	0.0062	12.66	0.078
6	Calcium hardness	12.1	75	0.025	16.13	0.403
7	Magnesium hardness	5.33	30	0.061	17.76	1.083
8	Chlorides	36.24	250	0.0074	14.49	0.107
9	Sulphates	0.67	150	0.01236	0.44	0.005
				ΣW_n= 1.09106		**Σq_nW_n= 101.983**
Water Quality Index = $\Sigma q_n W_n / \Sigma W_n$ = 93.471						

Table.3.11 Physico-chemical variation of the water body during January, 2014

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	9.2	6.5-8.5	0.2190	146.66	32.118
2	Total alkalinity	51	120	0.0155	42.5	0.658
3	Dissolved oxygen	8	5.00	0.3723	160	59.568
4	Biological oxygen demand	1.30	5.00	0.3723	26	9.679
5	Total hardness	33	300	0.0062	11	0.0682
6	Calcium hardness	12.7	75	0.025	16.93	0.423
7	Magnesium hardness	3.76	30	0.061	12.53	0.764
8	Chlorides	35.14	250	0.0074	14.05	0.104
9	Sulphates	0.76	150	0.01236	0.506	0.006
				ΣW_n= 1.09106		**Σq_nW_n= 103.388**
Water Quality Index = $\Sigma q_n W_n / \Sigma W_n$ = 94.759						

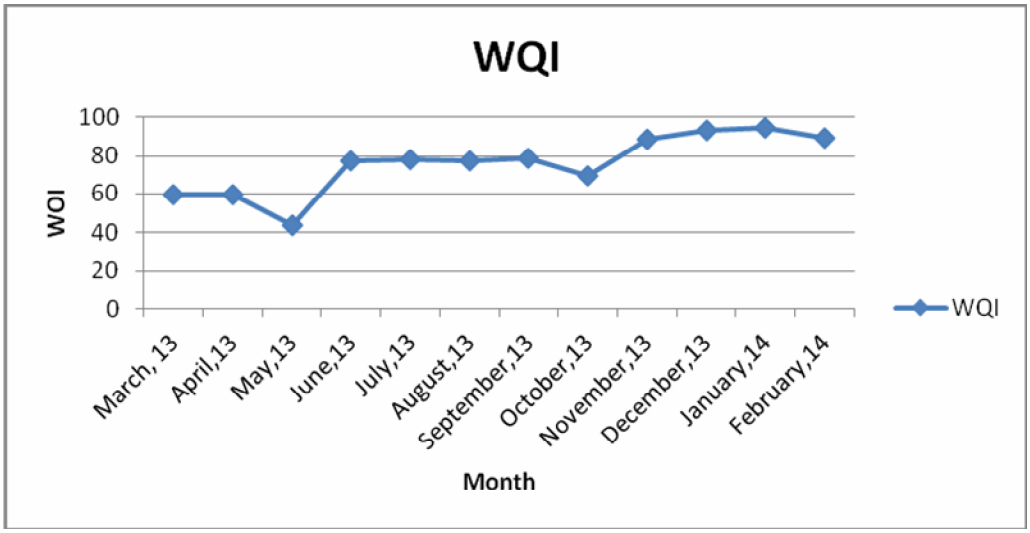
Table.3.12 Physico-chemical variation of the water body during February, 2014

Sr. No.	Parameters	Observed values (V_n)	Standard values (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	9.5	6.5-8.5	0.2190	166.66	36.49
2	Total alkalinity	52	120	0.0155	43.33	0.671
3	Dissolved oxygen	6.43	5.00	0.3723	128.6	47.87
4	Biological oxygen demand	1.52	5.00	0.3723	30.4	11.317
5	Total hardness	21	300	0.0062	7	0.0434
6	Calcium hardness	12.5	75	0.025	16.66	0.4165
7	Magnesium hardness	1.74	30	0.061	5.8	0.353
8	Chlorides	34.98	250	0.0074	13.992	0.1035
9	Sulphates	0.72	150	0.01236	0.48	0.005
				ΣW_n= 1.09106		**Σq_nW_n= 97.661**
Water Quality Index = **$\Sigma q_n W_n / \Sigma W_n$** = 89.510						

Table.4 Water quality index of Palnekond Reservoir

Sr. No.	**Month**	**WQI**
1	March 2013	59.8968
2	April 2013	59.376
3	May 2013	43.6318
4	June 2013	77.184
5	July 2013	77.806
6	August 2013	77.65
7	September 2013	78.701
8	October 2013	69.459
9	November 2013	88.464
10	December 2013	93.471
11	January 2014	94.759
12	February 2014	89.510
		Average :75.82

Fig.1 Statistical analysis of WQI of Palnekond Reservoir



The results of WQI revealed poor quality of water, Chaterjee and Raziuddin (2002). The WQI was found higher in month of January ranging upto 94.759 while minimum in month of May, which was 43.6318.

pH: pH determines the suitability of water for its different uses. Though, pH has no direct effect on human health, all biochemical reactions are sensitive to the variation of pH, Srinivas *et al* (2013). In present study the values of pH ranged in between 7.0 to 9.5 indicating alkaline nature of water. Similar observations were recorded by Yeole and Patil (2005) at Yedashi Lake and Sinha(1995) at Muzaffarpur, Bihar.

Total alkalinity: Alkalinity values were maximum in rainy season but showed decrease during winter. The total alkalinity values ranged in between 51 mg/lit. to 60 mg/lit. In accordance to Sahni *et al* (2011), decline in total alkalinity values during postmonsoon season may be attributed to dilution of water, whereas its higher values monsoon may be due to increased rate of organic decomposition that release carbondioxide, which reacts with water to for HCO_3, thereby increasing the total alkalinity.

Dissolved oxygen: Estimation of dissolved oxygen plays an important role in water quality assessment. In present study mean dissolved oxygen values ranged in between 6.06mg/lit to 9.26mg/lit. Dissolved oxygen concentration values were found higher in winter season while lower in summer season. The results also supported by observations of earlier workers Shaikh and Yeragi (2004) at Tansa River of Thane.

Biological oxygen demand: The values ranged in between 0.80mg/lit to 3.61mg/lit indicating higher values in monsoon while minimum values in winter season Biological Oxygen Demand proves to be one of the important quality assessment parameter.

Total hardness: The total hardness of

water represents primarily the total concentration of calcium and magnesium ions expressed as calcium carbonates. It values ranged in between 21mg/lit. to 47mg/lit. Maximum values were recorded in month of August while minimum values in February. Calcium hardness values ranged in between 11.6 mg/lit. to 12.9 mg/lit and did not show much variation throughout the year. Magnesium hardness values ranged in between 1.74mg/lit to 6.56mg/lit. Maximum values were found in winter and rainy season while minimum values were recorded in summer.

Chlorides: Moundiotiya *et al* (2004) stated the higher concentration of chlorides is considered to be an indicator of higher pollution due to higher organic waste of animal origin. In present study the values of chloride ranged in between 34.98mg/lit. to 45.07mg/lit.

Sulphates: The sulphate values ranged in between 0.44mg/lit. to 0.76mg/lit. Maximum values were recorded in winter while minimum values in rainy season.

Study revealed that WQI ranged in between 43.6318 to 94.759, with an average value of 75.82. This indicates poor quality of water which cannot be directly used for consumption and domestic utilization.

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