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Water Quality Index of Kolavai Lake, Chengalpet, Tamil Nadu, India

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Abstract: Water Quality Index (WQI) has been calculated for surface drinking water in Kolavai Lake, Chengalpet Taluk, Kancheepuram District, Tamil Nadu, India, at four different sites in the monsoon, post monsoon, summer and pre monsoon seasons. Water quality parameters thirteen were selected as per the BIS guidelines and water quality physico-chemical parameters were estimated following the standard methods and procedures. The lake water of some sites was found to be moderately contaminated. Water Quality Index during the years 2011 and 2012, in general, the water quality showed deterioration. It is felt that some remedial measures are urgently required to optimize the water quality for this region.

Key words: Kolavai Lake, Water Quality Index, Physico chemical parameters.

1. Introduction

The Kolavai Lake is one of the largest lakes, situated in Chengalpet Taluk, Kancheepuram District, Tamil Nadu, India, about 200 metres on the northeast of Chengalpet and close to Pulipakkam village This Lake has an annual storage capacity of 476.69 Mcft and with a depth of 4.59 metres. The total discharging capacity is about 5131 cusecs through by 5 sluices. The surplus water flows into Palar, Neenjal and Madura rivers. It is spread over 894 hectares and presently 12 villages are benefitted by this lake. Around 200 Kgs of fish are harvested per day. The Mahindra World City industrial park drew five million gallons of water from this lake daily. This lake is polluted by the agricultural wastes, domestic sewage, hospital wastes and industrial effluents. The Kolavai Lake also receives water from rain drain canals (27 km in length) during rainy season and in an average of 1450 litres of municipal waste water enters into the lake per day. The population of Chengalpet according to censes of 2011 is 64,136. They dump the garbage in most of the Stations nearby the lake. The town panchayat collects 48 tonnes of garbage per day. During the rainy season most of the garbage is washed into the lake and it also causes pollution.

The present investigation enabled a systematic analysis of physico-chemical and biological characteristics as well as seasonal variations of all in the lake. The following conclusions were derived through investigations.

Water Quality Index (WQI)

The concept was first proposed by Horton R.K.[1] It indicates the quality by an index number, which represents the overall quality of water for any intended use. It is defined as a rating reflecting the composite influence of different water quality parameters on the overall quality of water (6).The indices are among the most effective ways to communicate the information on water quality trends to the general public or to the

policy makers and in water quality management[12]. The WQI has been calculated from the point of view of the suitability of lake water for human consumption. Balakrishnan and Kuppusamy[2] studied the physico- chemical characteristics of drinking water samples from Palani. A heavy population pressure in the catchment area of the Anchar lake Kashmir was observed and it helps in understanding the trophic status of the lake[3]. They have studied diurnal cycle of physico-chemical characteristics of Amraboti park Lake[7]. The fluctuations on physico-chemical parameters of river Mandakini in Madhya Pradesh was investigated by **Garg, S. S.**[8].

Table (1a) Water Quality Index (WQI) values of different parameters at different stations.

STATIONS	NITRATE	TDS	PH	CO3	HARDNESS	Ca	Mg	chloride	sulphate
S1	36.25	93.1	31.49	67.24	69	63.66	39	33.7	45
S2	43.75	88.3	64.99	61.61	66.50	57	35.5	40.9	31.25
S3	65	102.71	36.49	73.91	78.58	62.32	41	48.1	53.75
S4	43.75	91.85	44.40	64.51	62.91	51.32	32.5	46.6	50

STATIONS	DO	BOD	COD	FLUORIDE
S1	62.49	218.5	206	23.75
S2	63.17	209	202	21.5
S3	47.49	210	249.5	29.5
S4	45.20	211	247.5	24.5

2. Materials and Methods

WQI Calculation

Water quality studies on the Nadankanna lake, Bhubaneshwar was carried out by (5). Assessment of water quality in a region is an important aspect for any developmental activity of the region[11]. The physical, chemical analysis is necessary to know whether the water body is fit for domestic consumption or not[3].

The parameters like BOD, COD, Nitrate, and Phosphate were varied with seasons and were found within the standards of prescribed. For calculation of WQI, selection of parameters has great importance. Since selection of too many parameters might widen the water quality index, and the importance of various parameters depends on the intended use of water. Thirteen physicochemical parameters, namely pH, TDS, Nitrate, Calcium, Magnesium, Total hardness, Chloride, Fluoride, sulphate, DO, COD and BOD were used to calculate the WQI. The Calculation of WQI was made using a weighted arithmetic index method given below Brown et al.[4] in the following steps. Calculation of sub index of quality rating (qn)Let there be n water quality parameters where the quality rating or sub index (qn) corresponding to the nth parameter is a number reflecting the relative value of this parameter in the polluted water with respect to its standard permissible value. The value of qn is calculated using the following expression.

qn= 100 [(Vn- Vio) / (Sn- Vio)] (1)
where
qn= quality rating for the nth water quality parameter.
Vn= estimated value of the nth parameter at a given sampling Station.
Sn= standard permissible value of nth parameter
Vio= ideal value of nth parameter in pure water.
All the ideal values (Vio) are taken as zero for drinking water except for pH =7.0 and dissolved Oxygen=14.6mg/l.
Calculation of quality rating for pH

For pH the ideal value is 7.0 (for natural water) and a permissible value is 8.5 (for polluted water). Therefore, the quality rating for pH is calculated from the following relation:

q pH = 100 [(V pH -7.0)/(8.5 -7.0)] (2)
where
V pH = observed value of pH during the study period.

Calculation of quality rating for dissolved oxygen

The ideal value (VDO) for dissolved oxygen is 14.6 mg/l and standard permitted value for drinking water is 5 mg/l. Therefore, quality rating is calculated from following relation:

qDO= 100 [(VDO - 14.6)/(5 – 14.6)] (3)
Calculation of unit weight (Wn)
Calculation of unit weight (Wn) for various water quality parameters are inversely proportional to the recommended standards for the corresponding parameters.
Wn= K/Sn
where
Wn= unit weight for nth parameters
Sn= standard value for nth parameters
K = constant for proportionality (1)
Calculation of WQI
WQI is calculated from the following equation
WQI =Σqn.Wn/ΣW n

3. Results and Discussion

The water quality index was derived from the four Stations of the Kolavai Lake. The WQI value was found in higher in Station-3. Particularly NO_3, TDS, CO_3, Hardness, Mg, Chloride, So_4, BOD, COD, Fl were observed higher than the other Stations. Whereas the pH, dissolved oxygen values were observed lesser than the other Stations. The WQI is presented in table-1a and the analysis of the lake water was done as per the standard methods of (1).

Calcium was found maximum in Station-1 with 63.7. In Stations-3, 2and 4 were found with values 62.3,57 and 51.3 respectively.

Magnesium was observed in higher value in Station-3. It was followed by the Stations-1, 2 and 4 with values of 39, 35.5 and 32.5 respectively.

Chloride was found maximum in the Station-3 and it was followed by the Stations -4, 2, 1 with values of 46.6, 40.9, and 33.7.

Sulphate was observed as 53.75, 50, 45, and 31.25 in the Stations -3, 4,1 and 2.

Nitrate was found in maximum in the Station-3 and it was followed by Stations -4, 2 and 1with values of 43.75, 43.75 and 36.25.

Fluoride was found in the Station -3 with a maximum value which was followed by Stations -4, 1 and 2 with values of 24.5, 23.75 and 21.5.

Hardness was observed maximum in the Station-3, it was followed by the Stations-1, 2 and 4 with values 69, 66.5, 62.91.

Carbonates were found maximum in the Station-3 with 73.91, which was followed by the Stations -1, 4 and 2 with the values of 67.2, 64.5 and 61.5.

Total dissolved solids were observed in higher level in the Station-3 with value of 102.71.which was followed by Stations -1, 4 and 2 with the values 93.1, 91.85, and 88.3.

pH was found as 64.9, 44.4, 36.5, and 31.5 in Stations -2, 4, 3, 1 respectively, with maximum value in Station-2.

Dissolved oxygen was observed as maximum in Station-2 with 63.17, which was followed by Stations-1 with 62.4, Station 3 with 47.5, Station-4 with 45.2.

BOD was found maximum in Station-1 with a value of 218,it was followed by Stations -4, 3 and 2 with the values of 211,210,209.

COD was observed in higher level in Station-3 with a value of 249.5, followed by this the Stations -4, 1 and 2 with values of 247.5,206,202.

The gradual development of Mahindra industrial World, Ford Ikon car factory, land fillings, entry of drainage water, Municipal wastes, Hospital wastes, garbage, anthropological activities, domestic and automobile pollution makes the changes in the water quality of the lake. The WQI was found higher in Stn 3 might be due to agricultural activities, the land filling and the anthropological activities of that region.

The WQI of Kalakho Lake at Rajasthan showed the higher index values were due to continuous discharge of agricultural runoff, industrial effluents, Municipal sewage flowing in to the lake. In summer WQI was found as 460, in monsoon 599, in winter 408 at Station.1. Dissolved oxygen is the sole source of oxygen for all aquatic life. DO is an important factor determining the productivity of water body. It is essential for metabolism. The changes of DO may be due to aeration of organic matter of sediments, algal activities and so on, Hasan[9].

Conclusion

Water quality index (WQI) was assessed in four Stations of the lake. In which the Station 3 had shown higher values in TDS,NO_3,CO_3,Mg,Cl, SO_4,BOD,COD,and Fl. Based on the observation the water quality of the Kolavai Lake was found unsuitable for drinking because of WQI values exceeds 100. (WQI 100 and above called as very poor and unsuitable for drinking).

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