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ORIGINAL ARTICLE

WATER QUALITY STATUS OF TWO VULNERABLE FRESHWATER LAKES OF KANYAKUMARI DISTRICT, INDIA

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ABSTRACT

The suburbs of Nagercoil, Kanyakumari District are expanding rapidly with a huge increase in the influx of population. Long spells of water shortages combined with rapid and urbanization has led to the over exploitation of the precious water bodies. Mindless dumping of sewage and garbage into the fresh water lakes has affected them seriously. The present study was undertaken to assess the quality of water in two important lakes of Nagercoil, Kanyakumari District, which recharges the ground water as well as harbours a diversity of plant and animal life. All the two lakes suffer from encroachments, dumping of wastes and un-checked inflow of domestic wastes. The parameters studied were: Colour, odour, temperature, pH, dissolved oxygen, biological oxygen demand, chemical oxygen demand, alkalinity, total hardness, total solids, total dissolved solids, total suspended solids, sulphate, chloride and salinity.

Keywords: Water Quality, Kanyakumari District

1.INTRODUCTION

Comprising over 70 % of the Earth's surface, water is one of the most vital natural resources for all life on Earth. The metropolitan cities of India are under the pressure of water scarcity. Nagarcoil, Kanyakumari District is among the worst affected because of its ever-expanding urban population demands for more freshwater. The availability and quality of water always have played an important role in determining quality of life. Water quality is closely linked to water use and to the state of economic development. Freshwater habitats occupy a relatively small portion of the earth's surface when compared to marine and terrestrial habitats. Their importance to man is far greater than their area of occupancy. They are the most convenient and cheapest available water source for domestic and industrial demands. Most of the pollutants mixed with water have led to a steady decline in aquatic life. Physical and chemical characteristics of water bodies affect the abundance, species composition, stability, productivity and physiological condition of aquatic organisms. The physico-chemical parameters of an aquatic body not only reflect the type and diversity of aquatic biota but also the water quality and pollution (Mir *et al.*, 2004).

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Therefore a regular monitoring is the need of the hour. In the present study, the various physico-chemical analyses of two fresh water lakes of Kanyakumari District have been undertaken as inflow of sewage and dumping of solid wastes affects all the two lakes.

2.MATERIALS AND METHODS

Sampling sites: Two fresh water lakes viz. Putheri lake, and Chemmankulam lake were subjected to physico-chemical analysis. The water bodies were labeled Site I, and Site 2 respectively. These lakes are located in the rapidly expanding Nagarcoil where ground water levels have gone down considerably.

Sample Collection: Samples were collected for a period of twelve months, starting from January 2010 to December 2010. 125ml glass bottles were used to collect and fix samples for estimation of dissolved oxygen (DO) content. Samples were collected in triplicate from each site during the four quarters of the year using PET bottles as per standard procedures.

Analysis: The samples thus collected were analysed for a number of physico-chemical parameters employing standard methods (APHA, 1998). The parameters include colour,

odour, temperature, pH, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD),Chemical Oxygen Demand (COD), Alkalinity, Total Hardness, Total Solids (TS), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Sulphates, Chlorides and Salinity.

3.RESULTS AND DISCUSSION

Four seasons are recognized at Nagercoil, even though it falls in the tropical zone. The seasons are post-monsoon (January-March), summer (April-June), pre-monsoon (July-September) and monsoon (October-December). The data presented here are discussed basis of these seasons. The results of physico-chemical analysis of two fresh water bodies for different seasons are given in Tables 1 and 2 .

The colour of water samples collected from two lakes had an unclear appearance. This may be the result of the presence of natural metallic ions, humus, plankton, weeds, and domestic wastes. The two lakes had multiple sewage inflows from numerous anthropogenic sources, which may contribute to the unclear appearance.

Even though all the sites exhibited agreeable odour, it may be due to the presence of organic and inorganic chemicals, decomposition of vegetation, microbial activity and influence of sewage.

The average pH value at Site 1 was 6.8 and whereas at Site 2 it was 7.0 respectively. The lowest pH values were recorded during monsoon and post-monsoon season, which implies the influence of run-off water entering into the water bodies. The pH was slightly alkaline during summer and pre-monsoon which may be due to dumping of garbage and inflow of sewage water. The desirable limit of pH recommended by Drinking Water Specification Indian Standard - IS 10500: 1991 is 6.5-8.5 (BIS, 1992).

The Dissolved Oxygen (DO) values at Site 1 ranged between 5.9 and 8.6 mg/L with a mean of 6.8 mg/L and the values at Site 2 varied between 5.9 and 8.6 mg/L (mean-7.0 mg/L). Considerable amount of variation in DO was observed in the two water bodies with higher values recorded during post-monsoon season at all sites. Dissolved Oxygen (DO) is an important aquatic environmental factor, which influences the health of an aquatic ecosystem. The higher values of DO may be due to the influence of run-off water from monsoon rain. Lower level of DO was recorded during pre-monsoon season at all the sites. Atmospheric aeration and photosynthetic production of O2 by the phytoplankton may be low during pre-monsoon and higher during post-monsoon season. DO levels between 5.3 and 8.0 mg/L are satisfactory for survival and growth of aquatic organisms.

The Biological Oxygen Demand (BOD) values at Site 1 ranged between 51 and 75 mg/L with a mean of 73.5 mg/L and the values at Site 2 varied between 51 and 75 mg/L (mean-62 mg/L). BOD is the measure of quantity of oxygen required by bacteria and other microorganisms under aerobic condition in order to biochemically degrade and transform organic matter present in the water bodies. BOD values were highest during pre-monsoon season in two freshwater bodies.

The Chemical Oxygen Demand (COD) at Site 1 varied between 39.6 and 78 mg/L with a mean value of 56.3-mg/L. the value at Site 2 ranged between 39.6 and 78 mg/L(mean-53.8 mg/L). The high concentration of COD indicates a heavy load of organic and inorganic pollution that require more oxygen to oxidize under increased thermal conditions (Koushik and Saksena, 1999).

The temperature of water varied between 22°C and 36.4°C at Site 1 with a mean of 32°C. At site 2 it ranged between 22°C and 34°C (mean-31°C). In all the three sites a high temperature was recorded during summer and lower temperature during post-monsoon, which is a normal feature in fresh water bodies.

The total alkalinity values at Site 1 ranged between 107.5 and 143 mg/L with a mean of129.4 mg/L. The values at Site 2 ranged between 107.5 and 143 mg/L (mean-128.9 mg/L). Excess alkalinity gives a bitter taste to water. Maximum alkalinity values were registered during summer at Site 1 and Site 2, it was during pre-monsoon. Higher alkalinity by itself is not harmful to human beings, but it still delimits the water for domestic uses. The higher alkalinity values may be due to the discharge of municipal sewage, domestic sewage and urban wash off into the freshwater bodies. The desirable limit of alkalinity prescribed for drinking water by Drinking Water Specification Indian Standard - IS 10500: 1991 is 200 mg/L whereas permissible limit goes up to 600 mg/L in the absence of alternate source. An increase in the free CO2 may result in the increase in alkalinity (Singhal *et al.*, 1986).

The Total Hardness (TH) values at Site 1 ranged between 142 and 241 mg/L with a mean of 180 mg/L. At Site 2 it ranged between 142 and 241 mg/L (mean-178 mg/L). In general, Total Hardness of water is due to the concentration of salts. In particular, it is due to the concentration of multivalent metallic ions of calcium and magnesium. Any increase in hardness causes scale deposition and scum formation. The desirable limit of TH is 300 mg/L.

The Total Solids (TS) at Site 1 ranged between 542 and 671 mg/L with a mean of608 mg/L and the values at Site 2 varied between 528 and 671 mg/L (mean-570 mg/L). Maximum values of Total Solids were recorded during monsoon at all the three sites. Run-off water, which carries dissolved solids and also organic wastes from garbage dumping, contributes to higher TS at these fresh water bodies.

In the present study, the Total Dissolved Solids (TDS) at Site 1 varied between 510ans 630 mg/L with a mean of 562 mg/L and at Site 2 ranged between 510 and 630 mg/L(mean555 mg/L). Maximum values of Total Dissolved Solids (TDS) were registered during pre monsoon season at all the sites. The desirable level of TDS is 500 mg/L; presence of excess TDS may cause gastro intestinal irritation when consumed. It elevates the density of water and reduces solubility of oxygen that may prove lethal to aquatic life.

The Total Suspended Solids (TSS) at Site I ranged between 88.4 and 134 mg/L with a mean of 108 mg/L and the values at Site 2 varied between 86 and 146 mg/L (mean-109 mg/ L). Higher values of Total Suspended Solids were recorded during monsoon season at Site 1 and Site 2. Increased concentration of TSS would reduce light penetration into the water and affect the plankton and fish by decreasing the Dissolved Oxygen (DO) levels in water.

At Site 1, the Sulphate value ranged between 261 and 321 mg/L with a mean of 295 mg/L. At Site 2 it was between 244 and 325 mg/L, the mean being 292 mg/L. Sulphate is another important parameter which when goes to higher concentration taint the taste of water and may create a laxative effect. Higher concentration of sulphate was observed during summer at Site 1 and Site 2. It may also indicate enrichment due to insufficient inflow of rainwater. Sulphate can be removed by several methods and aeration is very effective in removing H2S.

Table I. Physico-chemical parameters of Putheri Lake (Site 1) from January to December 2010

SI. No	Parameter	Jan-Mar'10	Apr-Jun '10	Jul-Sep'10	Oct-Dec'10	Range
1.	Colour (visual)	Unclear	Unclear	Unclear	Unclear	
2.	Odour (sensory)	Agreeable	Agreeable	Agreeable	Agreeable	
3.	Temperature (oC)	26	36.4	34	33.5	22-36.4
4.	pH	6.4	6.9	7.4	6.4	6.4-7.4
5.	DO (mg/L)	8.5	6.8	5.4	6.4	5.9-8.6
6.	BOD (mg/L)	59	64	81	49	51-75
7.	COD (mg/L)	42.6	48.7	56	78	39.6-78
8.	Alkalinity (mg/L)	107.5	148	139	123	107.5-143
9.	Total Hardness (mg/L)	181	146	142	142-241	9.
10.	TS (mg/L)	640	568.4	542	682	542-671
11.	TDS (mg/L)	556	523	630	537	510-630
12.	TSS (mg/L)	97	88.4	112	134	88.4-134
13.	Sulphate (mg/L)	313	321	284	261	261-321
14.	Chloride (mg/L)	271	223	161	138	138-271
15.	Salinity	0.23	0.3	0.37	0.2	0.2-0.37

Table 2. Physico-chemical parameters of Chemmankulam Lake (Site 2) from January to December 2010

S. No	Parameter	Date of Collection and Estimation				
		Jan-Mar'10	Apr-Jun '10	Jul-Sep'10	Oct-Dec'10	Range
1.	Colour (visual)	Unclear	Unclear	Unclear	Unclear	
2.	Odour (sensory)	Agreeable	Agreeable	Agreeable	Agreeable	
3.	Temperature (OC)	27.4	29.4	34	33.5	22-34
4.	pH	6.4	7.2	7.4	6.9	6.5-7.4
5.	DO (mg/L)	8.6	7.2	5.9	6.4	5.9-8.6
6.	BOD (mg/L)	54	67	75	51	51-75
7.	COD (mg/L)	39.6	46.7	51	78	39.6-78.0
8.	Alkalinity (mg/L)	107.5	138	143	127	107.5-143
9.	Total Hardness (mg/L) 241	173	154	142	142-241	9.
10.	TS (mg/L)	540	528.4	542	671	528.4-671
11.	TDS (mg/L)	543	510	630	537	510-630
12.	TSS (mg/L)	93	86	112	146	86-146
13.	Sulphate (mg/L)	325	329	244	269	244-325
14.	Chloride (mg/L)	268	243	159	138	138-268
15.	Salinity	0.19	0.32	0.36	0.22	0.19-0.36

Chlorinity values at Site 1 varied between 138 and 271 mg/L with a mean of 198mg/L and at Site 2 ranged between 138 and 268 mg/L (mean-202 mg/L). Chloride concentration was higher during post-monsoon. High chlorinity would reduce the DO content of water, which turns harmful for aquatic organisms.

Salinity values of Site 1 ranged between 0.2 and 0.37 with a mean of 0.28. At Site 2 it was between 0.19 and 0.36, the mean being 0.27. Minimum salinity values were recorded during monsoon at all the sites. This slight decrease in salinity during monsoon may be due to rainwater inflow.

Urbanization of Nagercoil has led to increased anthropogenic pres-sure on all the water bodies. The once unpolluted lakes are now rapidly becoming unusable. Mindless dumping of solid wastes and discharge of sewage has deteriorated them to a great extent. It causes a variety of health problems to humans as well as to other organisms dependent either directly or indirectly on this ecosystem. Periodic determination of physico-chemical parameters of such important water bodies is essential for assessing the suitability of water for human and animal use as well as for the aquatic biota. The present study, therefore, urges the need for the restoration of these degrading freshwater bodies in Nagercoil, Kanyakumari District, India to ensure sustainability of a healthy ecosystem.

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