Comparative Analysis of Physicochemical Parameters of Two Famous Temple Tanks in Kanyakumari District, S. India

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Abstract - The aim of current study was to evaluate the status of Nagercoil Nagaraja temple tank and Suchindrum Sthanumalaya Swamy temple tank waters of Kanyakumari District with respect to different physicochemical parameters (temperature, pH, electrical conductivity, dissolved oxygen, biological oxygen demand, carbon dioxide, hardness, calcium, magnesium, total alkalinity, chloride, phosphate, nitrate, total dissolved solids and total suspended solids). It was predicted that electrical conductivity, hardness, total alkalinity, chloride and total dissolved solids were above the permissible limit in Nagercoil Nagaraja temple tank.

Key words: water, chloride, hardness, TDS, electrical conductivity.

I. INTRODUCTION

Pure water is an animating fluid, while polluted water is a real curse to the human race. In spite of abundant availability of water resources, high standards of life together with poor maintenance and improper drainage system have destroyed the water quality to larger extent making them less suitable for drinking and domestic purposes. Kanyakumari District is famous for lot of cultural activities. There are many famous temples in this District. Among them Nagercoil Nagaraja temple and Suchindrum Sthanumalaya Swamy temple are very popular. The name Nagercoil is derived from Nagaraja temple. The religious significance of Sthanumalaya Swamy temple stem, from the fact that the main statue of linga represents Siva (Sthanu), Vishnu (Maal) and Brahma (Ayan). The representation of these three central Gods of Hinduism is one linga makes it one of the unique temples in India. At present the tanks in these temples are in badly polluted condition due to various anthropogenic activities. The temple tanks are mainly affected due to pilgrims and ritual activities by people living in the nearby areas. The people take holy dip in the temple tank water, leave products used in worshipping, washing of temple idols and utensils for temple rituals. This leads to significant alteration in the water quality. The present study was carried out to predict the actual status of Nagercoil Nagaraja temple tank (tank 1) and Suchindrum Sthanumalaya Swamy temple tank (Tank 2) in Kanyakumari District of South India.

II. MATERIALS AND METHODS

The water samples were collected and analysed from January 2009 to December 2009. The samples were collected in pre cleaned polyethylene bottles, immediately brought to the laboratory and analysed for various physicochemical parameters. The standard methods of APHA – 2005 (1) were followed for the analysis.

III. RESULT AND DISCUSSION

Temperature

Generally the weather in the study area is quite cool; however the temperature is of enormous significance as it regulates various physicochemical as well as biological activities (29). The maximum temperature of 30.7^{0}C (May) and minimum of 29.0^{0}C (November) were recorded in tank 1, while in tank 2, the temperature varied between 28.8^{0}C (October) and 30.9^{0}C (May). Maximum temperature is due to intense heating of the atmosphere which is in accordance with the study of R Purusothama et al (2005) (18).

pH

The pH of the water samples ranged from 6.7 (August) to 7.8 (November) in tank 1. But in tank 2, it was maximum in June & November (8.1) and minimum in September (6.9). The pH of water samples was alkaline throughout the study period. The alkaline nature of water might be due to high temperature that reduces the solubility of carbon dioxide (27) and also due to photosynthetic activity (20, 23 & 27). Change in pH is due to discharge of agricultural wastes, human anthropogenic activities and surface runoff (18).

Electrical conductivity

Conductivity of temple tank water is a measure of the capacity of substances or solution to conduct electrical flow. The electrical conductivity fluctuated between 1.33mS/cm (February & December) and 1.82mS/cm (July) in tank 1 and in tank 2, maximum was recorded as 0.54mS/cm and minimum as 0.36mS/cm in the months July and June respectively. Electrical conductivity in tank 1 is above the permissible limit of WHO (2). Electrical conductivity of water is high due to the presence of enormous amount of ions in the water. High specific conductance causes deterioration of water and is unsuitable for domestic purposes. So the water is not suitable for recreational purposes (9). Relatively higher electrical conductivity was due to more total dissolved solids and chloride content which is in coherence with the results of Janaki Arunan et al (2004) (12). High level of conductivity reflects on the pollution status. This is evident from the results and also matches with the findings of P P Baruah et al (2009) (29).

Dissolved oxygen

Dissolved oxygen shows health of the pond (17). The minimum value of dissolved oxygen in tank 1 was recorded as 1.3ppm in August and maximum was in May (7.6ppm). In tank 2, dissolved oxygen values ranged between 3.1ppm (August) and 7.6ppm (January, March & December). The dissolved oxygen values varied according to the rate of respiration and decomposition of organic materials in the water (18). Lower dissolved oxygen indicates higher organic input and stagnancy of water (7 & 10). Dissolved oxygen below 5ppm suggests aquatic contamination of water which leads to oxidation of substance, decomposition of organic matters (28). The low DO is due to increase in temperature (19 & 21).

Biological oxygen demand

BOD is the index of organic pollution. The BOD of the water samples in tank 1 ranged between 0.2ppm (November) to 9ppm (August). In tank 2, it was low in March (0.6ppm) and high in June (9.1ppm). Higher BOD indicates pollution by bio – degradable materials. This may be due to human activities in and around the pond (16). BOD increases because of higher suspended solids and dissolved solids (5). High load of BOD is due to usage of water for recreation purpose and another reason for increase of BOD is degraded algal biomass (24).

Carbon dioxide

The carbon dioxide content of water depends upon water temperature, depth, rate of respiration, decomposition of organic matter, chemical nature of bottom and geographical features of the terrain surrounding the water body. The value of free carbon dioxide ranged from 12ppm (February) to 31.2ppm (August) in tank 1, while in tank 2, it was measured high in October (17.6ppm) and low in May (13ppm). Higher carbon dioxide is due to rain, plant roots and decaying vegetation (23) and related to high rate of decomposition (30).

Hardness

Hardness is an important parameter in the detection of water pollution due to calcium and magnesium ions. Hardness values of tank 1 lie between the range 168ppm (December) to 363ppm (April). In tank 2, hardness values fluctuated from 61ppm (June) to 116ppm (April). Water having hardness above 300ppm is categorized as very hard water (11). Water samples in tank 1 falls on very hard water category (16). Higher hardness may be due to human activities in and around the temple tank (16). Hardness of water increases due to washing of clothes, agricultural runoff and automobile cleaning (31).

Calcium

The content of calcium in the water samples of tank 1 varied between 34.8ppm (July) and 76.7ppm (January), but it was minimum in May (18.7ppm) and maximum in December (28.2ppm). Calcium in the temple tank l water is due to deposition of flower and fruit remains in the tank after worshiping purposes (29). Highest amount of calcium was found in the tank due to washing, laundering, additional amount of detergents added by human bathing etc. (25 & 31). Excessive calcium in drinking water leads to formation of concentration in the body and may cause gastro intestinal diseases and stone formation (22).

Magnesium

Magnesium concentration in tank 1 during the study period ranged from 19.98ppm (May) to 42.72ppm (October). In tank 2, it varied from 2.43ppm (June) to 12.15ppm (April & December). The content of magnesium is less than calcium throughout the study period.

Total alkalinity

Phenolphalein alkalinity was absent in all the months during the study period. Alkalinity in the water samples was only due to bicarbonate. The maximum (331.7ppm) and minimum (143.6ppm) values of bicarbonate in tank 1 were observed in June and August respectively. In tank 2, the maximum value of 146.4ppm was recorded in December and the minimum was observed in February as 60.8ppm. Total alkalinity value was above the permissible limit of WHO and ISI (2, 3) in tank 1. High alkalinity is due to the use of soap and detergents (15) and low water table and lower temperature bringing down the rate of decomposition of salts to minimum, thereby increasing the alkalinity (27). In alkalinities point of view, quality of water is poor (27) in tank 1. Highly alkaline water is unpalatable and is not used for domestic supply (8).

Chloride

Chloride concentration in tank 1 lies between the range 250.4ppm (May) to 450.8ppm (October). In tank 2, chloride values fluctuated from 60.2ppm (December) to 102.5ppm (October). The amount of chloride in tank 1 is above the permissible limit of WHO and ISI. High chloride concentration is an indicator of pollution due to high organic wastes of animal or industrial origin. Human body releases very high quantity of chloride (11). Increase in chloride content is also due to eutrophication; chloride content has direct correlation with pollution load (24). When concentration of chloride is above 250ppm, it imparts unacceptable taste to water and it may affect a person, who is already suffering from heart and kidney problems (32).

Phosphate

Phosphate occurs in natural water in low quantity as many aquatic plants absorb and stored phosphate for their immediate needs (27). Excess amount of phosphate may lead to eutrophication (6). The minimum value of phosphate in tank 1 was recorded as 0.16ppm in April and maximum was 0.35ppm in June. In tank 2, phosphate values ranged between 0.11ppm (August) and 0.29ppm (June). Phosphate in both the tanks was below the permissible limit throughout the study period.

Nitrate

The main source of nitrate is decomposition of organic matters (4 & 14). Nitrate represents the final product of bio – chemical oxidation of ammonia. Monitoring of nitrate is important in drinking water because of health effects on human and animals (27). The maximum and minimum values of nitrate in tank 1 were observed in April (20ppm) and June (5ppm) respectively. In tank 2, the maximum value of 17ppm was recorded in December and the minimum was observed in August as 5ppm. During the study period, concentration of nitrate is below the permissible limit.

Total dissolved solids

Total dissolved solids is due to the presence of bicarbonates, chlorides, calcium, magnesium and sodium (13). Excess amount of total dissolved solids in water disturbed the ecological balance and cause suffocation of aquatic fanna (21). Water containing high total dissolved solids may cause constipation effects (11). During the study period, in tank 1 total dissolved solids was measured as high in July (1062ppm) and low in February (818ppm), but in tank 2 it was measured as maximum (343ppm) in July and minimum (228ppm) in September. Total dissolved solids is due to improper surrounding sanitation (26). Another reason for high total dissolved solids id due to waste disposal around the temple tank (4).

Total suspended solids

Total suspended solids is an index that the water is more polluted (27). The total suspended solids fluctuated between 158ppm (June) and 205ppm (August) in tank 1 and in tank 2, maximum was recorded as 81ppm and minimum as 45ppm in the months June and September respectively. High amount of total suspended solids is due to domestic and industrial discharge (15). Water with high TSS is aesthetically unsatisfactory for bathing (27) and the water is not suitable for recreational purposes (9).

Table 1.1: Monthly variation of physical parameters of water samples from the temple tanks in the year 2009

Parameters →	Temperature ^{0}C		pH		Conductivity mS/cm		TDS ppm		TSS ppm	
Month ↓	Tank 1	Tank 2	Tank 1	Tank 2	Tank 1	Tank 2	Tank 1	Tank 2	Tank 1	Tank 2
Jan.	30.3	30.0	7.6	7.5	1.32	0.40	885	268	198	56
Feb.	29.2	30.1	7.2	7.4	1.22	0.43	818	282	172	56
Mar.	30.1	29.6	7.7	7.6	1.28	0.42	858	288	193	51
Apr.	30.3	29.9	7.5	7.3	1.63	0.41	1003	259	162	57
May	30.7	30.9	7.7	7.9	1.44	0.45	963	232	174	48
June	30.0	29.2	6.9	8.1	1.38	0.36	956	254	158	81
July	30.1	29.3	7.1	7.5	1.82	0.54	1062	343	202	51
Aug.	30.2	29.7	6.7	7.3	1.72	0.52	967	334	205	48
Sept.	30.2	29.0	7.0	6.9	1.53	0.48	835	228	170	45
Oct	29.2	28.8	7.7	7.1	1.62	0.47	848	237	172	49
Nov.	29.0	30.0	7.8	8.1	1.58	0.40	826	243	161	62
Dec.	29.3	29.7	7.4	7.2	1.22	0.38	887	232	167	67

Table 2.1: Monthly variation of chemical parameters of water samples from the temple tanks in the year 2009

Parameters →	D O ppm		B O D ppm		Hardness Ppm		Calcium ppm		Magnesium ppm	
Month ↓	Tank 1	Tank 2	Tank 1	Tank 2	Tank 1	Tank 2	Tank 1	Tank 2	Tank 1	Tank 2
Jan.	5.2	7.6	3.0	1.2	338	98	76.7	23.9	22.56	9.60
Feb.	4.4	7.2	5.4	1.4	296	101	64.4	23.0	32.40	10.30
Mar.	3.6	7.6	2.2	0.6	286	92	62.4	20.8	31.21	9.62

Apr.	7.1	4.2	7.1	6.2	363	116	62.1	20.4	42.11	12.15
May	7.6	3.8	4.9	6.0	290	112	59.1	18.7	19.98	6.12
June	5.2	3.6	8.0	9.1	332	61	56.0	20.4	30.38	2.43
July	1.6	3.2	4.0	6.2	190	80	34.8	21.1	24.90	9.12
Aug.	1.3	3.1	9.0	6.3	176	97	36.4	21.2	24.72	8.70
Sept.	2.4	7.4	3.5	4.8	178	104	36.6	22.6	38.83	3.39
Oct	2.8	7.1	5.4	4.8	270	94	36.8	26.4	42.72	6.72
Nov.	7.0	7.5	0.2	2.0	344	108	67.2	27.2	34.56	9.62
Dec.	5.2	7.6	3.0	1.2	168	101	68.4	28.2	35.24	12.15

Table 2.2: Monthly variation of chemical parameters of water samples from the temple tanks in the year 2009

Parameters →	CO_2 ppm		Alkalinity ppm		Chloride Ppm		Phosphate ppm		Nitrate ppm	
Month ↓	Tank 1	Tank 2	Tank 1	Tank 2	Tank 1	Tank 2	Tank 1	Tank 2	Tank 1	Tank 2
Jan.	15.4	15.4	213.5	79.3	442.3	88.6	0.26	0.13	15.0	9.0
Feb.	12.0	15.2	187.6	60.8	284.0	75.0	0.24	0.16	14.0	11.0
Mar.	13.2	15.4	176.9	73.2	379.3	85.1	0.19	0.23	19.0	12.0
Apr.	14.0	15.7	280.6	85.4	404.7	95.7	0.16	0.22	20.0	14.0
May	28.2	13.0	317.8	137.2	250.4	64.9	0.20	0.25	8.0	11.0
June	21.5	13.2	331.7	90.1	287.1	70.9	0.35	0.29	5.0	8.0
July	25.2	14.4	158.6	109.8	329.6	99.2	0.29	0.15	18.0	10.0
Aug.	31.2	15.8	143.6	68.1	312.6	88.2	0.34	0.11	13.0	5.0
Sept.	21.3	16.2	207.0	91.5	434.7	99.3	0.27	0.23	12.0	13.0
Oct	26.4	17.6	219.6	94.4	450.8	102.5	0.22	0.19	14.0	13.0
Nov.	14.0	14.8	317.2	131.6	372.0	88.6	0.30	0.20	18.0	10.0
Dec.	15.4	15.0	326.7	146.4	287.1	60.2	0.25	0.17	17.0	17.0

IV. CONCLUSION

The present comparative study about two major temple tanks reveal that Nagercoil Nagaraja temple tank was highly disturbed due to anthropogenic activities. The reasons behind the disturbance were mainly due to washing, bathing and discharge of temple wastes by the visitors and temple priests into the temple tank. Another reason is stagnancy of the water in the temple tank due to the blockage of its inlet and outlet by encroachments.

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