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Water Quality Status of Main Temple Tanks in Kumbakonam City, Thanjavur District, Tamil Nadu

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Abstract:- The present study was conducted to determine the water quality in the selected main temple ponds of Kumbakonam city. Based on various physico-chemical analyses, high amount of TDS, turbidity, alkalinity and hardness are mainly caused by washing, bathing activities of devotees, discharges of temple wastes and sewage and surface run-offs. The results revealed that the tank of Varaha Perumal temple is severely affected by human activities and its lead to increasing eutrophication followed by Chakrapani temple. The present study recommended that awareness programmes should be taken up in the adjoining locations of the city to awake people about the detrimental effect of water pollution in the temple ponds. All the tanks should be periodically recharged by the freshwater through proper inlet and outlet channels.

Keywords:- *Surface water, Physico-chemical characteristics, human activities, rituals, and water pollution.*

I. INTRODUCTION

Water is most important for the presence of life on earth. Mainly the freshwater resources are considered as one of the most necessary natural sources for all the living things [1]. Less than 1% of water is readily available in ponds, lakes, rivers, dams, streams, canals, which is used for industrial, domestic and agricultural purposes [2].

Ponds are one of the significant water resources in urban and rural India. There are nearly 1000 temple tanks in Tamil Nadu. The pond is very essential and sustainable management for harvesting rainwater to assure the groundwater level [3]. Temples are centres of worship for Hindus. The devotees use many ponds as the holy water for washing their limbs, sometimes they make a holy dip into the water, and people believe that it can wash all their sins away. However, temple ponds located outside temples are used by people for bathing and washing their clothes [4].

The addition of Industrial effluent and municipal wastewater are affecting Physico-chemical characteristics of freshwater resources and its making unsuitable for feed to livestock, domestic and other purposes [5]. Overuse of water extraction has led to many of them drying up, inlets have been blocked by construction activities, and population pressure resulted in some drained and used for other purposes [3]. The present study was conducted to determine the actual water quality status of different temple ponds in Kumbakonam city, Thanjavur district.

II. MATERIALS AND METHODS

A. Study Area – Kumbakonam

Kumbakonam is a city and a special grade municipality in the Thanjavur district. It is situated 273 km (170 mi) south of Chennai, 96 km (60 mi) east of Tiruchirappalli, and about 40 km (25 mi) north-east of Thanjavur. The city is bounded by two rivers, the Cauvery River on the north and Arasalar River on the south [6].

There are around 188 Hindu temples within the municipal limits of Kumbakonam. Apart from these, there several thousand temples around the town thereby giving the town the sobriquets "Temple Town" and "City of temples". It is noted for its Mahamaham festival which attracts people from all over the country. It is the second-largest city in the Cauvery delta region. It is one of the economic hubs of Central Tamil Nadu [7].

B. Selected Temple Tanks

The following temples are situated within the Kumbakonam city. These temple ponds are regularly used by the local people and devotees during the year:

- Mahamaham Tank (MMP): one of the most prominent landmarks of the town. It is one of the largest ponds in the city. It is being used for a holy dip by the people every 12 years.
- Saeikulam Tank (SKP): It is a common tank for the public. The people are using this tank for all domestic purposes. It is fully fenced and prevents the contamination of the surface run-offs.
- Chakrapani Temple Tank (CPP): It is a Hindu temple dedicated to Vishnu located in Kumbakonam. This temple is located 2 km, away towards North West from the Kumbakonam Railway Station. The temple is one of the most prominent temples in Kumbakonam.
- Portramai Tank (PTP): It is located between Sarangapani and Kumbeswara temple at Kumbakonam on Thanjavur route, approximately 2 k.m from new bus-stand. It has the equal significance of Mahamaham tank.
- Varaha Perumal Temple Tank (AVP): It is located just behind the Chakrapani temple in Kumbakonam, which is ancient Aadhi Varaha Perumal Kovil, a temple that dates back to the Varaha Avatar. It has also a large tank when compared to others.
- Pidari Amman Temple Tank (PAP): It is also called Sri Ella Pidari Amman Temple, which is located in Motilal street of Kumbakonam.

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- Ayekulam Tank (AKP): It is a common tank for the public, which is located in the border of the city. The people using this tank for all domestic purposes.

C. Water Sampling and Analysis

In the present study, water samples from seven temple tanks were collected during three months (January, February and March - 2019). The samples were collected in plastic canes of two litres capacity without any air bubbles for physico-chemical examinations.

Some parameters like pH and dissolved oxygen were measured on-site. Grab sampling method was followed during the sampling. The water samples were analyzed for 12 physico-chemical parameters using standard methods [8].

D. Water Quality Index

Water quality index (WQI) is commonly used for the detection and evaluation of water pollution and may be defined as "a rating reflecting the composite influence of different quality parameters on the overall quality of water". WQI was calculated by the weighted arithmetic index method [9, 10, 11]. Twelve parameters were taken for calculation of water quality index: pH, TDS, turbidity, hardness, total alkalinity, DO, Cl^-, Ca^{2+}, Mg^{2+}, F^-, NO_3^- & SO_4^{2-}.

The relative weight of each value in the overall water quality was computed regarding the drinking water standards recommended by the Bureau of Indian Standards [12].

$Wi = K/S_n$

Where,

K = constant value of proportionality is calculated as

$$K = \frac{1}{1/S_1 + 1/S_2 + \ldots\ldots\ldots\ldots\ldots + 1/S_n}$$

Si - the standard value of the ith parameter

Quality rating scale: Each chemical factor has been consigned by dividing the concentration of each measured value by its respective standard value and the result multiplied by 100.

$$Qi = \left(\frac{Va - Vi}{Vs - Vi}\right).100$$

Where, V_a – actual or average value of ith parameter obtained from the water sample

V_i - ideal value for pure water (0 for all parameters except pH (7.0) and DO (14.6))

Vs - Standard value of the ith parameter

$$WQI = \left[\frac{\sum QiWi}{\sum Wi}\right]$$

Where, $\sum(Q_iW_i) = Q_i$ (pH) X W_i (pH) +...……+ Q_i (Fe) X W_i (Fe).

$\sum W_i$ - total relative weight of all parameters

The obtained water quality index values of samples were categorized into the following five classes: Clean (0 - 25), good (26 - 50), moderately polluted (51 - 75), severely polluted (76 - 100) and unfit for consumption (above 100) based on their suitability [13].

III. RESULTS AND DISCUSSION

A. Water Quality Characteristics

The results of physical and chemical characteristics of selected temple tanks in Kumbakonam city were presented in Table 1-3.

- ***pH:*** The pH of the water samples varied from 7.0 (January) to 8.5 (March) in Kumbakonam temple tanks. The high pH values were found during March all temple ponds except AKP. The minimum values were observed in January month except for CPP. The pH of water samples was found in alkaline nature during the study period. The alkaline character of water may be due to high temperature (during March) that reduces the dissolution of carbon dioxide and also due to photosynthetic process. pH changes in water were due to discharge of urban wastes, human activities and surface run-off [14].

- ***Total Dissolved Solids:*** TDS of all water samples are recorded with a maximum value of 650 mg/L in March and a minimum of 200 mg/L in January. The elevated value of TDS during March month can be due to the adding of garbage, domestic and municipal sewages, etc [15].

- ***Turbidity:*** The high value of turbidity (15.8 NTU) was found during March month (summer) and low value in Mahamaham tank (3.8 NTU) during January month respectively. The high amount of turbidity during summer may be the presence of high suspended particles and pathogenic organisms leading to increased turbid water has also been proposed [16].

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S.No.	Parameter	MMP	PTP	CPP	AVP	SKP	PAP	AKP
1	pH	7.5	8.0	8.5	8.0	7.5	8.0	7.5
2	TDS (mg/l)	200	420	530	570	440	350	410
3	Turbid (NTU)	3.8	6.5	10.7	11.2	8.6	4.5	6.3
4	TA (mg/l)	137.5	275	375	300	200	250	275
5	TH (mg/l)	150	310	410	435	200	300	285
6	DO (mg/l)	6.1	5.5	5.2	4.8	5.3	5.7	5.0
7	Cl^- (mg/l)	27.3	57.1	67	59.6	57.1	54.6	59.6
8	NO_3^- (mg/l)	2.3	3.20	2.80	3.10	3.5	3.2	3.6
9	SO_4^- (mg/l)	29.5	22.5	21.0	45.0	40.0	24.5	33.0
10	PO_4^- (mg/l)	0.16	0.2	0.22	0.25	0.2	0.18	0.2
11	Ca_2^+ (mg/l)	28.1	50.1	74.2	76.1	34.1	32.1	38.2
12	Mg_2^+ (mg/l)	21.9	45	54.7	62	27.9	27.9	33.4

Table 1:- Physico-Chemical Characteristics of Temple Tanks in January

S.No.	Parameter	MMP	PTP	CPP	AVP	SKP	PAP	AKP
1	pH	8.0	8.0	8.0	8.5	8.0	8.0	8.0
2	TDS (mg/l)	240	450	570	610	465	365	440
3	Turbid (NTU)	4.3	6.7	12.9	13.6	9.1	5.0	6.8
4	TA (mg/l)	152.5	300	410	325	215	270	310
5	TH (mg/l)	190	325	435	450	235	325	310
6	DO (mg/l)	5.6	5.1	4.6	4.5	4.9	5.4	4.6
7	Cl^- (mg/l)	34.6	64.3	77.1	67.1	64.3	59.6	67.1
8	NO_3^- (mg/l)	2.6	3.40	3.40	3.40	3.9	3.5	3.9
9	SO_4^- (mg/l)	30.5	26.0	24.5	46.5	42.5	27.0	35.5
10	PO_4^- (mg/l)	0.18	0.22	0.26	0.28	0.24	0.2	0.22
11	Ca_2^+ (mg/l)	34.1	58.1	79.7	80.1	38.2	38.2	48.2
12	Mg_2^+ (mg/l)	27.9	45	59.7	65	33.4	29.1	42

Table 2:- Physico-Chemical Characteristics of Temple Tanks in February

S.No.	Parameter	MMP	PTP	CPP	AVP	SKP	PAP	AKP
1	pH	8.0	8.5	8.5	8.5	8.0	8.5	7.5
2	TDS (mg/l)	330	465	600	650	490	385	510
3	Turbid (NTU)	5.5	6.9	13.4	15.8	9.7	5.4	8.7
4	TA (mg/l)	200	330	440	335	242.5	285	340
5	TH (mg/l)	230	345	460	475	280	340	355
6	DO (mg/l)	5.0	4.7	4.0	4.1	4.4	5.0	3.9
7	Cl^- (mg/l)	59.6	67.1	84	69.6	70.7	67.1	84
8	NO_3^- (mg/l)	3.3	3.90	3.90	3.90	4.1	3.8	4.7
9	SO_4^- (mg/l)	35.0	36.5	27.0	49.0	44.5	29.5	39.0
10	PO_4^- (mg/l)	0.21	0.24	0.28	0.3	0.27	0.22	0.25
11	Ca_2^+ (mg/l)	50.2	74.2	82.1	82.1	48.2	50.1	74.2
12	Mg_2^+ (mg/l)	38.1	52.1	62	67.4	42	37.9	59.7

Table 3:- Physico-Chemical Characteristics of Temple Tanks in March

- ***Total Alkalinity***: The high value of total alkalinity was observed in March (440 mg/L in CPP) and the low value was found in January (137.5 mg/L MMP) month. Higher values of alkalinity recorded during summer (March) might be due to the presence of free carbon dioxide as a result of the decomposition activity by the mixing of municipal sewage and domestic wastewater [17]. The low alkalinity values during the monsoon (January) might be due to dilution of waste.

- ***Total Hardness***: In the current investigation, the minimum (150 mg/L) and maximum value (475 mg/L) of total hardness were seen in January to March respectively. Higher values of hardness during summer (March) can be attributed to low water level and high rate of evaporation of water and the addition of calcium and magnesium salts [14].

- ***Dissolved Oxygen***: The lowest value of DO was 3.9 mg/L (AKP) in March, and the highest value 6.1 mg/L (MMP) in January were determined. Minimum values of dissolved oxygen indicate higher organic inputs and stagnancy of water of ponds. According to Singh [18], less DO values during summer might be consigned to the high temperature and its consumption by microorganisms for their rapid growth.

- ***Chloride***: The least Chloride value in January (27.3 mg/L) and the most value recorded in March (84.0 mg/L) were distinguished in the water samples. It is attributed to the high amount of salts is considered as an indicator of high contamination due to plant and animal decomposition [19].

- ***Nitrate***: The value of Nitrate was observed low value (2.3 mg/L) in January and high value (4.7 mg/L) in July months. All nitrate values of water samples are well within the acceptable limit for drinking water.

- ***Sulphate***: The amount of sulphate varied between 21.0 mg/L and 49.0 mg/L. The sulphate values do not exceed in all the tanks and the values are well within the permissible limits of the standards. The high content of sulphate was found in AVP tank in March.

- ***Phosphate:*** A high amount of phosphate is an indicator of pollution, which induce the possibility of eutrophication. The minimum value of phosphate in MMP was recorded as 0.16 mg/l in January and the maximum in AVP was found as 0.30 mg/l in March.

- ***Calcium***: In the present study, the lowest value (28.1 mg/L) of calcium in January at MMP and the highest value (82.1 mg/L) in March were observed. Some amount of calcium is present in surface water naturally, but the high amount of calcium is discharging of wastewater from urban areas. Excess amount of calcium in potable water leads to increases salt in the human body and may cause gastrointestinal diseases and stone development [20].

- ***Magnesium***: Varaha Perumal temple was found with the highest values of magnesium in January (62.0 mg/L) and March (67.4 mg/L) months. The lowest magnesium was observed in MMP (21.9 mg/l) in January month. The insufficient level of magnesium can reduce the light penetration, temperature and phytoplankton, it is recommended that the adequate amount of magnesium necessary to surface water [21].

B. Water Quality Index

The calculated WQI values of selected temple tanks in Kumbakonam city are presented in Table 4. During January month, Mahamaham tank was found in moderately polluted

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category, all other samples were found to be severely polluted and unfit for human consumption categories. In the February month, all tanks were found to be unfit for consumption category except two tanks (MMP & PAP). Except for Mahamaham tank, all tanks of Kumbakonam city were found to be unfit for human consumption category in March. Among the seven tanks, Mahamaham tank only slightly polluted when compared to other tanks. It is due to recently the Mahamaham tank filled with fresh water for the Mahamaham festival. Other tanks are consists of the existing water and concentrating the contaminants itself.

S.No.	St. Code	Jan	Category	Feb	Category	Mar	Category
1	**MMP**	69.3	Moderate	83.0	Severely	96.5	Severely
2	**PTP**	103.6	Unfit	106.9	Unfit	118.8	Unfit
3	**CPP**	144.3	Unfit	156.4	Unfit	169.6	Unfit
4	**AVP**	144.0	Unfit	169.6	Unfit	187.0	Unfit
5	**SKP**	107.9	Unfit	121.1	Unfit	129.3	Unfit
6	**PAP**	85.0	Severely	90.2	Severely	103.5	Unfit
7	**AKP**	94.6	Severely	108.6	Unfit	122.2	Unfit

Table 4:- WQI Values of Temple Tanks in Kumbakonam City

The high value of WQI was found in the temple tank waters due to the higher values of TDS, turbidity, hardness and low dissolved oxygen. The increasing trend of WQI from January to March of each water samples was due to the cumulative impact of the several pollutants from surface run-offs and cleaning activities of devotees. The variations in WQI values could be due to the fluctuations in the water levels and waste disposal in selected water bodies. No one sample was found in safe and good categories in all months.

IV. CONCLUSION

The results of Physico-chemical analyses revealed that the tank of Varaha Perumal temple is significantly affected by anthropogenic activities and showed an increasing rate of eutrophication followed by Chakrapani temple. It is due to the high amount of TDS, turbidity, alkalinity and hardness are mainly caused by washing, bathing activities of devotees, discharges of temple wastes and sewage and surface run-offs from the local activities. Based on the WQI, maximum water samples found in unfit for human consumption. No one tank water is safe for human use. Hence, this study concluded that the selected tanks of temples are not suitable for drinking purpose but all are suitable for cleaning purposes of the people. The present study recommended that awareness activities should be taken up in the adjoining locations of the city to awake people about the detrimental effect of water pollution in the ponds. All the tanks should be periodically recharged by the freshwater through proper inlet and outlet channels.

REFERENCES

[1]. B. Elayaraj, M. Selvaraju, M. and K.V. Ajayan, "Assay on water quality variations of Pasupatheswarar temple pond, Annamalainagar, Tamilnadu, India", J. Inter. Acad. Res. Multidis, 2016, vol. 3(12), pp. 97-108.

[2]. A. Sargaonkar and V. Deshpande, "Development of an overall index of pollution for surface water based on a general classification scheme in Indian context", Environ. Monitor. Assess, 2003, vol. 89, pp. 43-67.

[3]. M. Alaguraj, C. Divyapriya and S. Lalitha, "Temple tanks – The ancient water harvesting systems and their multifarious roles", Global J. Eng. Sci. Res., 2017, vol. 4(12), pp. 138-142.

[4]. S. Bramhanand and U. Nidhi, "Limnological study of Hanuman temple pond of Shahdol municipality", International Journal of Zoology Studies, 2017, vol. 2(5), pp. 27-30.

[5]. B.K. Dwivedi, and G.C. Pandey, "Physicochemical factors and algal diversity of two ponds Girja Kund and Maqubara pond, Faizabad", Pollution Research, 2002, vol. 21, pp. 361-370.

[6]. Katti and N, Madhav, "Studies in Indian place names", Place Names Society of India, 1980.

[7]. E.K. Sashadri, "Sri Brihadisvara: the great temple of Thānjavūr", Nile Books, 1998, p. 2.

[8]. APHA, AWWA, WEF, "Standard methods for the examination of water and wastewater", 21st ed. Washington, D.C, 2001.

[9]. J. Yisa and T. Jimoh, "Analytical studies on water quality index if river Landzu", American Journal of Applied Science, 2010, vol. **7**(4), pp. 453-458.

[10]. S. Kalavathy, T.R. Sharma and P. Sureshkumar, "Water quality index of river Cauvery in Tiruchirappalli district, Tamilnadu", Archives of Environ. Sci, 2011, vol. 5, pp. 55-61.

[11]. S. Purohit, "Seasonal variations in water quality index of groundwater of Osian region, Jodhpur, India", Inter. J. Innov. Res. Sci. Eng. Tech, 2014, vol. 1, 2.

[12]. BIS, "Indian standards specification for drinking water", IS: 10500. Bureau of Indian Standards, New Delhi, India, 2012.

[13]. P. Swarnalatha, K. Nageswara Rao, P.V. Ramesh Kumar and M, Harikrishna, "Water quality

assessment by using an index at village level: A case study", Poll. Res. 2007, vol. 26, pp. 619-622.

[14]. T. Rakesh Sharma, "Water quality assessment of river Cauvery in Tiruchirappalli region", M.Phil. dissertation, Tamil University, Thanjavur, Tamilnadu, 2009.

[15]. P. Martin and M.A. Haniffa, "Water quality profile in the south-Indian river Tamiraparani", IJEP, 2003, vol. 23(3), pp. 286-292.

[16]. A. Kumar, and Y. Bahadur, "Physico – chemical Studies on the pollution potential of river Kosi at Rampur (India)", World J. Agri. Sci, 2009, vol. 5(1), pp. 01-04.

[17]. M.G. Masters, "Introduction to Environmental Engineering and Science", 2nd ed. Pearson Education, Pte. Ltd. Delhi, 2004.

[18]. Singh Namrata., "Physicochemical properties of polluted water of river Ganga at Varanasi", Inter. J. Energy Environ, 2010, vol. 1(5), pp. 823-832.

[19]. S. Arya, V. Kumar, M. Raikwar, A. Dhaka and Minakshi, "Physico-chemical analysis of selected surface water samples of laxmi tal (pond) in Jhansi city, up, Bundelkhand region", Central India Journal of Experimental Sciences, 2011, vol. 2(8), pp. 01-06.

[20]. V. Saritha, V. Rohini Kumari and V.S. Jyothi, "Subsurface water quality of a semi-urban region", Indian J. of Environ. & Ecoplan, 2009, vol. 16(2-3), pp. 361-366.

[21]. R. K. Garg, R. J. Rao, D. Uchchariya, G. Shukala and D.N. Saksena, "Seasonal variation in water quality and major threats to Ramsagar reservoir, India", African Journal of Environmental Science and Technology, 2010, vol. 4(2), pp. 61-76.