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Evaluation of hydrobiological properties of temple ponds in Tiruchirappalli, Tamilnadu, India

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ABSTRACT

This study was to analyses the water quality of Tiruvanai Kaval: Brahma theertham, Srirangam temple pond and Cauvery river. The water samples were collected and analyzed using APHA standard analytical procedures. Water quality assessment revealed that pH, TDS, sulfate and phosphate were within acceptable limits. Investigations further showed that both temple ponds were polluted due to human activities. The water quality index values of ThiruvanaiKaval: Brahma theertham was of poor (25-49); at Srirangan temple pond, the water quality index was slightly better (50-69). From this study, it was concluded that the water is commonly contaminated with microbes and this contamination may be due to human activity which might be the cause for transmission of diseases to devotees. Therefore, it is suggested that the temple pond water cannot be used directly for drinking as (theertham) without prior treatment.

Keywords: Temple Pond Water, ThiruvanaiKaval, Srirangam, Microbial Studies

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INTRODUCTION

Water is life" is such a standard expression that we use it almost as a cliché. However, that phrase is perhaps one among the foremost powerfully true messages the entire creation bears witness to. If, as we learn from geography, the world is 2/3 water, and science says the physical body is 70% water, then it goes without saying that no life are often sustained without water such a lot has been written about the importance of water. From an early age we were taught the water cycle and the way it sustains life, but we still take it without any consideration. We pollute water basins, rivers, and even the atmosphere that gives us with this precious commodity. So, once more, let's attempt to consider the extremely important message that water is everything and water changes everything (Mohammad, 2015).

Water stockpiling is crucial for meet all family, mechanical and fire insurance needs in most open water supply frameworks. The sort and limit of water stockpiling needed by the appropriation framework shift with the size of the framework, the geology of the space, the format of the water framework, and different variables. As per the requirements of explicit networks, there are four kinds of water stockpiling structures, to be specific hydro-pneumatic capacity tanks, ground stockpiling tanks, underground stockpiling tanks and the most widely recognized overhead stockpiling tanks. Water stockpiling is a wide term that alludes to non-drinking water utilized for utilization and agribusiness. In non-industrial nations with heat and humidities and some created nations, drinking water should be put away during the dry season. In horticulture, the water is put away for later use in characteristic water sources, for example, groundwater springs, soil waters, regular wetlands, and little counterfeit lakes, supplies and repositories behind primary dams. Water stockpiling represents various likely issues, paying little mind to the planned utilization of the waters, incorporating pollution with natural and inorganic specialists (Harry, 2008).

Sanctuary tanks are wells or tanks worked as a component of a sanctuary complex close to Indian sanctuaries. They are called Pushkarini, Kalyani, Kunda, Sarovara, Tirtha, Talab, Pukhuri and so on in various dialects and areas of India. Some tank showers are said to mend an assortment of illnesses and conditions. It is conceivable that these are the social remaining parts of such constructions as the Great Bath of Mohenjo-daro or Dholavira, which was essential for the Indus Valley Civilization. Since antiquated occasions, the water stockpiling configuration has been significant in India's sanctuary design (Alaguraj, 2018).

The plan of the sanctuary tank itself turns into a work of art. An illustration of the specialty of tank configuration is the enormous, geometrically terrific Stepped Tank at the Royal Center at the vestiges of Vijayanagara, the capital of the Vijayanagara Empire, encompassing the cutting-edge town of Hampi. It is fixed with green diorite and has no channel. The tanks are utilized for custom purifying and during rituals of sanctification. The water in the tank is considered to be consecrated water from the Ganges River. In India, a stepwell is a profound brick work well with steps going down to the water level in the well. It is known as a vav in west India and a baoli in north India. Some were worked by rulers and were luxuriously ornamented. They regularly were worked by respectability, some being for common use from which anybody could acquire water. Haridra Nadhi is the biggest sanctuary tank in India, possibly on the planet, particularly in western India, where the dry and rainstorm seasons substitute. The sanctuary repository configuration has become a fine art in itself. An illustration of the craft of tank on the planet. It is situated in Mannargudi, Thiruvarur District, Tamil Nadu. It is the sanctuary supply of one of the biggest Hindu sanctuaries, the Rajagopalaswamy Temple, Mannargudi. The sanctuary repository covers 23 sections of land (93,000 m2). It is likewise called the daughter of the Kaveri River. Seldom, just sanctuary tanks are presented to mechanical contamination or sewage, despite the fact that there is light contamination in certain tanks that are utilized for washing or washing garments. Numerous sanctuaries gloat tanks that are saved uniquely for sanctuary customs. Furthermore, obviously, a critical benefit of these plants is that they fill in a spotless and clean climate, and are accordingly liberated from substantial metal and mechanical pollution. Changing the water quality influences the biotic local area of the amphibian environment, at last decreasing essential profitability (MadhaviGanesan, 2008). The deviation of the physicochemical boundaries causes pressure and antagonistically influences the fish population. The yearly fishing right of the religious community lake (one of the six homes of Lord TirupparankundramMuruga) is valued at Rs. 47,000. The current work is centered around two sanctuary lakes, in particular the aquatic biology of ThiruvanaiKaval: Brahmin theertham, and Srirangam, which are likewise reasonable for fish cultivating.

MATERIALS AND METHODS

Study area

Samples were taken from ThiruvanaiKaval: Brahma theertham, Srirangam temple pond and Cauvery river, Tiruchirappalli (Fig.1).

Brahmma theertham, which is located on the south side of 4th Praharam (South Car Street), a pond at the west gate of Srirangam Temple: Teppotsava is important this month. It is a feast where Lord Perumal sails on a teppama (boat) in a reservoir west of the temple. The Cauvery is the fourth-largest river in south India. Originating in the Western Ghats at Talakaveri in Karnataka's Kodagu district, it passes through Tamil Nadu. The samples were collected in sterilized plastic bags / bottles and shipped to the Zoology Research Laboratory, Jamal Mohamed College, Tiruchirappallli, TN, India and stored in a refrigerator at 4 ^{0}C until further processing.

The physical and chemical parameters of ThiruvanaiKaval: Brahma theertham, Srirangam Temple pond Cauvery river waters were analyzed using APHA (1998) standard analysis procedures. The colour of the sample is recorded by visual observation and by measuring the odour by smelling the sample immediately after collection.

Bacteriological studies

Use an inoculating needle to streak the sample to grow colonies isolated on nutrient agar. The plate was then incubated at 37°C for 24 hours for bacteria. After 24 hours, check the morphology of the colonies growing on the plate and use the same colonies for gram staining and then identification using standard microbiological methods.

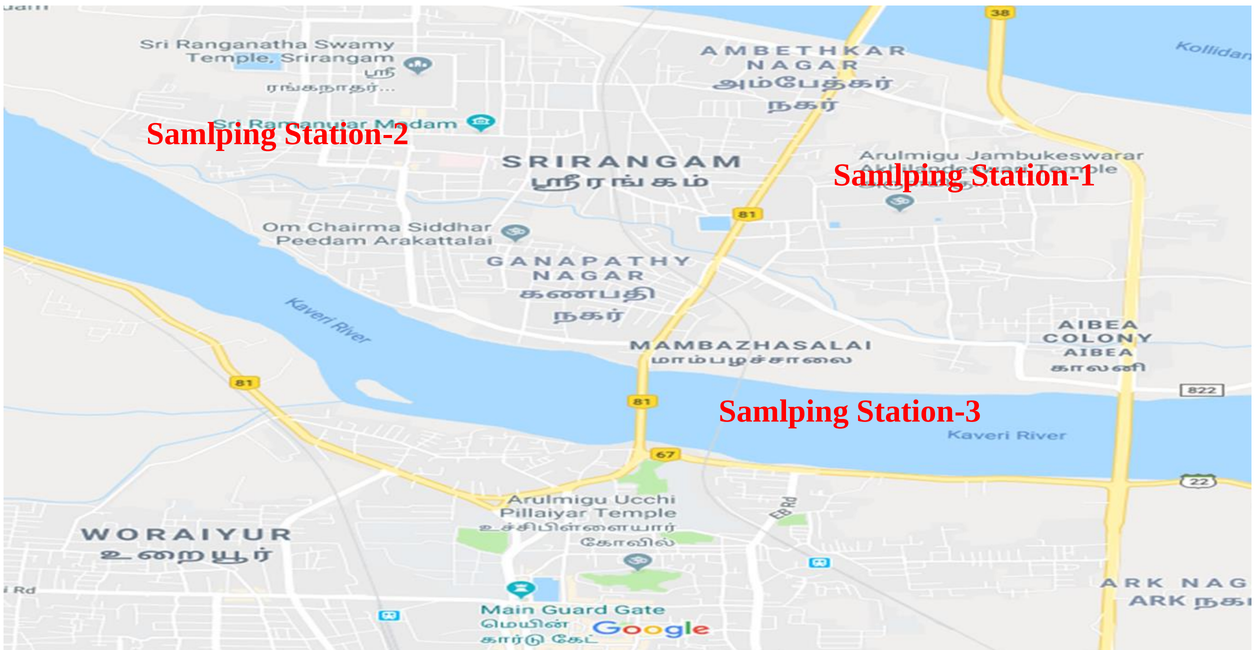

Figure 1: Shows the sampling stations Thiruvanaikaval (brammatheertham), Srirangam temple pond and Cauvery River, Tiruchirappalli.

Physical and chemical inspection of groundwater samples

Fungal Studies

Aseptically, using forceps, place a sheet of sterile filter paper in a petri dish. Place the sterile U-shaped glass rod on the filter paper. (The rod can be sterilized by arson if held with forceps. Pour enough sterile water (approximately 4 ml) onto the filter paper to keep it completely moist. Using forceps, place the sterile slide on the U-bar. Gently burn the scalpel to sterilize, and cut a 5 mm square block of medium from the Sabouraud agar plate or Emmons medium. Insert a scalpel, remove the agar block, and carefully transfer it aseptically to the centre of the glass slide. The four sides of the agar square are inoculated with spores or mycelial fragments of the test fungus. Inoculate the four sides of the agar square with spores or mycelial fragments of the test fungal. Three sample replicates were collected for temple ponds to increase accuracy of the result. Cultures were maintained on Sabouraud agar medium by using lacto phenol cotton blue stain, the isolated fungi were identified.

RESULTS AND DISCUSSION

Physical and Chemical Parameters

For the present study the water samples were collected from four Sampling stations Thiruvanaikaval: Brahma theertham and Srirangam temple pond. The water quality parameters were compared with nearer Cauvery river water. These samples were analysed for physical and chemical parameters such as Temperature, pH, Colour (Hazen units), Odour Electrical Conductivity (Micromhos/cm@25^{0}C), Dissolved Oxygen (Mg/l), Salinity (ppt), Carbonate (Mg/l), Total Dissolved Solids (Mg/l), Suspended Solids (Mg/l), Total hardness ($CaCo_3$) (Mg/l), Alkalinity ($CaCo_3$) (Mg/l), Bicarbonate (Mg/l), Chloride (Mg/l), Calcium (Mg/l), Magnesium (Mg/l), Sodium (Mg/l), Sulfate (Mg/l), Potassium (Mg/l), Nitrate (Mg/l), Fluoride (Mg/l) and Turbidity (NTU),the results are presented in Table 1.

The results of the present study reveal that the sample from the stations was colourless or clear and odourless. The pertinent major water quality factors are safety, taste and odour, appearance and chemical balance. Water quality may deteriorate because of poor quality water put into the distribution system, chemical interaction between water and pipe, biological degradation, biological infestation, cross connections, inadequate main disinfection, defects in storage facilities, and other less common factors such as blowoffs and vacuum or air relief valves improperly constructed or located. The consequences may be one or more of the following: Unsafe water, turbid or rusty water, unpleasant taste and odour, or coloured water (www.neospark.com/images/waterqua.pdf).

The temple ponds water temperature levels were ranged from 30.5to 31.4^{0}C. The optimum range of temperature for the aquaculture pond is between 28°C- 30°C. A temperature increase of more than 30°C will increase activity levels and metabolism. This also increases the growth rate. If the temperature still increases then the fishes reaches a threshold of physical and nutritional tolerance, which is 33 °C in poor quality water or 35°C in good quality water and remains stationary at the pond bottom (FAO,2016).

Hydrogen ion concentration of the water samples were ranged between 7.9- 8.7 and it was more or less equal to Cauvery river water (7.5). It is an important chemical parameter to consider because it affects the metabolism and other physiological processes of culture organisms. The pH value should be kept within a certain range (pH 6.8-8.7) to achieve acceptable growth and production. Exceedingly alkaline water (greater than pH 9) is dangerous as ammonia toxicity increases rapidly. At higher temperatures fish are more sensitive to pH changes (www.pir.sa.gov.au/factsheets).

In natural waters dissolved solids are composed mainly to carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium, potassium, iron and manganese etc., Among the sample analysed for the Electrical Conductivity levels in temple ponds water were ranged from 520-4420Micromhos/cm@25^{0}C),

Table 1: Physical and Chemical parameters of Thiruvanaikaval temple pond (Brahmatheertham –S1), Srirangam temple pond- S2 and Cauvery river- S3.

S. No	Parameter	Sample 1	Sample 2	Sample 3
1	Temperature (^{0}C)	31.4	30.5	29.2
2	pH	7.9	8.7	7.50
3	Colour (Hazen units)	Colourless	Colourless	Colourless
4	Odour	Odourless	Odourless	Odourless
5	Electrical Conductivity*	4420	520	267
6	Dissolved Oxygen (Mg/l)	3.1	4.9	5.2

7	Salinity (ppt)	0.27	0.24	0.22
8	Carbonate (Mg/l)	00	00	4.27
9	Total Dissolved Solids (Mg/l)	2768	295	495
10	Suspended Solids (Mg/l)	1.0	BDL	BDL
11	Total hardness ($CaCo_3$) (Mg/l)	1140	200	77
12	Alkalinity ($CaCo_3$) (Mg/l)	460	150	205
13	Bicarbonate (Mg/l)	561	183	24.0
14	Chloride (Mg/l)	482	71	60
15	Calcium (Mg/l)	128	26	36.1
16	Magnesium (Mg/l)	199	33	25.3
17	Sodium (Mg/l)	435	12	58
18	Sulfate (Mg/l)	960	19	16
19	Potassium (Mg/l)	98	27	10.9
20	Nitrate (Mg/l)	185	15	4.26
21	Fluoride (Mg/l)	0.61	0.47	0.28
22	Turbidity (NTU)	2.0	BDL	13

*Micromhos/cm@25^{0}C

Brahma theertham and Srirangam temple ponds water EC were comparing than that of Cauvery river water (267Micromhos/cm@25^{0}C). Electrical conductivity (EC) is a measure of the conductivity of a solution. It is related to salt content; the higher the salt content, the higher the EC. Freshwater fish generally thrive over a wide range of electrical conductivity (Nathan et al., 2013).

The salinity levels in temple ponds water were between 0.24- 0.27ppt and slightly higher than that of Cauvery river water (0.22ppt). The optimum range of salinity for aquaculture pond is between 10 and 25 ppt, although the fishes will accept salinity between 5 and 38 ppt. since its eurihaline character. The early life stages of both fishes and prawn require standard seawater salinities but while growing they can with stand to brackish water or even to freshwater. However, for better survival and growth optimum range of salinity should be maintained in the aquaculture ponds (www.neospark.com/images/waterqua.pdf).

The Turbidity of the temple ponds water was BDL-2.0NTU. The turbidity of the water is important because it determines the amount of light penetration that occurs in the pond water column. In turn, this will affect the water temperature and the number of vegetation and algae growing in the pond itself. For example, a highly turbid pond will allow less light penetration therefore the temperature of the water will be lower (www.pir.sa.gov.au/factsheets).

Table 2: Morphological and cultural characteristics of the organisms isolated from temple pond water samples

SlNo	Samples	CFU	Gram's Staining	Morphology	Colony Morphology	Percentage
1.	ThiruvanaiKaval (BrahmmaTheertham)	145 x10^7	G +ve	Rod	White rhizoidal	G +ve - 50
			G +ve	Cocci	Small circular opaque	
			G –ve	Rod	Puncti white	
			G -ve	Rod	Large irregular flat	G –**ve** - 50
2.	Srirangam	120 x10^7	G -ve	Filament	Small Circular	G +ve - 67
			G +ve	Rod	Small Circular opaque	
			G +ve	Rod	Punctin white	G –ve - 33

Table 3: Fungi morphological and identify the isolated organisms from temple pond water

Sl No	Sample	CFU	Colony Morphology	Fungal name
1	Thiruvanaikaval (brammatheertham)	1x10^3	Green colour	*Aspergillusniger*
2	Srirangam	15x10^3	Green, yellow, white colour	*A.niger*
				A.rlaus
				A.rumiqatus
				Mucor.sp
				Neurosporasp

The Total Hardness of the temple ponds water was ranged from 200- 1140mg/l and it was higher than that of Cauvery river water (77 mg/l). Numerous inorganic (mineral) substances are dissolved in water. Among them, calcium and magnesium metals and their counter carbonate ions (CO3-2) form the basis of "hardness" measurement. Optimum hardness for aquaculture is in the range of 40 to 400 ppm of hardness(www.FAO.org,2016).

Carbonate is a naturally occurring ion found in almost all kinds of water bodies. It is also an important ion imparting hardness to the waters (Trivedy*et al.*, 1987). Carbonate has been found to occur in ground water in concentration ranging from a few to several thousand milligrams per litre. In the present studies carbonate concentrations are found to be BDL in temple ponds water and Cauvery river water was 4.27 mg/l. Fluctuations in these values among the sampling stations with the concentration of carbonate linked to the status in and around environment. The entry of more domestic sewage might be the main cause for carbonate content (Pasternak and Starzecka 1979).

Bicarbonate is the abundant citation in land waters imparting hardness. The values of Bicarbonate were between183 and 561mg/l in temple ponds water and it was higher than that of Cauvery river water (24.0 mg/l). Also, the carbonate and bicarbonate caused by far the greatest portion of the hardness occurring in natural waters. Hardness of water is objectionable from the viewpoint of water use for aquaculture purpose. So the hardness of the water increases day by day. Hard water is unsuitable for domestic /other purpose and reports indicate that it has a role in heart diseases (Peter, 1974).

Chloride occurs naturally in all types of waters. In natural fresh water, its concentration remains quite low but it is typically associated with industrial discharges and urban runoff. Chloride concentration depends on the characteristics of sediments and the pollution load. The chlorides concentrations temple ponds water was between 71.0- 482.0mg/l and it was higher than that of Cauvery river water (60 mg/l). Although chlorine is very deadly to fish, chlorine is a component of most waters and is essential to help fish maintain osmotic pressure balance. In commercial catfish production, chloride (in the form of salt) is often added to water to obtain a minimum concentration of 100 mg/L (Nathan et al., 2013).

It has been found that the concentration of sodium ions in groundwater ranges from several thousand to several thousand milligrams per litter. Sulfate and sodium interfere with the normal function of the intestine. In this study, it was found that the sodium concentration in the temple pond water was 12.0-435 mg/l, and the sodium concentration in the Rama and Uchhipillayar temple pond water was compared with the Cauvery river water (58 mg/l). The fluctuation of these values between sampling stations is related to the concentration of sodium and the conditions of the surrounding environment. More entry into the salt and marine chemical industries may be the main reason for the increase in sodium content (Pasternak and Starzecka 1979).

Potassium in water bodies is responsible for the growth of blue green algae (Patel and Tiwari, 1989). Potassium that is present in the aquatic system may either be assimilated by algae and aquatic macrophytes or transferred to underlying sediments where it undergoes denitrification. Potassium values were ranged from 27.0- 98.0mg/l in the temple ponds water and it was higher than that of Cauvery river water (10.9 mg/l). For inland shrimp production, potassium and magnesium may need to be supplemented in the pond water at the same time, because these elements in inland brine are usually less than those in the rare sea (Nathan et al., 2013).

The temple ponds water nitrate concentrations were ranged between 15.0- 185.0 mg/l. Depending on the watershed soil, land use and fertilizer management, this level can be increased. Nationally, the median concentration of nitrate nitrogen in household wells tested between 1994 and 2004 was 0.55 mg/L (DeSimone et al., 2004). However, nitrate is non-toxic to fish and harmless to health unless the content is extremely high (more than 90 mg/L NO3-N) (Nathan et al., 2013).

Sulfate is one of the most abundant elements in natural water imparting hardness in them. The concentrations of Sulfate in temple ponds water were between 19.0- 960.0 mg/l and it was higher than that of Cauvery river water (16 mg/l). Sulfate is a common compound in water. It is produced by the dissolution of minerals from soil and rocks. Typical levels are between 0 and 1,000 mg/L. Some well water and most coastal pond water will have higher sulfate concentrations. Fish can tolerate a variety of sulfate concentrations. It is only a problem that the sulfate content is greater than 500 mg/L when the water is used for other purposes (Nathan et al., 2013).

The concentrations of fluoride in temple ponds water were ranged from 0.47- 0.61mg/l. Fluoride is a trace element usually found in water at levels of 0.51 to 0.53 mg/L. It can be added to water to prevent human tooth decay (at a concentration of 0.7 mg/L). Levels at or above 3 mg/L are reported to cause losses of some fish species, depending upon complex water conditions (Nathan et al., 1993).

Calcium is one of the most abundant elements in natural water imparting hardness in them. The concentrations of calcium in the temple ponds water were between26.0 and 126.0mg/l in Brahma theertham and Srirangam temple ponds water were lower than that of Cauvery river water (36.1 mg/l). Magnesium is the second abundant citation in land waters imparting hardness. The value of magnesium 4.0 – 28.0mg/l in temple pond water and it was compared with the Cauvery river water (25.3 mg/l). Calcium and magnesium are the largest part of natural water hardness. Hardness of water is objectionable from the viewpoint of water use for domestic purpose. So the hardness of the water increases day by day. Hard water is not suitable for home use, and reports indicate that it has a certain effect on heart disease (Peter, 1974).

The water sample was collected from temple ponds and processed to identify the microorganisms and the results were presented in Table 2-3. The results for microscopic examination such as staining, cultural characters and colony morphology. The bacteria were isolated from water samples yielded 6 colonies isolates from each station and gram positive and gram-negative bacteria's are identified. Enterobacteria are believed to exist in freshwater bodies under starvation conditions, and their growth is mainly limited by the lack of suitable carbon sources. Although this hypothesis is based on the use of selected Enterobacteria as an indicator of faecal contamination, there is evidence that the growth of Enterobacteria may be limited in specific river water (Shweta Sao &Rajshree Singh, 2014). Bacteria were isolated from the water samples, and 16 isolates were obtained, representing 6 different types of bacteria, namely *Escherichia coli*, *Klebsiella pneumoniae*, *Vibrio cholerae*, *Proteus* Sp, *Pseudomonas pneumoniae* and *Staphylococcus aureus*. The conclusion drawn from this study is that water is usually contaminated by microorganisms and this contamination may play a role in the spread of potentially harmful organisms (Panneerselvam and Arumugam, 2012). In Asia there is not a good awareness about water borne diseases. The present study showed that *Aspergillusniger, A.rlaus, A.rumiqatus, Mucor*spp. *and Neurospora*spp. were registered in terms of species richness and abundance. According to reports, aquatic fungi and molds from freshwater sources are the cause of aquatic species infections (Ogbonna and Alabi, 1991). The presence of toxic aquatic fungi in the water often infects aquatic animals, including animals that are eaten by humans. These fungal species not only affect fish but also fish eggs (Sinclair and Eicker,1983). By observing changes in the appearance of bacteria and the inability to produce a protective layer due to the damage caused by the toxic substances secreted by the fungus, infected fish can be observed (Fernández et al., 2008).

From this investigation and the foregoing discussions, it can be concluded that available water from ThiruvanaiKaval: Brahma theertham water samples most of the parameters are elevated or more or less equal to Cauvery river water. Srirangam temple ponds water samples most of the parameters are slight elevated or more or less equal to Cauvery river water. ThiruvanaiKaval: Brahma theertham temple pond was not suitable for the fish culture and, Srirangam temple ponds were suitable for the fish culture.

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