LIMNOLOGICAL STUDIES OF TWO TEMPLE TANKS LOCATED IN THE URBAN AND SUB-URBAN AREAS OF COIMBATORE DISTRICT, TAMILNADU.

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***Abstract*:** A comparative limnological studies was carried out in two temple tanks namely Karamadai temple pond positioned at the suburban regions of the Coimbatore with that of VenugopalKrishnaswamy temple tank located in the prime area of urbanization area of the Coimbatore city, Tamil Nadu. These temple ponds show some differences namely location, size of the pond, source for the tank, algal diversity and physico-chemical analysis. Both the temple tanks includes Cyanophyceae, Chlorophyceae, Euglenophyceae and Bacillariophyceae members in during the study period. Apart, from the algal diversity (individual cell count using haemocytometer cells/ml), physico-chemical parameters, environmental factors, trophic status of the water body, species diversity index, pollution status of the tank and species richness were calculated. Thus, this investigation is an attempt and also help in understanding the current status of the water, maintenance of the tank without pollution, as these are sacred water conservation is another important criterion. This part deals with algal diversity & physico-chemical parameters studied during the period.

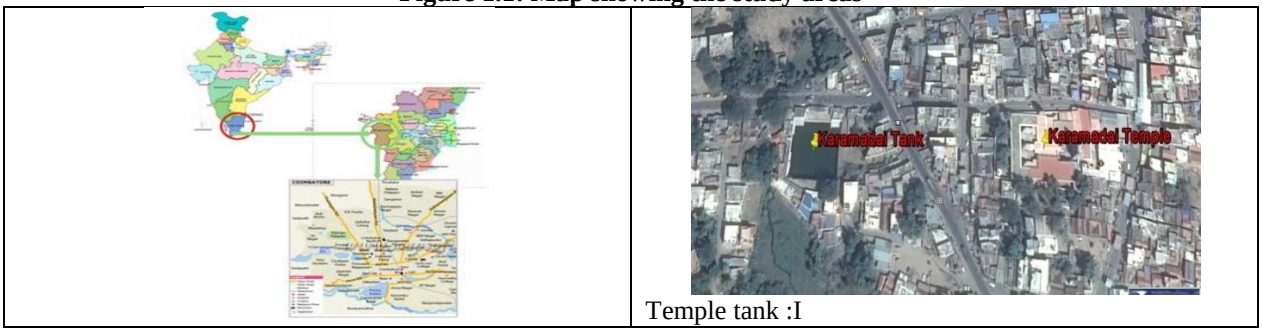
***Keywords* :** Algal diversity, temple tanks, Coimbatore, Cyanophyceae, Chlorophyceae, Bacillariophyceae, haemocytometer.

I. Introduction

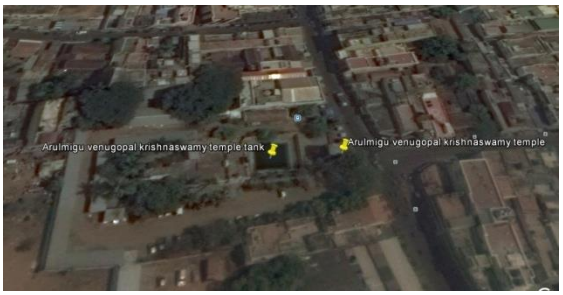
Water is the elixir of life. It surrounds about 71% in the Earth's surface and it is vital element even for the non-living forms. Water can be distinguished into 2 types based on their salinity, namely fresh water and marine water. The marine ecosystem contributes about 97% and only 2.5% to 2.75 % by fresh water. This fresh water is further divided into Lentic, ground and lotic water. Lotic water refers to the dynamic water habitat like river, brook streams, snow streams and so on. Lentic waters are the ones which are static, and they can be classified as natural and artificial or man-made water bodies. Natural system includes natural ponds, springs and artificial like reservoir, drainage channel, canal, quarry and temple tanks.

Temple tank are the traditional and propitious water storage structures which was build near the temple or inside the temple premises. The sources for the temple tanks would be rain water, springs or constructed wells. In early days, these man-made water bodies were used for three activities namely holy shower for the deities, taking spiritualbathing to get rid of sins and skin diseases and used for drinking purposes. As days passed these tanks are slowly changed to act as garbage dumping area. But, this is mainly due to over population, which in turn increases the anthropogenic activities. Most of the temple tanks are found outside the temple in order to clean the limbs before entering for worship. So, local people use this water for drinking, washing the clothes, cleaning utensils, bathing , illegal activities are the main reasons for the disturbance in water quality. Apart from the ritual cleansing these temple tanks are the boon to the nature in following ways; i) recharge of ground water, ii)storage during over flooding, iii) maintenance of bio-geocycles, iv) upholding the high level of ecosystem, v) besides, all these water protects the water table. From this one can understand the importance of these spiritually connected water bodies. In this context, present investigation deals with algal diversity with reference to the meteorological &physico-chemical analysis. Algae are found most abundantly in fresh water environment and the water quality are assessed by the physico-chemical and biological parameters(Arti & Saxena,2012). In this context,this work was carried out in two temple tanks named as Karamadai temple tank and Venugopal krishnaswamy temple pond (Figure 1.1) for about seven monthsto assess the water quality with special reference to algal biodiversity.

Figure 1.1: Map showing the study areas



Temple tank :I



Temple tank :II

II. Materials & Methods:

1. Studyarea:

1.1. Temple tank: I - Karamadai pond was situated in 29 Km away from the Manchester of TamilNadu, Coimbatore city (Figure 2.1) and 7 Km from Mettupalayam. Spread across the lush green pastures of Karamadai, this temple is one of largestVainava temple in the entire Kongu region. The pond is located inside the temple, which is 11.24˚N and 76.96˚E.It is a northern suburb of Coimbatore city, located on Coimbatore-Ooty NH 67. History behind the stay of Lord Vishnu is as follows - Garuda the eagle, vehicle of lord Vishnu desired to see the wedding of Lord Vishnu & Goddess and his desire was fulfilled and stayed in this place (Karamadai, Coimbatore District) on the place. It was covered with dense growth of Canthium *parviflorum (Karaimaram)* trees. This temple is accompanied with a huge temple tank situated on the northern side. The temple tank is called by various names namely Brahmatheertham, Ashtathreertham& Garuda theertham. Since1939, the temple was maintained by the members of the trust for chamber of TamilNadu Hindu society. Rain water is the only source of temple pond. The water is green in colour throughout the study period. This water is mainly used for the temple purposes namely sacred bathing of the deities (*Abhisekam*) and cleaning the utensils used in making sacred food (*Prasadham*). This temple pond is high in productivity which contains the main consumers such as fishes, crabs, prawn, frogs and snakes. The temple tank remains undisturbed by other pollutants (industrial & domestic), this is clear by the proof that the algal species is same in almost all the months. The total acre of the temple tank is about one acre, the purity and vicinity of the tank is highly maintained by the trust board of the temple and panchayat. The temple tank is protected by constructed concrete walls and iron bars. The pond is around for the 308 m and depth is 8540 m.

Figure 2.1: Current view of the Temple tank–I, Karamadai Temple tank, Coimbatore

1.2. Temple tank II: The temple was built by Wodeyar rulers of Mysore. The history of the temple was quite interesting, as the King Maharaja Krishnaraja Wodeyar and Queen visited this temple for offering prayers as they have no progeny. After visiting the temple, the royal couples were blessed with a child. The King showed his courtesy to God by raising the temple in this area. The temple is located in the prime area of the city in 1.5 acres. This major area is highly populated and more amount of vehicle population. The temple tank is found inside the temple and hence there is no much interference of local people. Now, the temple tank is completely protected and kept under lock and key. The pond is around for the 40 X 40sq feet and square in shape 20 feet in depth. One bore wells near by the temple pond which is the main source of this taken (figure 2.2).

Figure 2.2: Current view of the temple tank –II, Venugopal Krishnaswamy Temple Tank, Coimbatore

In these temple tanks following parameters were noted. Samples were collected from different parts of the pond, pooled and fixed in the spot itself in order arrest the stages of the algal which is helpful for monthly study. Separate water sample was collected for the physico-chemical analysis. All these samples were made into a composite sample for further analyses.During the sample collection some of the parameters were measured on the spot, namely Temperature, light intensity and humidity were recorded using thermometer, lux meter and hygrometer. Depth was recorded using measured tape. Monthly average rainfall data was obtained from meteorological department.

III. Result & Discussion

In the present study, a preliminary attempt was made to record the algal diversity, environmental and physico-chemical analysis were recorded in two temple tanks. The environmental parameters recorded in the spot during the collection and rainfall alone was obtained from Meteorological Department (Table 3.1).

Table 3.1: Environmental Parameters of Two Temple Tanks for the Study Period

Parameters	Atmospheric temperature in ºC		Humidity in %		Water temperature in ºC		Light intensity in Lux		Depth of water in metre (m)		Average rainfall in cm	
Month&year	Tank I	Tank II	Tank I	Tank II	Tank I	Tank II	Tank I	Tank II	Tank I	Tank II	Tank I	Tank II
September 2016	33	30	80	75	29	28	6300	6000	28	18	130	150
October 2016	33	31	81	75	29	28	6100	6000	29	20	145	175.6
November 2016	32	28	78	80	27	25	6200	5800	24	12	80	66
December 2016	28	28	87	82	25	25	5700	5000	22	19	70	160
January 2017	29	30	85	70	30	29	6200	5500	19	12	68	70
February 2017	28	32	77	73	31	29	6400	6000	21	10	70	50
March 2017	34	33	70	75	29	28	6250	6750	24	18	75	150

Environmental parameters - Table 1 reveals the meteorological parameters of the two temple tanks. The atmospheric temperature was ranging from 28^0C (in Feb 2017) to 34^0C (in March 2017) in the tank I and in tank II it is 28^0C (in Nov 2016) to 34^0C (in March 2017). This fluctuation was coinciding with the water temperature. The humidity and light intensity was quite a supporting factor for the dense growth of algae. In the current observation, temperature, pH and light were helpful in the development of algae especially green algal growth is enhanced. In 2008, Murugesan & Sivasubramanian stated that there was a high growth of Chlorophyta members in Porur lake which is similar to the present study. The average rainfall and depth of the water body always go hand in hand. Whenever there is an increase in the rainfall it is reflected in the depth of the study area in the both the temple tanks.

Physico-chemical parameters – water sample was collected separately for the analysis of physico-chemical parameters like colour of the water, odour, total dissolved solids (TDS), Total hardness, pH, carbonate, calcium, magnesium, ammonia, nitrate, chloride, silica, phosphate and D.O. This was recorded month-wise and it is tabulated in the form of average data (Table 3.2). Colour of the water body remains to be green in both the temple ponds. Hence there was always a dense growth of algal diversity and species richness in all the months. Even the climatic factors were supporting the algal dense growth during the study period.

The total dissolved solids (TDS) in tank I is 955NTU and 984 NTU in tank II both the values were nearly same. The pH remains to be neutral to slightly alkaline. The pH value remained above 7.0 throughout the seasons and the mean value during the period of study. Kavitha *et. al.,* (2007) had recorded high pH during non monsoon season which coincided with heavy blooms of *Microcystis aeruginosa*, *Oscillatoria* sp. and *Chroococcus turgidus*. But in the current investigation there is no bloom as the pH is

neutral to slightly alkaline. The ammonia is less than one, which means there is no contamination of agricultural wastes into the temple tanks. Calcium, phosphate, dissolved oxygen was more or less same and calcium is slightly in higher level may be due to anthropogenic activities are low as the temple tanks.this is mainly due to the deposition of flower and fruits (*prasadam*) remains in the tank after worshipping purposes. This report goes hand in hand with the early observation by Maria *et.al.*, (2013). Dissolved Oxygen (D.O.) is the indicator of the healthy pond (Lokhande *et.al.,* 2005). Low D.O indicates the higher organic input and stagnancy of water (Panda *et.al., 2004*). Present study also reveals the same regarding the calcium and dissolved oxygen. In the case of carbonate it is 47.8 mg/l in tank I and 21.3 a mg/l in tank II. The silica interconnected with the algae especially with the bacillariophyceae. The content of the silica is ranged from 11.2mg/litre in tank I and 2.5 mg/l this is reflected in diatoms growth.
Algal biodiversity (Figure 3.1)- Algal biodiversity in Karamadai temple tank (Tank I) has about a total of 32 algal species were identified from the pond.Among them7 species were Cyanophyceae,17 species were Chlorophyceae,8 species were Bacillariophyceae. The Chlorophyceae in the order of Volvocales,Chlorococcales&Zygnematales. In the study the genus *Scenedesmus*showed wide range of species diversity which included *Scenedesmusdimorphos* (Turpin), *S.parvas, S.naegelii, S.quadricauda* and *Pediastrum simplex,Pediastrum duplex.* The haemocytometer studies of this pond total individual cell count of which chlorophyceae is, Bacillariophyceae cells. Chlorophyceae is highest cell count wherebacillariophyceae showed lowest.The phytoplankton is very high in February month compared other month Hemocytometer 128660 cells/ml (Table 3).*Pandorina,Oscillatoria, Pinnularia*was found to be present in all the month,but it is very rare amount. *Nitzschiapalea, Merismopedia, Microcystis,* were absent in only one month,such as February, September, December and September respectively. Few species were common during the study period such as *Gomphonema, Cosmarium, Selenastrum gracile, Ankistrodes mussigmoides, Synedraulna, Tetrahedron muticum,Paediastrum simplex* was common in almost all the months. *Ankistrodes musfalcatus* in the only species found to abundance in two months namely September and October, absent in November and February. In the month of December, January and March it is very common. During the period of study there was considerable amount of algal species throughout the study. The appearance and colour indicate that the water is green and algal smell during the study period.

Table 3.2: Physico- Chemical parameters of the two temple tanks during the study period

S.No	Parameters	Tank I	Tank II
1.	Colour	Greenish	Green
2.	Odour	Algal smell	Algal odour
3.	TDS	955NTU	984 NTU
4.	Carbonate	47.8	21.3
5.	Total hardness	460	392
6.	Calcium	110	128
7.	Magnesium	5.1	1.7
8.	Ammonia	0.78	0.34
9.	Nitrate	6.26	1.08
10.	Chloride	252	180.72
11.	silica	11.2	2.5
12.	DO	5.6	3.9
13.	Phosphate	0.04	0.02

Table 3.3 -Haemocytometer readings of algal species individual cell count cells/ml of Karamadai Temple tank ,Coimbatore

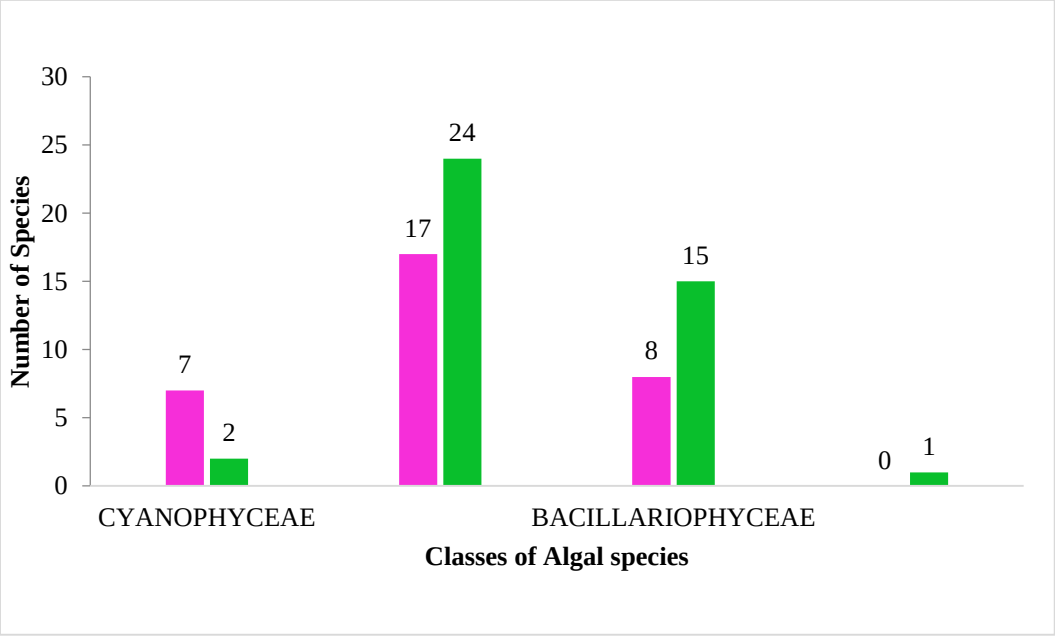
S.NO	ALGAL NAME	SEP'16	OCT'16	NOV'16	DEC'16	JAN'17	FEB' 17	MAR'17
1	*Oscillatoria*	1750000	5650000	4500000	3000000	2250000	0	2000000
2	*Merismopedia*	0	4500000	3750000	2350000	3750000	0	4000000
3	*Microcystis*	1750000	2750000	5750000	0	3750000	300000	1450000
4	*Chamaesiphon*	3750000	4500000	42500000	0	3250000	0	0
5	*Pandorina morum*	4500000	4250000	400000	4250000	3000000	225000	2000000
6	*Chlorococcum*	1750000	2750000	5750000	3750000	3000000	0	0
7	*Ankistrodesmus falcatus*	1250000	135000	0	235000	0	125000	0
8	*Oocystis*	1150000	1500000	0	2000000	0	0	540000
9	*Selenastrum*	150000	750000	125000	300000	1450000	450000	0
10	*Scenedesmus dimorphos*	5750000	0	4250000	0	350000	350000	0
11	*Scenedesmus quadricauda*	425000	125000	0	0	1350000	735000	2750000
12	*Scenedesmusnaegelii*	375000	0	0	275000		0	0
13	*Scenedsmus*	235000	4000000	4500000	4250000	0	0	4250000
14	*Pediastrum simplex*	0	3500000	0	750000	3750000	450000	42500000
15	*Pediastrum tetras*	1500000	0	5750000	0	3000000	125000	2350000
16	*Tetrahedron muticum*	1300000	0	3750000	2750000	2250000	200000	2750000

17	*Closterium*	0	275000	3750000	0	4350000	0	3500000
18	*Cyclotella*	4250	1750	2500	1000	350	0	500
19	*Synedra ulna*	32500	20000	37500	0	14500	0	5400
20	*Navicula*	3250000	0	5750000	0	2560000	0	2750000
21	*Pinnularia*	4750000	1500000	8750000	1000000	1250000	0	1750000
22	*Nitzschia*	1750000	2450000	2500000	3570000	2000000	0	1500000

Table 4- Haemocytometer readings of algal species individual cell count cells/ml of Venugopal Krishnaswamy Temple tank, Coimbatore

S.NO	ALGAL NAME	SEP'16	OCT'16	NOV'16	DEC'16	JAN'17	FEB' 17	MAR'17
1	*Volvox*	525000	80000	850000	80000	30000	210000	300000
2	*Eudorina elegans*	200000	350000	22000	31000	34000	3000	23000
3	*Pandorina*	330000	240000	400000	100000	320000	22000	310000
4	*Chlorococcum humicola*	70000	90000	20000	10000	30000	22000	12000
5	*Choroccus turgidus*	22000	0	340000	430000	0	340000	20000
6	*Kricheriella sps*	400000	32000	40000	32000	22000	140000	30000
7	*Oocystis*	40000	60000	220000	350000	400000	350000	320000
8	*Westella botryoies*	300000	323000	340000	210000	43000	242000	400000
9	*Senedesmus dimorphus*	300000	340000	34500	230000	43000	320000	40000
10	*S.quadricauda*	34000	3500	23000	2000	21000	2300	24000
11	*Pediastrum simplex*	34000	3500	23000	2000	21000	2300	24000
12	*.Pediastrum duplex*	43000	42000	43000	52000	40000	3800	33000
13	*Cosmarium pseudogranatum.Nordst:*	500	510	400	430	0	500	230
14	*Cyclotella*	60	48	500	400	430	525	423
15	*Fragillaria intermedia*	5500	4300	400	420	510	450	260
16	*Pinnularia viridis*	550	0	400	300	210	410	200
17	*Gomphonema*	700	340	450	250	350	630	420
18	*Nitzschia palea*	340	520	520	420	420	410	350

Figure 3.1: Total number of Algal species found in Tank I & Tank II



Algal biodiversity in Venugopal Krishnaswamy Temple tank, Coimbatore(Tank II) shows the following results during the study period.Phytoplankton month-wise study reveals a detail note of phytoplankton density as individual cell count by haemocytometer study (Table 4). Few species such as *Chroococus turgidus, Chlorococcum cumicoda, Volvox, Eudorina elegans, Pandorina sps,Closteridium sps, Krichernella lunaris,oocystis sps,Dictyophaerium ehrenbergianum,westella botryoies, Merismopedia glauca, Pediastrum tetras, P.simplex, P.boryanum, Scendesmus quadricauda, S.bijugatus, S.dimorphus, Dictyosphaerium*

ehrenbergianum, Cosmarium pseudogranatum were chlorophyceae members. *Cylotella,Fragillaria intermedia,Pinnularia viridis,Gomphonena clavetoides,Nitchia palea, Surriellaelegans*were diatoms.

According to the haemocytometer study, was high with in the month of November, the highest number of species has been reported. This may be due to the heavy rainfall. Only 4 species such *as Chroococcus turgidus, Cylotella meneghiana and Fragilaria intermedia*, were found in almost all the month. Some species namely *Merismopedia glacua, Dactylococcus sps*&*Gomphonema* occurred only in the month of November and *Senedesmus*found in august month. In this present investigation, diatoms were highest in *Senedesmus*&single cell *Chloroccum*species. Hence the Bacillariophyceae members were high in number. They are *Cyclotella meneghiana, Fragillaria intermedia, Nitzschia obtusa, Nitzschia palea, Cymbella turgida, C.turgidula, Navicula rostellum, Pinnularia viridis, Gomphonema clevatoides, G.aparuvulum,* Table 3.3 shows the occurrence of algae in the venukopalakrishnasamy temple bond pond. Desmids mainly found during the hot period of the study. Cyanophyceae members found in high peak during the month of November this may be due the rainy season. A part from the algae species there are other communities in the pond. They are zooplanktons, crustaceans like crab, prawn, pond snails, rotifers, copepod, fishes, frog and snakes.

Conclusion

To conclude the present investigation reveals that these temple tanks show a rich diversity. The total phytoplanktondiversity is 32 Nos, in the tank I and 42 sps were recorded respectively. In which only few pollution indicating algal sps were also recorded. As this is an attempt, the present data is an ecological tool for further studies. This study also helps to maintain temple tanks in proper manner as this water can be used for many purposes. As said earlier the temple tanks are so much important, once the stored water can be used for drinking and agricultural purposes.

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