International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Evaluation of Hydrological Parameters and Phytoplankton Diversity of Moolikulam Pond in Tirunelveli, Tamilnadu

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Abstract: ***Water, the most abundant and wonderful natural resource, especially the fresh water become a precious commodity today and its quality is threatened by numerous sources of pollution. Water quality is affected directly or indirectly by physico-chemical parameters. Ponds are fresh water bodies; either naturally formed or constructed and one among the major components of wetlands. Ponds have been used since time immemorial as a traditional source of water supply in India. In addition to that ponds have multifaceted uses including domestic utility, irrigation, fishery and they possess valuable resources that offer splendid services to the society and functioning of the environment. Phytoplankton studies and monitoring are also useful for control of the physico-chemical and biological conditions of water. However, the pond water are polluted mainly due to discharged waste water from residential areas, sewage outlets, solid wastes, detergents, automobile oil wastes, fishing facilities and agricultural pesticides from farmlands and also the most threatened habitats like the other wetland habitats on earth and therefore require proper management for the remaining ponds. The present study aimed to that analyze the hydrological parameters and monitor the phytoplankton diversity in Moolikulam fresh water bond of Tirunelveli Dist. Tamil nadu India. So fresh water resources need special care and attention to make it available sustainably for the present and future generations.***

Keywords: Fresh water, Parameters, Phytoplankton, Physico chemical

1. Introduction

Water is an essential requirement of human and industrial development and is one of the most delicate parts of the environment [14]. In the last few decades, there has been a tremendous increase in the demand for freshwater due to rapid growth of population and the accelerated pace of industrialization [36]. Water, a basic necessity of life is needed for drinking, for domestic uses, for irrigation of crops, production of different goods and for recreation purposes [8]. A pond is referred to as a man-made or natural water body which is between 1m2 and 2 ha (~ 5 acres or 20,000 m2) in area, which holds fresh water for four months of the year or more [11]. In India, natural ponds are estimated to have an area of about 0.72 million ha, most of which are found in the vicinity of villages, places of religious worship and other human inhabitations.[29][40][35]. The foremost important to monitor the pond system by both spatial and temporal means to establish pond habitat for the improved utilization and sustainability.[23].

Phytoplankton is one of the initial biological components from which the energy is transferred to higher organisms through food chain.[46][44] Phytoplanktons are the microscopic single celled aquatic plants forming the prime component in the food chain of aquatic ecosystems.

Phytoplankton converts solar energy into biological energy through photosynthesis as primary production. It plays an important role in conditioning the microclimate which helps in regulating the atmospheric level of O_2 and CO_2, vital gases for life [10].

Study Area - Moolikulam

Moolikulam is a fresh water pond, situated 5 Kms to the west of Tirunelveli Town and 2 Kms to the east of Tirunelveli Pettai, Tirunelveli District, Tamilnadu,India. It receives water from Tamirabarani river and Palavoor anicut through Palayam canal with an average depth of about 2.0 m. The bottom of the pond is silty, sand and loose mud. The pond is surrounded by agricultural field with a few deciduous trees in the bank. This pond is polluted by urban house hold waste, sewage and agricultural run – off. The local village inhabitants use the pond for various purpose like washing vehicles, clothes, bathing of cattles and fishing. The pond is fully occupied by *Ipomoea cornea* and *Eichhornia crassipes*

2. Materials and Methods

Hydrological study

Sample collection

Various physico-chemical and biological parameters of the water sample were analysed following the standard methods of APHA 2005. The pond water sampling programme was well designed by considering the following major factors: four representative samples were collected monthly from pond in the year 2017- 2018. Data of the monthly samples were pooled together according to the seasons (Southwest monsoon (SWM)-July, August and September (2017); Northeast monsoon (NEM)-October, November and December (2017); Post monsoon (PM) - January, February and March (2018); Summer (SUM)-April, May and June (2018). The point of collection of sample was inlet, outlet and two points at the middle of the pond.

The physico-chemical and biological parameter analyzed were temperature, electrical conductivity, turbidity, total dissolved solids (TDS), alkalinity, total hardness, calcium, magnesium, sodium, potassium, chloride, dissolved oxygen (DO), biochemical oxygen demand (BOD), phosphate and nitrate. The physical parameters like, temperature, pH, electrical conductivity, total dissolved solids and turbidity measurements were made in the field itself using Deluxe water and soil analysis kit Model 191E, M.S Electronics (India) Pvt. Ltd. For the rest of the parameters, the analysis was performed in the laboratory within 48 hours.

Phytoplankton Diversity

Sample Collection

The collections were made on each month from the sampling pond early in the morning by using the standard plankton net (No. 25) with 30 cm mouth diameter and length of 1 m. 100 litre of surface water was filtered and the filtrate was put into clean labeled plastic containers. The volume of the concentrate was adjusted to 25 ml and it was preserved immediately with 4 % formalin or Lugol's solution for further analysis.

Counting

From the collected and concentrated filtrate, 1 ml of the sample was taken; the concentrate was shaken, in order to get an even distribution of phytoplankton for analysis. The analysis was repeated for 10 times and computed. The counting was done in a Sedgwick- Rafter counting cell [48].From this, the number of cells per litre was calculated and the percent compositions of various groups of phytoplankton were computed.

Identification

The collected Phytoplankton were identified by using Standard literatures.[4] [17] [16][22].

3. Results and Discussion

Table 1: Water quality characteristics of Moolikulam during the study period

Parameters	Minimum	Maximum	Standard Deviation	Standard Error
Temperature °C	26	31	1.70	0.51
pH	7.6	8.1	0.14	0.04
Electrical conductivity mS/cm	0.3	1.2	0.1	0.07
Turbidity (NTU)	1.2	3.2	0.27	0.09
Total Dissolved Solids	128.5	315.4	26.07	8.72
Alkalinity	48	130.8	26.15	7.89
Total hardness	110.5	170.5	17.03	5.14
Calcium	24	52.5	8.96	2.00
Magnesium	4.8	20.5	3.98	0.80
Sodium	12.5	26.5	4.59	1.38
Potassium	1.1	3.2	0.48	0.16
Chloride	16.5	42.5	8.97	2.70
Dissolved Oxygen	3.8	5.6	0.57	0.17
BOD	2.1	3.8	0.53	0.16
Phosphate	0.1	0.2	0.03	0.01
Nitrate	0.15	0.70	0.08	0.02

In the present study reveals that, the surface water temperature was maximum (31^{o}C) during summer and minimum (26.3^{o}C) during southwest monsoon. At high temperature, which is usually observed in dry season, the solubility of oxygen decreases where as at lower temperature (wet season) it increases [2]. Temperature a catalyst, a depressant an activator, a restrictor, a controller, a killer is one of the most influential water quality characteristic of life in water.

The surface water pH ranged from 7.6 to 8.1. In the present study, pond water were slightly alkaline in nature. Most of the similar study suggested that pond water samples are slightly alkaline due to presence of carbonates and bicarbonates [43] [26][47].

The electrical conductivity of the surface water varied from 0.20 mS/cm to 1.35 mS/cm . The conductivity value increased with the increase in total dissolved solids and water temperature [20]. During the study period, dilution caused by heavy rains during monsoon may explain lowest record of electrical conductivity and is supported by the findings of Pandey and Pandey, 2003; [20] [47]. Similar observation was made by Francis et al., (1997) in fresh pond of Coimbatore.

Turbidity of water ranged from 1.2NTU to 3.2NTU. Turbidity of water is actually the expression of optical property in which the light is scattered by the particle present in the water. During monsoon, silt clay and other suspended particles contribute to the turbidity values, while during winter season settlement of slit, clay resulting low turbidity[13]. Dagaonkar and Saksena (1992) and Grag *et al.*, (2006) have also reported high turbidity during rainy season.

The total dissolved solids ranged from 120.5 mg/l to 315.4 mg/l. High content of dissolved solids elevated density of water, influencing osmo regulation and reducing gas solubility utility of water for drinking, irrigation and industries [19] [33]. The total dissolved solids have also been reported to be directly related to biological productivity [37].

The alkalinity of water varied from 48mg/l to 130.8mg/l. The high value of alkalinity indicates the presence of weak and strong base such as carbonates, bicarbonates and hydroxides in the water body [1] [28]. Nearly similar values were observed by Anjana and Kanhere, (1995) in fresh water pond at Barwani, Madhya Pradesh.

The total hardness ranged from 110.5 mg/l to 185.2 mg/l. Total hardness showed significant monthly variation. Water hardness up to 60 mg/l is considered as soft water, from 61-121 mg/l as moderately hard water, from 121-180 mg/l as hard water and above 180 mg/l as very hard water [30]. In the present investigation water in these pond are not useful for drinking purpose. Similar study was observed by Sreenivasa *et al.*, (2001) in fresh water ponds in Kolleyu lake region.

The high concentration of calcium in water is undesirable for washing and bathing, if it is present in excess in the drinking water, causes hypocalcaemia, coma and death [15].

Magnesium value in (18.3 mg/l) during northeast monsoon and minimum (6.15 mg/l) during summer. The high concentration of magnesium reduces the utility of water for domestic use and adds on unpleasant taste to water[18] [27].

Sodium is ranged from 12.5mg/l to 26.5mg/l. Allochthonous input of weathered rock material, sewage and sediments, agricultural drainage, animal and human waste into ponds along with monsoon runoff may rise sodium level in the water [7]. High concentration limits of sodium limits the biological diversity due to osmotic stress [3].

During the study period the potassium is ranged from 1.1 to 3.2. Potassium is maximum in different seasons may be caused due to increased evaporation at high temperature increased salt concentration due to water level decline and decomposition of organic matter [40].

Chloride ranged from 16.5mg/l to 42.5mg/l. Sinha, (1986), recorded that high concentration of chloride are indicators of large amount of organic matter in the water eutrophic condition. Sarojini *et al*., (1997) pointed out that high amount of chloride influences the amount of dissolved oxygen in water.

In the present study desirable concentration of BOD level was observed throughout the study period. The lower values reported were due to low The increased application of fertilizers, use of detergents and domestic sewage greatly contribute to the heavy loading of phosphate in water [25].

Phosphorous is one of the most important nutrients limiting the growth of autotrophs and biological productivity of the system. High phosphate content causes increased algal growth, often as blooms [39]. Koshy and Nayar (2000) reported that the major sources of phosphate in water are domestic sewage, agricultural runoff, industrial effluents and fertilizers. biological activity and also by the mixing of rain waters into the ponds. Similar observation was made by Tiwary *et al*., (2005)

The surface water nitrate ranged from 0.15 mg/l to 0.70mg/l. The main source of the formation of nitrate is the decomposition and biodegradation of organic matters. High nitrates would indicate pollution load. Several workers had reported similar observations in fresh water bodies [9][31]

Phycology Study

A total number of 15 algal species has been identified of which 6 species belonged to Chlorophyceae, 4 species to Bacillariophyceae, 3 species to Cyanophyceae and 2 species to Euglenophyceae.

Table 2: Diversity and abundance of phytoplankton species collected at Moolikulam during the study period

S.No	Species Name	SWM	NEM	PM	SUM	Total
Chlorophyceae						
1	*Volvox sp.*	48	68	64	32	212
2	*Cladophora sp.*	0	52	68	38	158
3	*Ankistrodesmus falcatus*	0	46	45	17	108
4	*Chlorococcum sp.*	14	54	30	10	108
5	*Chlorella vulgaris*	17	39	59	9	124
6	*Hydrodictyon sp.*	16	41	42	9	108
Bacillariophyceae						
1	*Synedra sp.*	23	60	42	20	145
2	*Amphora sp.*	0	76	39	13	128
3	*Fragillaria sp.*	0	39	43	0	82
4	*Stauronesis sp.*	42	28	39	10	119
Cyanophyceae						
1	*Oscillatoria princeps*	0	23	25	22	70
2	*Merimoedia sp.*	20	29	24	27	100
3	*Phormidium sp.*	12	14	19	7	52
Euglenophyceae						
1	*Euglena sp.*	14	9	6	8	37
2	*Phacus sp.*	2	6	14	0	22
Total		208	584	559	222	1573

*All the phytoplankton species are expressed in number of cells/l

In Moolikulam, a total number of 15 species of phytoplankton has been identified of which 6 species belonging to Chlorophyceae, 4 species to Bacillariophyceae, 3 species to Cyanophyceae and two species to Euglenophyceae. Members of Chlorophyceae were dominant throughout the study period. The mean abundance of phytoplankton showed clear seasonal change, being most dominant in post monsoon and low in southwest monsoon. In overall the occurrence of phytoplankton showed the following trend as follows: Chlorophyceae > Bacillariophyceae > Cyanophyceae > Euglenophyceae.

4. Conclusion

Water is the most important substance required for life on earth. But today good quality water has become a scare commodity. The poor quality of water affects human health. Thus it is an urgent need to monitor the water quality regularly. The present study explores how water quality is affected directly or indirectly by physico-chemical parameters and diversity and abundance of phytoplankton. Distribution of phytoplankton and their variation at different zones of water body is known to be influenced by physico-chemical parameters of water.

Phytoplankton plays an important role in conditioning the microclimate which helps in regulating the atmospheric level of O2 and CO2, vital gases for life. Apart from primary production, phytoplankton plays an important role as food for herbivorous animals. Phytoplanktons not only serve as food for aquatic animals, but also plays an important role in maintaining the biological balance and quality of water.

5. Future Scope

The aquatic freshwater ecosystem should not be disturbed by human interference such as poaching, hunting, anthropogenic pressure or by any means. Heavy metal analysis, soil quality analysis and aquatic insect study in pond ecosystem can be done in the future. The information presented will assist in maintain a balanced ecosystem, establishment of more comprehensive wetland management programmes and practices.

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