Seasonal Variations in Physico-Chemical Parameters of Sri Kamatchiamman Temple Pond Chidambaram Taluk, Tamilnadu

B. Elayaraj and M. Selvaraju*

Division of Environmental Science, Department of Botany, Annamalai University, Annamalai Nagar - 608 002, Tamilnadu, India.

Received: 02/02/2015 Accepted: 08/06/2015 Published: 30/06/2015

Abstract
In present work an attempt has been made to study the physico-chemical water quality parameters of Sri Kamatchiamman temple pond (SKT pond), which is an ancient water body located in Kavarappattu village, Chidambaram taluk. The study was carried out for a period of one year from January to December 2014. Monthly details were collected and represented seasonally. Different physico-chemical parameters like Air and Water temperature, Turbidity, Electrical conductivity, Total solids, Total dissolved solids, total suspended solids, Total alkalinity, Total hardness, pH, Free CO₂, Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Calcium, Magnesium, Chloride, Phosphate and Nitrate were analysed. The result indicates that the pond water is in eutrophication and polluted condition.

Key words: Sri Kamatchiamman temple pond, Physico-chemical parameters, Eutrophication.

1 Introduction
Water is one of the most important resources, whether it is for irrigation, power generation or for purposes of drinking, manufacturing, etc. The quality of water is getting vastly deteriorated due to unscientific waste disposal, improper water management and carelessness towards the environment; this has led to scarcity of potable water affecting the human health. About 71% of the earth surface is covered with water in which Marine (97.3%), only freshwater (2.7%). Out of this (freshwater) rivers and lakes form 0.01%, ground water 0.59% and ice and glacier 2.1%. India is bestowed with vast freshwater regimes consisting of 45000 km of rivers, 26,325 km of canals, 2.36 million hectares of ponds/tanks and 2.05 million hectares of reservoirs. The water quality in ponds, rivers and streams may vary depending on the geological morphology, vegetation and land use (modification by human activities such as agriculture, industrialization and urbanization) in the catchment.

Industries, agriculture and urban settlements produce nutrients (sewage effluent and fertilizers) and toxic substances, such as organic and inorganic pollutants, and other chemicals including heavy metals. Water pollution occurs when these substances, which degrade the water quality of river, enter the waterway and alter their natural function. Where ponds and lakes have been profoundly altered and have lost much of their value, the scientific understanding of these water bodies is being used in prescribing restoration methods [1]. Recent reviews indicate that land degradation, forest loss, biodiversity and habitat degradation, scarcity and pollution of fresh water are increasing hence this limnological study is important. There are many man-made ponds in the village and water from these ponds in used for drinking purposes. The pond is very economical and eco-friendly management for harvesting rain water to check the ground water level depletion. Industrial sewage and municipal wastes are being added to water reservoirs affecting physico-chemical quality of water and making unfit for use of livestock and other organism [2].

Physico-chemical factors are very important in pollutant or contaminant. The chemical and biological factors are interrelated and interdependent. The main objective of the physico-chemical analysis of water is to determine the status of different chemical constituents, which are present in the natural and disturbed aquatic ecosystem. The quality of water may be affected in various ways due to pollution. The pollution manifests itself either by altering the existing elements in the water or by generating new substances (e.g. Ammonia, nitrates, etc.). Hence, an attempt was made to analyse the physico-chemical parameters of Sri Kamatchiamman temple pond water at different seasons.

2 Materials and Methods
2.1 Study area
The pond selected for the present investigation, is Sri Kamatchiamman Temple Pond (SKT pond) near Kavarappattu Village and it is situated at 11° 22’ N latitude and 79° 44’ E longitude at an elevation of 7.00 m above the msl., at a distance of about 7 Km, South East of Chidambaram Taluk in Cuddalore district of Tamilnadu state (Fig. 1).
2.2 Sampling collection and analysis

This rain fed pond is partly loaded by the inflow of municipal sewage and also anthropogenic activities. Present investigation was carried out to study the physico-chemical parameters of the Sri Kamatchiamman temple pond (SKT pond) for four seasons post-monsoon (January to March), summer (April to June), pre-monsoon (July to September) and monsoon (October to December). The sampling stations were selected on the basis of nature and degree of pollution load being added to the pond. The water samples for the present study were collected at a monthly interval for a period of one year from January to December 2014. Samples were collected every month from the surface of the pond at 09.00 am - 11.00 pm in order to maintain uniformity. Since the pond is shallow, samples were collected from the surface level so as to give integrated sample [3]. The analysis was carried out as per APHA [4] method.

3 Results and Discussion

3.1 Physical parameters

3.1.1 Air temperature and Water temperature (ºC)

The air temperature was recorded high 37.2ºC in summer season and low 28.0 ºC in monsoon season and the maximum temperature of pond water was recorded as 36.8ºC in summer season and minimum of 27.4 ºC monsoon season (Fig.2.). Temperature plays an important role, which governs the seasonal succession of the biota. Temperature was high in the months of May and June which is associated with decreased solubility of gases in the pond. This investigation is also in close conformity with the findings of [5 and 6].

3.1.2 Turbidity (NTU)

Turbidity reduces the amount of light penetrating the water due to the presence of various suspended particles such as clay, silt, plankton, algae, etc. These suspended particles absorb more light and results in rising of the water temperature. High value of turbidity (59.1 NTU) seen during summer season and low value (31.7 NTU) during monsoon season respectively (Fig.2.). The high turbidity during summer season might be responsible for the higher water temperature because suspended particles absorb heat from the sun light making the water warm [7].

3.1.3 Electrical conductivity (µS)

The electrical conductivity (EC) was maximum (788.9 µS) in monsoon season and minimum (619.5 µS) in summer season respectively (Fig.3.). The high values of EC are due to high concentration of ionic constituents present in the water bodies and reflect the pollution by domestic wastes. EC is found to be good indicators of the overall water quality [8, 9].

3.1.4 Total solids (mg/l)

The maximum total solids were recorded as 139 mg/l in monsoon season and the minimum of 113 mg/l was noted during summer season in pond water (Fig.3.). According to [3] total solids in the most of the cases are organic in nature and pose serious problems of pollution. These observations also support the findings of [6, 9 and 10].

3.1.6 Total suspended solids (mg/l)

The maximum TSS was recorded as 51.7 mg/l in summer season and minimum of 42.0 mg/l in monsoon season (Fig.4.). Solids refer to suspended and dissolved matter in water. They are very useful parameters in describing the chemical constituents of the water and can be considered as a general of edaphic relations that contribute to productivity within the water body [14].

3.2 Chemical parameters

3.2.1 Total alkalinity (mg/l)

Total alkalinity was high (103.2 mg/l) during summer season and low (81.2 mg/l) in monsoon season (Fig.5.). The higher alkalinity values may be due to the discharge of municipal sewage, domestic sewage and urban wash off into the fresh water bodies. The maximum alkalinity was obtained in summer season whereas minimum in monsoon season may be because of presence of bicarbonate and hydroxide of Ca, Mg, Na, K and protein in pond water. The result is also in close conformity with the findings of [5 and 9].
Fig. 2: Seasonal variations of Air temperature, Water temperature and Turbidity of SKT pond

Fig. 3: Seasonal variations of Electrical conductivity and Total solids of SKT pond

Fig. 4: Seasonal variations of Total dissolved solids and Total suspended solids of SKT pond
3.2.2 Total hardness (mg/l)

The maximum value of total hardness in pond water was observed as 67.1 mg/l during summer season. However the minimum value was observed as 56.7 mg/l in the monsoon season (Fig.5). The increase in hardness can be attributed to the decrease in water volume and increase in the rate of evaporation at high temperature, high loading organic substances, detergents, chlorides and other pollutants [15].

3.2.3 pH

The maximum pH value was recorded as 9.09 in summer season and minimum of 7.67 in monsoon season (Fig.6). The lower pH during monsoon is due to high turbidity and in summer the temperature enhances microbial activity, causing excessive production of CO₂ and reduced pH. Higher pH value was normally associated with the high photosynthetic activity in water. Mishra et al. [9] also found the pH in alkaline trend throughout the study period. This investigation is also in close conformity with the report of [5].

3.2.4 Free Carbon dioxide (mg/l)

Carbon dioxide in a water body may be derived from the atmospheric sources, biotic respiration, inflowing ground water which seep into the pond, decomposition of organic matter due to bacteria and may also from within the water body itself in combination of other substances mainly calcium, magnesium etc. The maximum (3.38 mg/l) free carbon dioxide (FCO₂) was observed during summer season and minimum (2.91 mg/l) value was observed during monsoon season (Fig.6). The maximum free carbon dioxide in summer is due to the decomposition of organic matter and the respiration of aquatic flora and fauna, however minimum free carbon dioxide during monsoon is probably due to a decrease in the photosynthetic activity of aquatic flora. This investigation is also in close conformity with the report of [16].

3.2.5 Dissolved oxygen (mg/l)

Dissolved oxygen (DO) is one of the important parameters in water quality assessment. Dissolved oxygen was high (7.65 mg/l) during monsoon season and low (6.01 mg/l) in summer season during the study period (Fig.6). During summer low value of DO was noticed which may be due to increase values of phytoplankton or decrease of photosynthetic activity. DO is regulator of metabolic activities of organisms and thus governs metabolism of the biological community as a whole and also acts as an indicator of trophic status of the water body [17]. Dissolved oxygen showed inverse relationship with water temperature [18].

3.2.6 Biological oxygen demand (mg/l)

The Biological oxygen demand (BOD) was maximum (4.68 mg/l) during summer season and the minimum (2.57 mg/l) during post-monsoon season (Fig.7). The increased levels of BOD and COD indicated the nature of chemical pollution by the entry of sewage water and industrial effluents. The reason for high BOD in summer was several microbes present in the water bodies accelerated their metabolic activities with concentrated amount of organic matter in the form of municipal and domestic wastes discharge into water bodies and hence required more amount of oxygen and so the demand of O₂ increased [19].

3.2.7 Chemical oxygen demand (mg/l)

Chemical oxygen demand (COD) is a measure of oxygen required for complete oxidation of organic matter by a strong oxidant. The Chemical oxygen demand was high (7.84 mg/l) during post-monsoon season and low (5.58 mg/l) in pre-monsoon season during the study period (Fig.7). During the course of study the value of COD were found to be higher than BOD values. The high COD values indicate that some degree of non-biodegradable oxygen demanding pollutants were present in the water. The values of COD in conjugation with BOD are helpful in knowing the toxic conditions and presence of biologically resist organic substances. These observations support the findings of [20 and 21]. The other factor responsible for increased COD concentration might be the establishment of human colonies at the bank of pond who are responsible for adding domestic sewage thus resulting in higher COD [22 and 23].
Fig. 6. Seasonal variations of pH, Free CO$_2$ and Dissolved oxygen of SKT pond

![Seasonal variations of pH, Free CO$_2$ and Dissolved oxygen of SKT pond](chart1)

**3.2.8 Calcium (mg/l)**

Calcium is an important nutrient for aquatic organism and it is commonly present in all water bodies [24]. The maximum (36.2 mg/l) amount of calcium in the water was recorded during summer season and minimum (26.61 mg/l) amount was recorded during monsoon season (Fig. 8.). Calcium is present in water naturally, but the addition of sewage waste might also be responsible for the increase in amount of calcium [25 and 26]. The decrease in amount of calcium may be due to its absorption by living organisms.

**3.2.9 Magnesium (mg/l)**

Magnesium is found in various salt and minerals, frequently in association with iron compound. Magnesium is vital micronutrient for both plant and animal. Magnesium is often associated with calcium in all kind of water, but its concentration remains generally lower than the calcium [27]. The maximum (15.8 mg/l) amount of magnesium in the water was recorded during summer season and minimum (9.48 mg/l) amount was recorded during monsoon season (Fig.8.). Decrease in level of magnesium reduces the phytoplankton population [28] suggested that the considerable amount of magnesium influence water quality. Various sub-processes like hating, picking, tanning, dyeing and fat liquor ing causes water pollution [29].

**3.2.10 Chloride (mg/l)**

The chloride content was maximum (70.88 mg/l) during summer season and minimum (59.64 mg/l) during post-monsoon season (Fig.8.). The higher concentration of Chloride is considered to be an indicator of higher pollution due to higher organic waste of animal origin. Moundiotiya et al, [10], Mishra et al, [9] and Arya et al, [5] also reported similar results. Govindan and Sundaresan [30] observed that concentration of higher Chloride in the summer period could be also due to...
sewage mixing and increased temperature and evaporation by water.

3.2.11 Phosphate (mg/l)

The maximum phosphate content was recorded (2.26 mg/l) during summer season and minimum (1.8 mg/l) in monsoon season (Fig.9.). Phosphate has a few sources in nature and also acts as a regulating factor for productivity of water body. Phosphate may occur in lake as result of domestic waste, detergent and agricultural run-off containing fertilizer [31]. Higher concentration of phosphate is an indicator of pollution, which induce possibility of eutrophication [32].

![Fig.8. Seasonal variations of Calcium, Magnesium and Chloride of SKT pond](image)

![Fig.9. Seasonal variations of Phosphate and Nitrate of SKT pond](image)

3.2.1 Nitrate (mg/l)

During the study period pond water showed the maximum nitrate content 3.27 mg/l respectively during post-monsoon season and minimum of 2.78 mg/l in summer and monsoon season respectively (Fig.9.). The different water sources showed significant effect on pond water nitrate content. Nitrogen-nitrite is the middle step of nitrogen. Oxidation of ammonia first produces nitrite and then nitrate. Lower concentration of nitrite in summer and monsoon may due to the utilization by eutrophication [33].

4 Conclusions

The critical parameters like TS, TDS, TSS, total alkalinity, total hardness, BOD and COD are above prescribed limits. The summer and post-monsoon season are more polluted when compared to other seasons. The pond water is highly polluted and unsafe for human use.
The analysis of physico-chemical parameters had indicated the wider human activity and influx of domestic waste in ponds which caused eutrophication. Therefore it can be concluded through this study that the Sri Kamatchiamman temple (SKT) pond with social and cultural importance is degrading at an alarming rate. It is suggested that an awareness programmes should be taken up in the adjoin area to educate people about the adverse effect of water pollution. Also, periodic monitoring of water quality in the pond to ensure no further degradation has been recommended.

References
5- 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. 2(8) (2011) 01-06.

