

**ASSAY ON WATER QUALITY VARIATIONS OF PASUPATHESWARAR TEMPLE
POND, ANNAMALAI NAGAR, TAMIL NADU, INDIA**

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ABSTRACT

The present study deals with water quality variations in the highly eutrophic pond. Several water quality parameters were evaluated during the period from July 2014 to June 2015 from sampling station sited from Annamalai university campus *viz.*, Pasupatheswarar temple pond. The physical parameters like temperature, turbidity, electrical conductivity, total solids, total suspended solids, total dissolved solids and chemical parameters such as total alkalinity, total hardness, pH, free CO₂, dissolved oxygen (DO₂), biological oxygen demand (BOD), chemical oxygen demand (COD), calcium, magnesium, chloride, phosphate and nitrate were examined. The experimental values of various physico-chemical parameters of water samples were tallied with desirable, permissible, acceptable range - recommended by BIS, FAO, ICAR, NRAC, SRAC and WHO guideline whichever is properly applicable for the purpose of irrigation, pisciculture and drinking. The pond was found to be moderately polluted and showed a trend of increasing eutrophication.

KEYWORDS: Eutrophication, Pasupatheswarar temple pond, Physico-chemical parameters, Water quality.

1. INTRODUCTION

Hydrological investigations on water bodies were aimed to assess the deterioration of water quality due to pollution. The water is one of the most important compounds of the ecosystem. Living things exist on the earth because existence of water occurs in this planet only. Water is significant for the survival of life. Mainly the freshwater ecosystems are considered as one of the most essential natural resources for all the living organisms on the earth. The various freshwater ecosystems include rivers, lakes, ponds, bogs, and wetlands etc. Ponds are one of the significant water resources used in this area. Ponds are normally small,

shallow, restricted bodies of standing water, habitats of great importance provided that water for domestic, industrial and agricultural uses.

The health of these pond systems depends upon the nature of the pond and also various environmental and anthropogenic factors influencing it. In today's time, the exponential growth of population, with the consequent rise of sewage quantities has posed a big problem for its disposal. This has subsequently led to the boost in contamination levels of the water bodies, resulting in eutrophication of the pond.

Eutrophication is the process of water enrichment with nutrients that change fauna, flora and water chemistry, food chains and nutrient cycles [1-2]. Eutrophication can be natural, stems from natural processes such as climate variations [3]. The natural eutrophication occurs slowly over a period of many years by aging process [4]. Human activities increase nutrient loading and intensify this natural process [5], which is called cultural eutrophication. The cultural eutrophication is the most important global water quality problem [6].

The physico-chemical characteristics of the aquatic environment directly influence the life inhabiting it. Fluctuation in these constituents often create an adverse environment to organisms, limiting their growth and interfering in the physiological processes, which reduce their ability to compete with other populations within the environment, ultimately changing the community structure [7]. 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.) [8].

Hence, the present study involves the investigation of water quality in terms of some physico-chemical parameters of Pasupatheswarar temple pond water at different months.

2. MATERIALS AND METHODS

2.1 Study area

Pasupatheswarar temple pond is located in Annamalai Nagar, Chidambaram, Tamil Nadu (Fig. 1). The Latitude and Longitude of Pasupatheswarar temple pond is 11.39' N and 79.72' N respectively. It spreads about approximately 125m in length and 85m in width. The depth of the water ranges from 2 meters to 4 meters in different seasons.

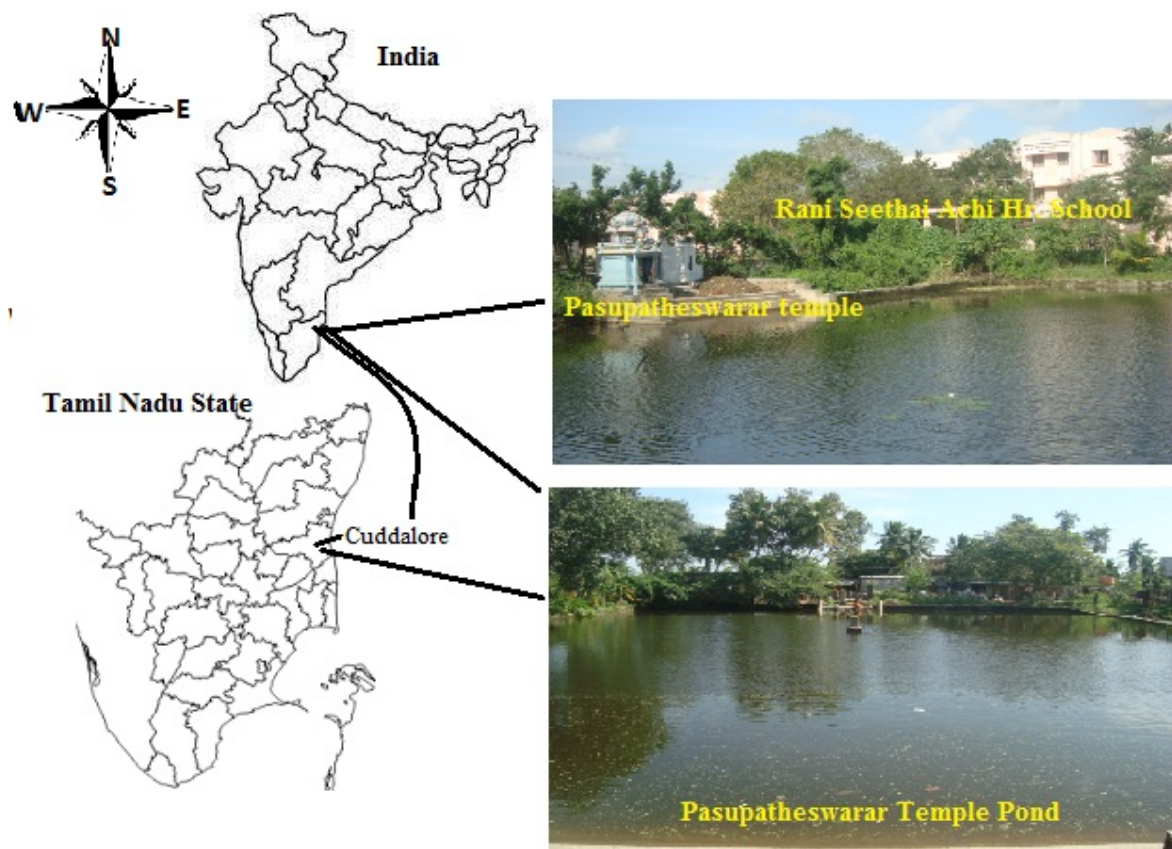


Figure 1. Picture showing on Pasupatheswarar temple pond in Annamalai Nagar

2.2 Water sample collection and analysis

The water samples were collected during the month of July 2014 to June 2015. Samples were collected every month in polythene bottles from the surface of the pond at 09.00 am - 11.00 pm in order to maintain uniformity. Almost care was taken, so that no bubbling should observe during sampling, which avoids influence of the dissolved oxygen. The temperature was recorded at the sample site. The pH of water sample was measured with the help of pH meter (Elico LI-617) with a glass electrode. The pH meter was calibrated using buffer of pH 4.0 and 7.0. The total dissolved solids and conductance of water samples was measured using conductivity meter (Elico CM-183). Dissolved oxygen is determined by dissolved oxygen analyzer (Elico PE-135). Turbidity is determined with turbidity meter (Elico CL-52D). The Physico chemical parameters of water will be analyzed by standard method devised by Trivedy and Goel [9] and APHA [10].

3. RESULT AND DISCUSSION

It is fact that maintenance of healthy aquatic ecosystem is dependent on the physico-chemical properties of water. The physico-chemical properties of the pond were given below.

3.1 Physical parameters

3.1.1 Temperature (°C)

Temperature is one of the most significant environmental factors, which controls the physiological behavior and distribution of organisms. In present study, lowest value of air and water temperature was found in December (28.0; 27.1 °C) and highest in June (37.2; 36.3 °C) (Fig. 2). 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 [11-13].

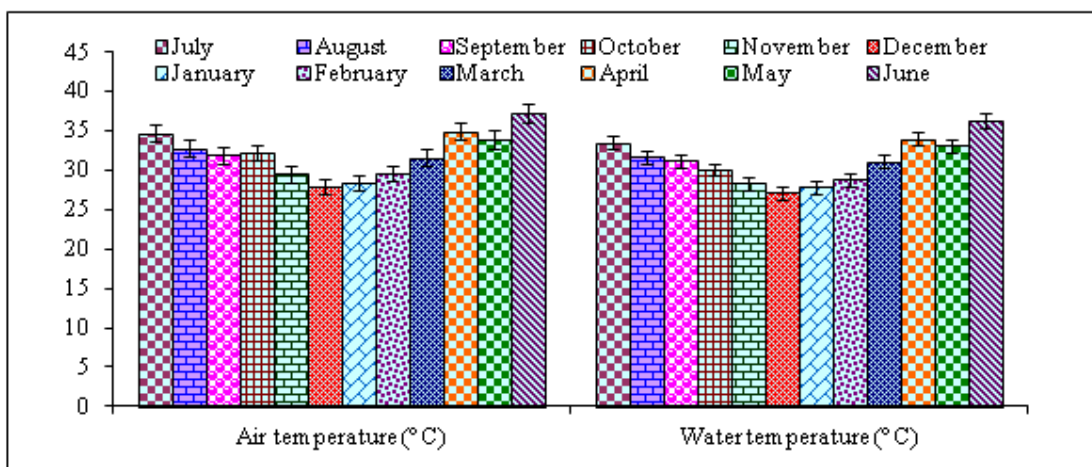


Figure 2. Monthly variations of Air temperature and Water temperature of Pasupatheswarar temple pond

3.1.2 Turbidity (NTU)

Turbidity is an important physical parameter which has a significant bearing on productivity of aquatic ecosystem. Highest value of turbidity (50.4 NTU) was seen during May and lowest value (26.3 NTU) during November month (Fig. 3). 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 [14].

3.1.3 Electrical Conductivity (µS/cm)

Electrical Conductivity of water is a numerical expression of the ability of water sample to carry an electric current. It depends on the nature and concentration of mineral substances or electrolytes dissolved in water. In the present investigation lowest value (303.4 µS/cm) was recorded in September and highest value (566.3 µS/cm) in June (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 [8].

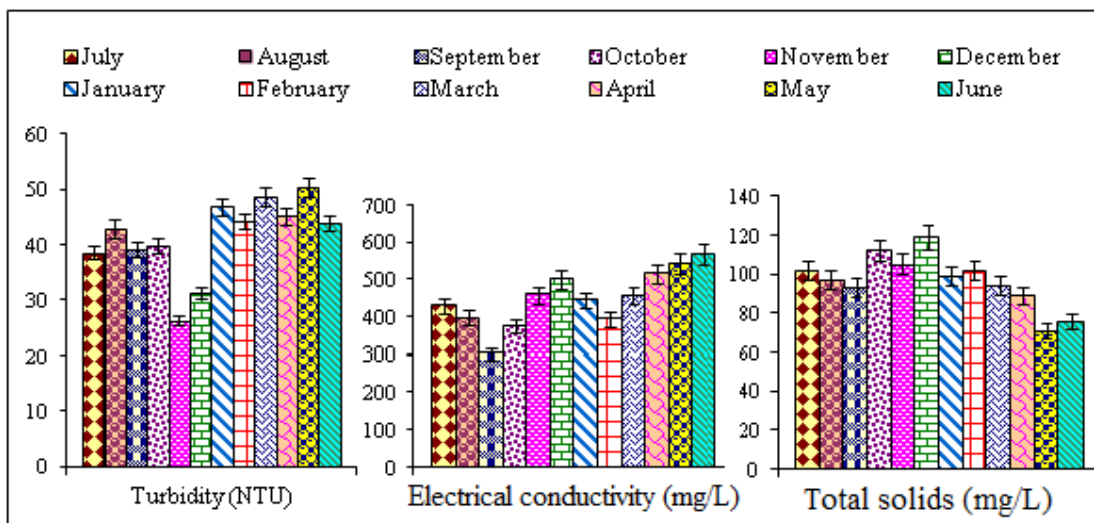


Figure 3. Monthly variations of Turbidity, Electrical conductivity and Total solids of Pasupatheswarar temple pond

3.1.4 Total solids (mg/L)

The peak values of total solids were found (119.0 mg/L) in December and the least value (71.0 mg/L) was noted during the month of May (Fig. 3). According to (Trivedy and Goel, 1987) total solids in the most of the cases are organic in nature and pose serious problems of pollution. Similar observation coincides with the findings [12, 8].

3.1.5 Total suspended solids (mg/L)

The highest total suspended solids were recorded as 48.9 mg/L in June and minimum of 35.2 mg/L in November (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 [15].

3.1.6 Total dissolved solids (mg/L)

A total dissolved solid (TDS) is measure of all the dissolved substances, both organic and inorganic in water. TDS of the pond water recorded the maximum value of 59.1 mg/L in December and minimum of 32.2 mg/L in May respectively (Fig. 4). The high value of TDS during rainy season may be due to addition of domestic waste water, garbage and sewage etc. in the natural surface water body [16]. Increased high concentration of TDS increases the nutrient status of water body which was resulted into eutrophication of aquatic bodies [17].

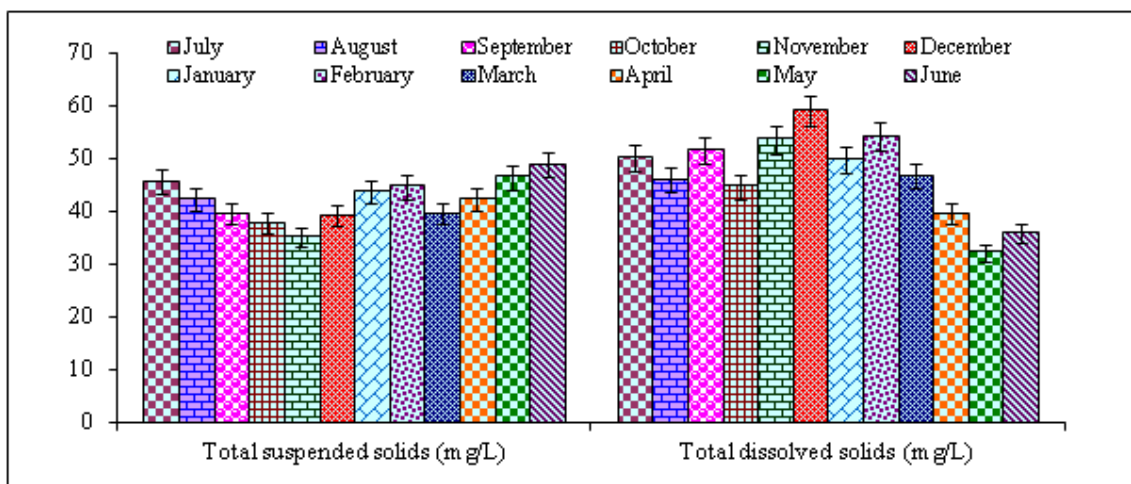


Figure 4. Monthly variations of Total suspended solids and Total dissolved solids of Pasupatheswarar temple pond

3.2 Chemical parameters

3.2.1 Total alkalinity (mg/L)

Alkalinity of water is the capacity to neutralize strong acids that gives primarily a function of carbonate, bicarbonate, hydroxide, phosphate, borate and organic acids content and formed due to the dissolution of CO₂ in water. Pasupatheswarar temple pond measured as a nutrient rich pond because during the current study the peak value of total alkalinity was examined in May (202.9 mg/L) and least value in November (96.2 mg/L) month (Fig. 5). Higher values of alkalinity registered during summer (May and June) might be due to the presence of excess of free CO₂ product as a result of decomposition process coupled with the mixing of sewage and domestic waste. The low alkalinity during rainy season (November) may be due to dilution [18].

3.2.2 Total hardness (mg/L)

The hardness of water is mainly governed by the content of calcium and magnesium which largely combine with bicarbonates and carbonates (temporary hardness) and with sulphate, chlorides and other anions of minerals (permanent hardness). In the current investigation, the minimum (51.0 mg/L) and maximum value (79.4 mg/L) was seen in the month of October to June respectively (Fig. 5). Higher values of hardness during summer (May and June) can be attributed to low water level and high rate of evaporation of water and addition of calcium and magnesium salts [19].

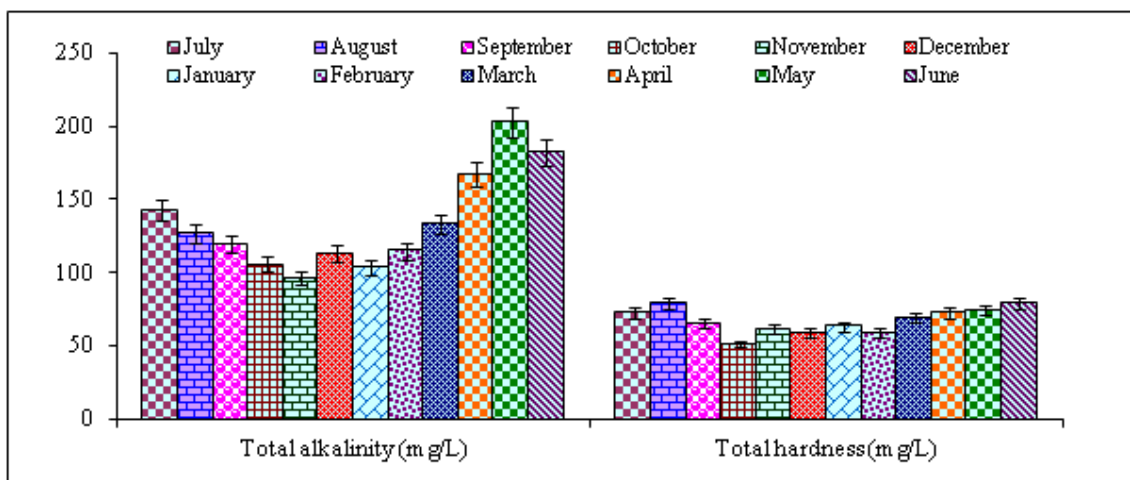


Figure 5. Monthly variations of Total alkalinity and Total hardness of Pasupatheswarar temple pond

3.2.3 pH

Hydrogen ion concentration (pH) regulated most of biological processes, bio-chemical reactions and is a measure of acidity or alkalinity. In the Pasupatheswarar Temple Pond water least value (7.06) in November and peak value (8.87) in June (Fig. 6). The high pH was observed in summer season it is due to aquatic plants use carbon dioxide in their photosynthetic activity and its removal is responsible for such a high pH [20].

3.2.4 Free Carbon-dioxide (mg/L)

Free CO₂ enters into chemical mixture of aquatic system to form carbonates and bicarbonates. It assimilates carbon and incorporates into the skeleton of aquatic autotrophs. In the present study minimum (3.45 mg/L) value in September and maximum (5.35 mg/L) value in May was seen (Fig. 6). Elayaraj and Selvaraju (21) reported similar occasional presence of free carbon dioxide liberated during respiration and decay of organic matter is highly soluble in natural water bodies of Chidambaram, Tamil Nadu.

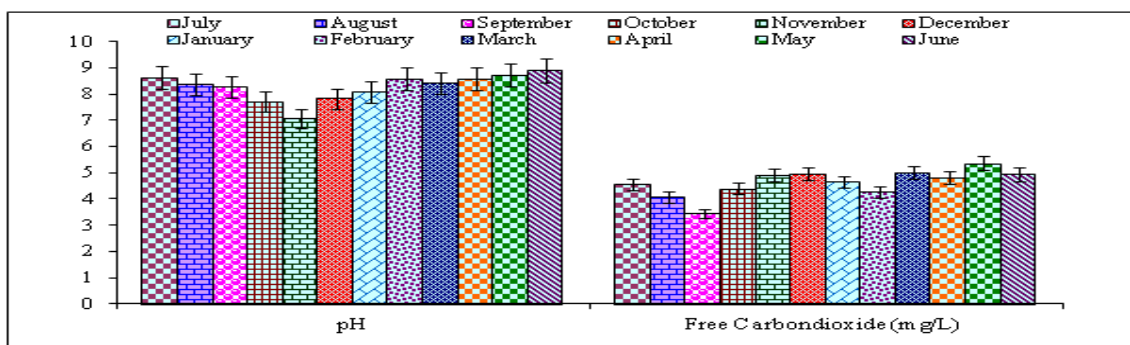


Figure 6. Monthly variations of pH and Free carbon-dioxide of Pasupatheswarar temple pond

3.2.5 Dissolved oxygen (mg/L)

Dissolved oxygen (DO₂) is significant hydrological parameter representing the level of water quality and organic production in the pond. The lowest value of DO₂ was observed in June 5.16 mg/L and highest value in December 6.8 mg/L (Fig. 7). According to [22] lower DO₂ values during summer may be attributed to the high temperature and its consumption due to high growth and activities of microorganism.

3.2.6 Biochemical oxygen demand (mg/L)

Biochemical oxygen demand (BOD) determinate the amount of O₂ required for biological oxidation of organic matter with the help of microbial activities. In the present study, lowest value of BOD was recorded in November 2.36 mg/L and high value in June 6.12 mg/L (Fig. 7). High value of BOD in summer may be due to higher rate of organic decomposition. Gradual decline of BOD in rainy season may be due to decrease temperature which in turn retards microbial activity. The similar result was observed by Garg et al. [23].

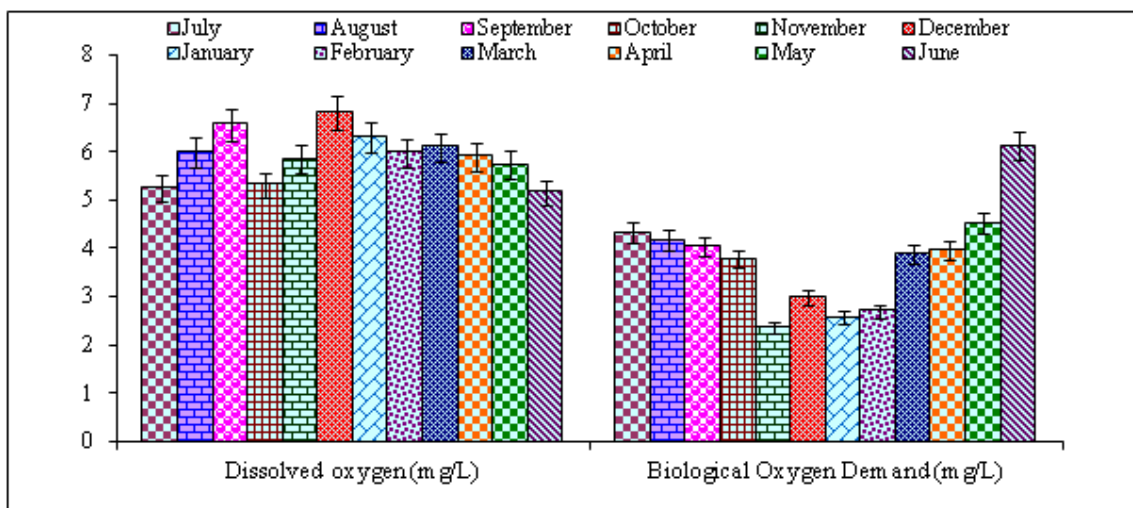


Figure 7. Monthly variations of Dissolved oxygen and Biological oxygen demand of Pasupatheswarar temple pond

3.2.7 Chemical oxygen demand (mg/L)

Chemical oxygen demand (COD) determinates the amount of oxygen required for chemical oxidation of most organic matter and oxidizable inorganic substances with the help of strong chemical oxidant. In the present investigation, Low value of COD (4.8 mg/L) in December and high in May (9.93 mg/L) was examined (Fig. 8). These results were conformity with the study of Shib Abir [24].

3.2.8 Calcium (mg/L)

Calcium is necessary nutrient for all the living organisms. It is required as micronutrient for algae and important nutrient for the metabolism of higher plants. In current investigation, the lowest value of (68.4 mg/L) in November and high (111.2 mg/L) in July (Fig. 8) was noted. Calcium is present in water naturally, but the addition of sewage waste might also be responsible for the increase in amount of calcium [25].

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. Pasupatheswarar temple pond measured as a nutrient rich pond because during the current study the least value of magnesium was examined in November (12.24 mg/L) and peak value in May (45.8 mg/L) month (Fig. 9). Decline in level of magnesium reduces the light, temperature and phytoplankton population suggested that the considerable amount of magnesium influence water quality [8].

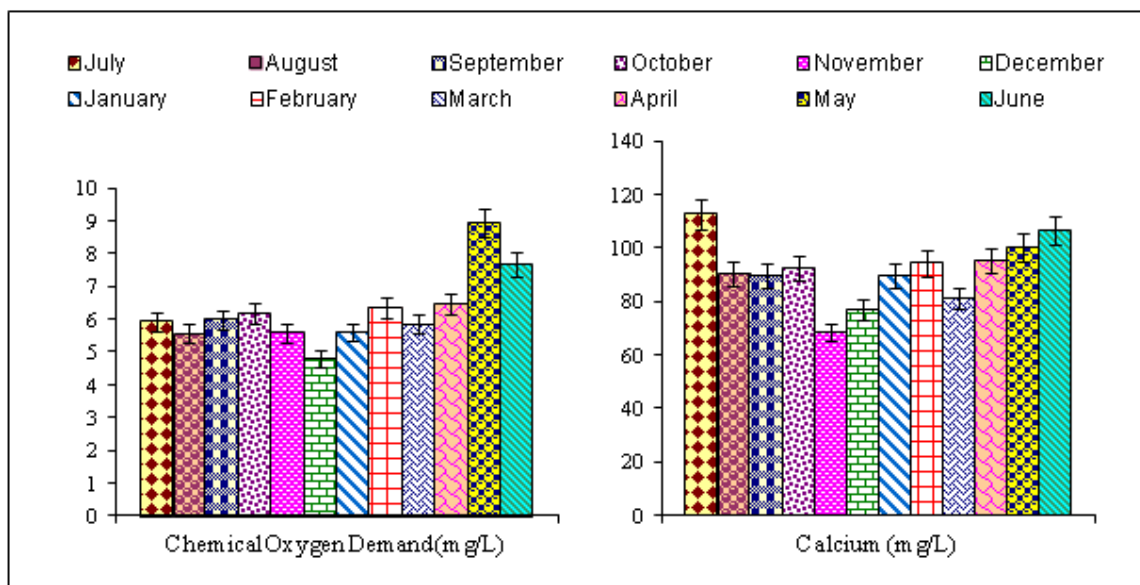


Figure 8. Monthly variations of Chemical oxygen demand and Calcium of Pasupatheswarar temple pond

3.2.10 Chloride (mg/L)

Chloride is broadly distributed in nature in the form of salt sodium, potassium and calcium. The chloride status in water is indicative of pollution, especially of animal origin. The minimum Chloride in November (28.75 mg/L) and maximum value recorded in June (64.52 mg/L) was noted (Fig. 9). Mishra et al, [26] and Arya et al, [11] attributed the higher concentration of Chloride is considered to be an indicator of higher pollution due to higher organic waste of plant and animal origin.

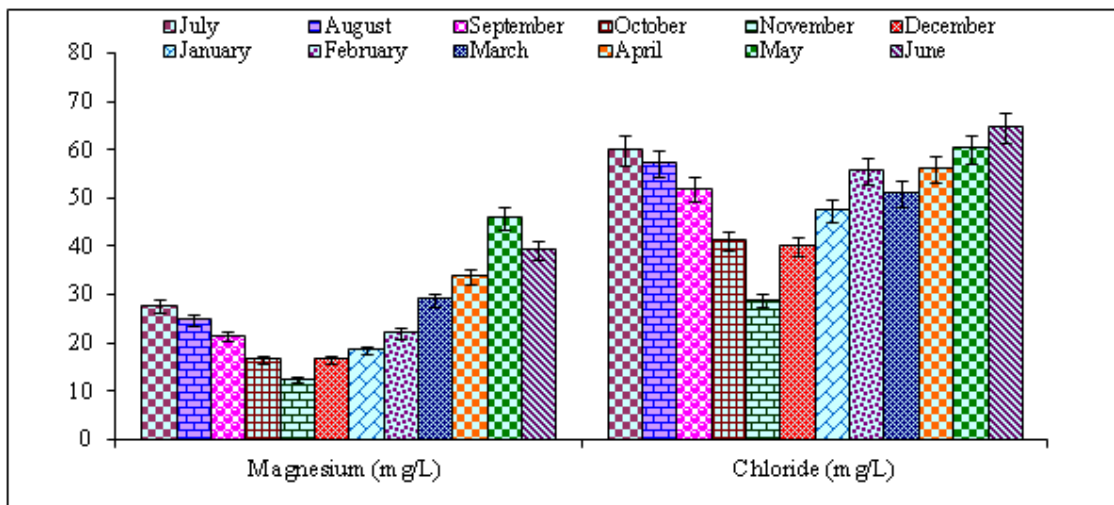


Figure 9. Monthly variations of Magnesium and Chloride of Pasupatheswarar temple pond

3.2.11 Phosphate (mg/L)

Phosphate is an important plant nutrient and plays a role of limiting factor among all other plant nutrient so its determination is useful. The value of Phosphate varies from minimum of 1.31 mg/L (December) and maximum of 2.85 mg/L (June) at Pasupatheswarar temple pond (fig. 10). Phosphate has a few sources in nature and also acts as a regulating factor for productivity of water body. Higher concentration of phosphate is an indicator of pollution, which induce possibility of eutrophication [8, 27].

3.2.12 Nitrate (mg/L)

Nitrate is basic nutrient, which is determined by the productivity of pond. It represents the end product of oxidation of Nitrogenous matter and its concentration may depend on the nitrification and de-nitrification activities of micro organism. The value of Nitrate was observed in January 0.87 mg/L was low and in July 3.31 mg/L was high (Fig. 10). Similar results were also reported by Singh Namrata [22].

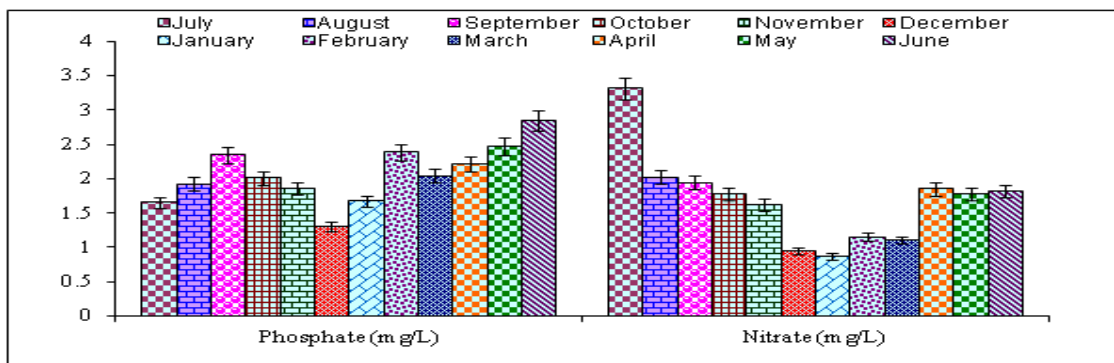


Figure 10. Monthly variations of Phosphate and Nitrate of Pasupatheswarar temple pond

4. CONCLUSION

High concentration of TSS, TDS, phosphate, nitrate, etc., value indicates that the pond was moderately eutrophicated. Fluctuations in various physico chemical parameters were observed during all months. The present investigation of water quality parameters of Pasupatheswarar temple pond has revealed that the pond water is adversely affected by anthropogenic pollution and showed a trend of increasing eutrophication. As the pond is surrounded by temple and school, it should be ensured that no waste materials of any kind are thrown into the pond. It would also be necessary to have a periodic monitoring of water quality of pond with a view to ensure that no further degradation in water quality takes place in future and the pond is restored and managed in the form of a fresh water body.

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