RESEARCH ARTICLE

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Annual Variations of Physico-chemical Properties of the Periyakulam Lake, Tiruchirappalli, Tamil Nadu, Southern India

Sivanantham Mohanraj and Jeganathan Pandiyan

ABSTRACT

The annual the physico-chemical variation of the Periyakulam Lake, Tiruchirappalli, Southern India was assessed from January 2011 to December 2013 aquatic life. The study was carried out to examine level of varying physic-chemical parameters such as Water Depth (m), Turbidity (NTU), Salinity (ppt), Dissolved Oxygen (mg/l), pH, Electrical conductivity (µS/cm), Carbonate (mg/l), Bicarbonate (mg/l), Chloride (mg/l), Sulphate (mg/l), Calcium (mg/l), Magnesium (mg/l), Sodium (mg/l), Potassium (mg/l). The physico-chemical parameters have exhibited considerable yearly and variations. The qualitative study revealed of the physico-chemical parameters, which would be very helpful for policy makers to take precautionary measures to save the wetland.

Keywords: Annual Variation, physico-chemical parameters, Periyakulam wetland, Tiruchirappalli, Tamil Nadu, Southern India.

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I. Introduction

The ecological factors particularly physico-chemical parameters of water and soil are the most important components in an ecosystem, The quality of water in any ecosystem provides significant information about the available resources for supporting life in that ecosystem. Good quality of water resources depends on a large number of physicochemical parameters, the magnitude and source of any pollution load; and to assess that, monitoring of these parameters is essential. Researches are being carried out till present [1]-[16]. That the water and soil chemistry are the significant ecological factors that regulate the diversity of benthic and pelagic organisms. According to [17], the nutrients such as These works also include various types of water bodies like ponds, rivers, lakes, estuaries and reservoirs. However, very little information is available in relation to physico-chemical Changes in the water chemistry in any aquatic ecosystems can lead to simultaneous alterations of trophic structure and community composition [18]. The importance of associating distributions and limnological characteristics of wetlands has been recognized [19]. It has also been reported that the physical and chemical characteristics of water bodies affect the species composition, abundance, productivity, and physiological conditions of aquatic organisms [20]. Hence, the present study was conducted to study the physico-chemical properties of water in the annual variations of physico-chemical properties of the Periyakulam Lake, Tiruchirappalli, Tamil Nadu, Southern India.

II. Study Area

Periaykulam Lake is located in the Koothapar Village of Thiruvarampur, Tiruchirapalli District, Tamil Nadu, Southern India. It covers an area of 74.085 ha. The major water source for this lake is Cauvery River via Uyyakondan canal. The water resource is largely used for agriculture and inland aquaculture. About 629.84 ha agricultural land is irrigated from this lake. The escape is capable of disposing of the surplus with a M.W.L. depth of 2 feet over crest Since the natural rocky escape is very uneven, it is proposed to construct a weir of 19'-8", long to the left of weir in continuation to make up a total length of 83'-0", and this will discharge 645 c/s with a head of 2 feet.

III. Methodology

A. Determination of Water Quality

Water samples were collected four times in a month from at least three random sites in each sampling area and the following variables were measured as per the methods parameter were evaluated using standard methods APHA [21] or BIS.

B. Turbidity

Turbidity was measured by using a NTU (Nephelo Turbidity Units).

C. Electrical Conductivity

Electrical conductance is the ability of a substance to conduct the electric current in water. The unit of conductivity measurement was given as mhos/cm.

D. pH

pH of the water samples was determined by immersing a commercially available direct-reading electronic pH meter in the water and pH values were read directly from the digital screen.

E. Dissolved Oxygen

Dissolved oxygen contents were estimated by the standard volumetric Winkler's method. The amount of dissolved oxygen was calculated and expressed ml/ [22].

F. Salinity

The salinity of the water sample was determined by measuring of chlorinity. Salinity of the samples were expressed in ppt.

G. Chloride

The analysis of chloride was made following Argentometric Method. Chloride was determined in a natural or slightly alkaline solution by titrimetric method with standard silver nitrate, and potassium chromate was used as indicator. Silver chloride was quantitatively precipitated before red silver chromate was formed.

H. Calcium Hardness

Calcium hardness was estimated by the compleximetric titration using EDTA [23].

I. Carbonates and Bicarbonates

Carbonate and bicarbonate ions in the sample were determined by titrating it with standard sulphuric acid (H2SO4) using phenolphthalein and methyl orange as indicators.

J. Calcium and Magnesium Hardness

The calcium and magnesium hardness of water was estimated by EDTA titrimetric method.

K. Sodium

A flame photometer measures photo electrically the intensity of colour imparted to the flame of a Meker-type burner where the sample was introduced into the flame under carefully standardized conditions. The intensity of colour was proportional to the sodium content in the sample. Sodium was determined at a wavelength of 589 nm.

L. Sulphate

Sulphate levels were estimated by the barium chloride [23].

M. Magnesium

Diammonium hydrogen phosphate was made to quantitatively precipitate the magnesium in ammoniacal solution as magnesium ammonium phosphate. The precipitate was ignited and weighed as magnesium pyrophosphate. Below 1 mg/L atomic absorption Spectrophotometric method was desirable.

N. Pottasium (Flame Photometric method)

Trace amounts of potassium was determined by way of direct reading in an internal standard type of flame photometer at a wavelength of 766.5 nm.

IV. Result

Physico-chemical parameters of water**:** Fifteen different physico-chemical parameters were determined in the Koothapar Periyakuam Lake 2011 and 2013. The results are presented Table I. The highest mean water depth (1.3±0.15 m) was recorded in 2012 (Table I and Fig. 1). The water depth differed significantly among the years, (P<0.05). The mean turbidity of the lake was relatively higher in 2011 (9.1±0.42 NTU) than the other two years (Table I and Fig. 2). The mean salinity was higher (0.5±0.03 ppt) in 2011 than the other two years (Table I and Fig. 3). The highest level of mean dissolved oxygen was recorded in the lake in of 2013 (7.8±0.86 ml/l) (Table I and Fig. 4). The level of dissolved oxygen showed significant differences among the years (P<0.05). The pH value of was higher in 2011 (7.5±0.09) than the other two years. (Table I and Fig. 5). A higher value of electrical conductivity (1.2±0.13) was recorded 2013 compared to 2011 to 2012 (Table I and Fig. 6).

The mean carbonate level was high in 2011 (0.5±0.11 mg/l) (Table I and Fig. 7). Higher level of mean bicarbonate (5.7±0.45 mg/l) was recorded in 2013 than the two years (Table I and Fig. 8). Like carbonate the mean bicarbonate was also higher though the level of bicarbonate varied significantly among the years (P<0.05). The mean chloride was relatively higher (6.5±0.96 mg/l) in 2013 than the other two years (Fig. 9). The level of mean sulphate was relatively higher (0.1 ±0.04 mg/l) in 2011 (Table I and Fig. 10). The highest mean calcium level (2.3±0.16 mg/l) was recorded in the 2011 when compared to the other two years (Table I and Fig. 11). The magnesium recorded the maximum mean level (2.9±0.30 mg/l) in 2013 (Table I and Fig. 12). In 2013, highest mean sodium value 7.0±1.06 and 5.3±0.45 mg/l. The mean level of potassium level high level (0.6±0.07 mg/l) in 2013 (Table I and Fig. 14). During 2013, highest mean Magnesium: Calcium level (1.5±0.20 mg/l) and during 2011 lowest mean Magnesium: Calcium level were recorded (1.2±0.14 mg/l), respectively.

TABLE I: Overall Year Wise Variations of Water Parameter Recorded from January 2011 to December 2013. (Values Are Mean ± SE)

S. No.	Water Parameter	Years (January 2011 – December 2013)		
		2011	2012	2013
1	Water Depth (m)	1.3±0.15	1.3±0.15	1.3±0.15
2	Turbidity (NTU)	9.1±0.42	8.2±0.37	6.8±0.57
3	Salinity (ppt)	0.5±0.03	0.4±0.03	0.3±0.03
4	Dissolved Oxygen (mg/l)	7.1±0.40	7.5±0.33	7.8±0.86
5	pH	7.5±0.09	7.4±0.10	7.4±0.15
6	Electrical conductivity (µS/c)	1.0±0.05	1.1±0.11	1.2±0.13
7	Carbonate (mg/l)	0.5±0.11	0.4±0.11	0.5±0.09
8	Bicarbonate (mg/l)	4.8±0.22	5.4±0.37	5.7±0.45
9	Chloride (mg/l)	5.0±0.47	5.8±0.85	6.5±0.96
10	Sulphate (mg/l)	0.1±0.04	0.06±0.02	0.09±0.04
11	Calcium (mg/l)	2.3±0.16	1.9±0.09	2.0±0.173
12	Magnesium (mg/l)	2.4±0.20	2.6±0.25	2.9±0.30
13	Sodium (mg/l)	5.3±0.45	6.5±0.94	7.0±1.06
14	Potassium (mg/l)	0.4±0.02	0.6±0.06	0.6±0.07
15	Magnesium: Calcium (mg/l)	1.2±0.14	1.4±0.17	1.5±0.20

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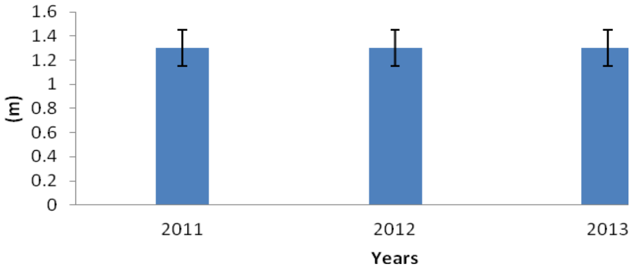

Fig. 1. Overall year wise variation of environmental parameter of water depth recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

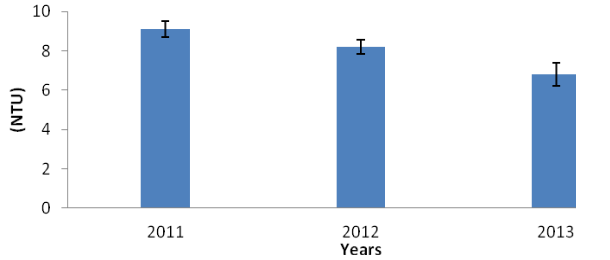

Fig. 2. Overall year wise variation of water parameter of turbidity recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

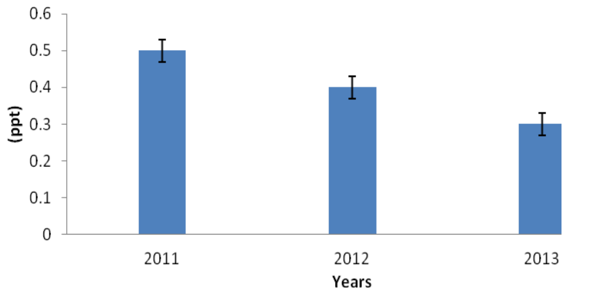

Fig. 3. Overall year wise variation of water parameter of salinity recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

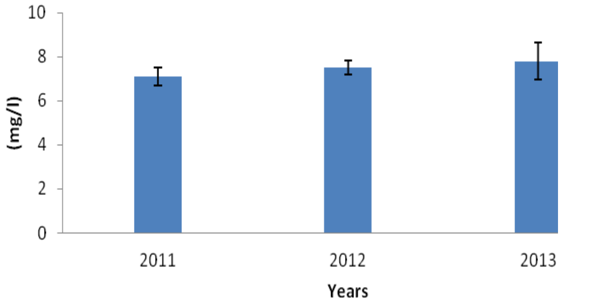

Fig. 4. Overall year wise variation of water parameter of oxygen recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

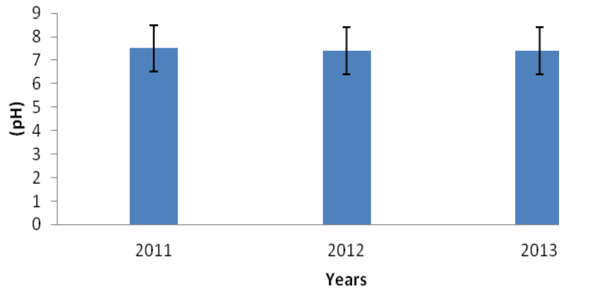

Fig. 5. Overall year wise variation of water parameter of pH recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

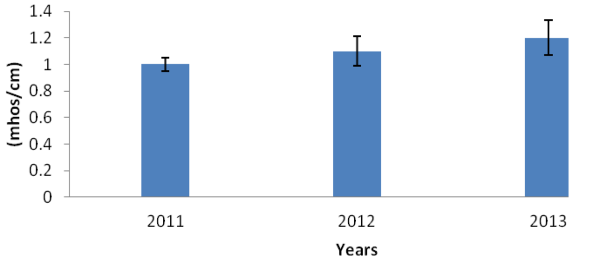

Fig. 6. Overall year wise variation of water parameter of electrical conductivity recorded from January 2011 to December 201(Values are Mean ± SE) (N=1296).

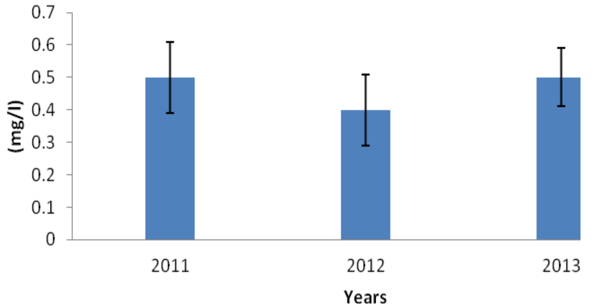

Fig. 7. Overall year wise variation of water parameter of corbonate recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

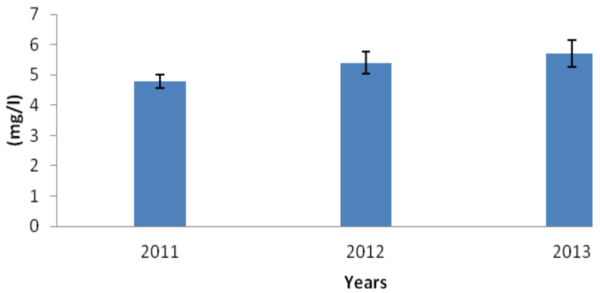

Fig. 8. Overall year wise variation of water parameter of bi-corbonate recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

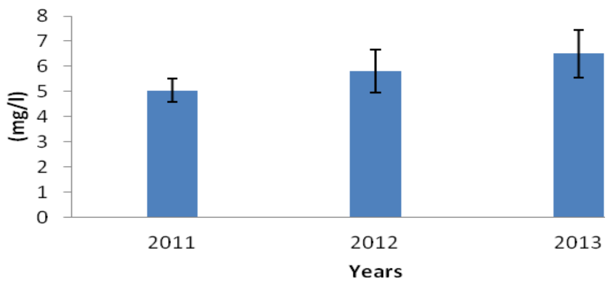

Fig. 9. Overall year wise variation of water parameter of chloride recorded from January 2011 to December 2013. (Values are Mean ± SE) (N=1296)

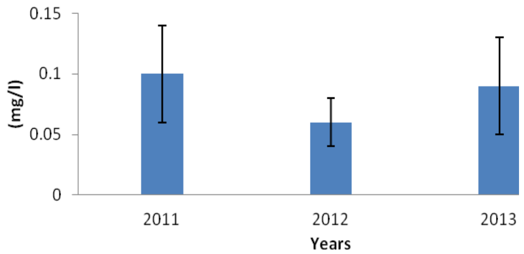

Fig. 10. Overall year wise variation of water parameter of sulphate recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

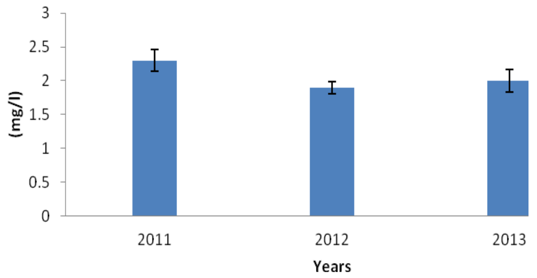

Fig. 11. Overall year wise variation of water parameter of calcium recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

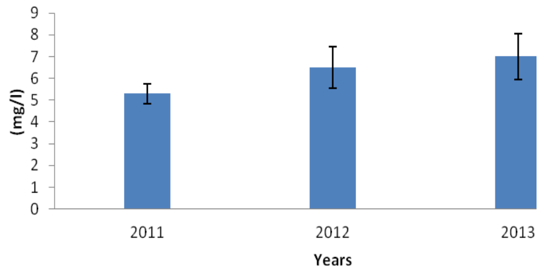

Fig. 12. Overall year wise variation of water parameter of magnesium recorded from January 2011 to December 2013. (ValuesareMean±SE) (N=1296).

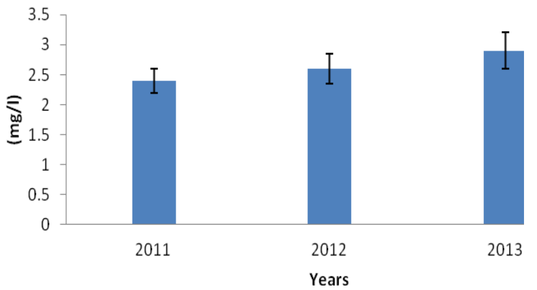

Fig. 13. Overall year wise variation of water parameter of sodium recorded from January2011toDecember2013.(ValuesareMean±SE) (N=1296).

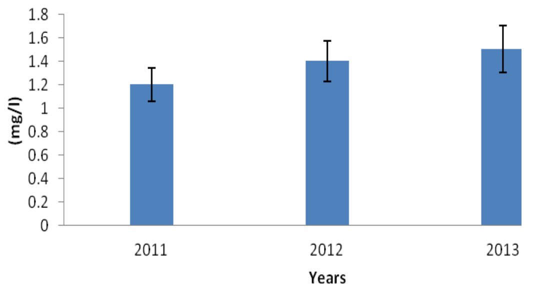

Fig. 14. Overall year wise variation of water parameter of pottasium recorded from January 2011 to December 2013. (Values are Mean ± SE) (N= 1296).

V. Discussion

The physic-chemical variables were subjected to wide. Apart from which observations the physico-chemical factors of the water and the environmental factors were evaluated to understand their relationship with the waterbird community. In addition to that the aquatic habitats are dynamic in nature. Level of the substratum fluctuates rapidly within a day due to water level, and the annual variations also influence the physico-chemical properties of water and thus by habitat use of waterbirds [24]-[26].

Hence, the fluctuations in the density of waterbirds occur annually, which could not be avoided. In general, the depth of water could regulate the different species of waterbirds based on their feeding mechanism or adaptations. In addition to that the water depth may also facilitate the different species of plants growth and its sustainability and which is very much essential for the waterbirds. For example, when the water level was elevated upto moderate depth level, the areas that were dominated by emergent vegetation sank and the other plants such as lotus, lilly etc., became dominant species [27]. The present study supports many earlier studies, for example, a study emphasized that the turbidity of lake water could influence the density, diversity and richness of waterbirds in Albufera de Adra lakes [28]. The level of turbidity could influence the macrophytes and it could turn to facilitate the waterbird species abundance and distribution in a wetland habitats [29]-[33].

The pH is accepted as one of the important ecological factors in the wetland habitat which predominantly regulates the distribution year of waterbirds [34]. Certainly, density or availability of food levels is altered in the aquatic habitat, which will disturb the distribution and population of waterbirds. It has been reported that the electrical conductivity could influence the waterbirds in the North American lakes [35]. Recently [36], The salinity negatively influenced the characteristics of waterbirds in the lake. It was found that when the salinity is increased the waterbird characteristics were decreased (Table I). In fact, the level of salinity is one of the primary factors for aquatic organisms and there are many studies available to corporate the salinity factors with aquatic organisms. Nevertheless, it has been reported that salinity has no directly effect on the waterbirds in an aquatic habitat, whereas the salinity directly influence the prey species of waterbirds, other aquatic organisms, which are the principle prey for waterbirds [37].

Water salinity also determines the distribution of zoobenthos and aquatic animals and thus influences the foraging sites of the waterbirds and their use. The effects of water salinity on zoobenthos and aquatic animals are taxa dependent. [38], [39] reported that chironomid fly larvae, amphipods, and copepods predominate in relatively low-salinity (<50 ppt) water but are replaced by brine-adapted organisms such as Artemia and Ephydra in high-salinity water (>150 ppt). In the salt ponds in San Fransisco Bay estuary, zoobenthos were found abundant in relatively low (<100 ppt) and high (>200 ppt) salinity water but are scarce at midsalinities (100–200 ppt). Another study reported that the distribution of mussels in relation to salinity gradient in the northeastern Baltic Sea and found a marked decline in mussel size and biomass from the saline west to the less saline east [40]. They added that the long period of low salinity negatively affected the growth of population of mussels. [41] reported that the salinity could influence the progression and control of various aquatic organisms to a large extent. The range of higher salinities was reported to cause declining of the fish diversity and abundances [42], [43]. It has been reported that among all the abiotic factors, dissolved oxygen is the most important factor in the water life as it provided valuable information about the biological and biochemical reactions going on in waters [44]. [45] Stated that dissolved oxygen is of great limnological significance as it regulates metabolic processes of aquatic organisms and indicates the status of a water body. In fact, the dissolved oxygen could also regulate the cellular respiration of all taxa in which the level of oxygen in the water is a vital factor not only in an aquatic habitat but also in the terrestrial or land ecosystem. Dissolved oxygen is also very essential for the metabolism of all aquatic organisms that mediates the aerobic respiratory biochemistry [46]. Many authors stated that the level of dissolved oxygen in the water can one of the significant and regulating factor for waterbirds in the wetland habitats [47]-[49]. In addition to that selection of wetlands by waterfowl is influenced by complexities of factor including water chemistry, aquatic vegetation, invertebrate fauna, and physical features [50], [51].

VI. Management and Conservation

This suggests that management solutions benefiting all species may not exist [52]. Consequently, optimal wetland management to multi-species comes from assessing priorities and trade-offs among different species and groups of conservation concern [53]. The drainage water entering the lake is one of the major pollutions to the lake water, which could potentially damage and alter the aquatic taxa. Many studies have indicated that hydrology is the most important variable that determine the development and maintenance of wetland structure and functions [54]. and that hydrology greatly affects the waterbird response to wetland dynamics**.** Unsuitable hydrological condition is usually the major reason for the failure of wetland restoration. In a natshell, ecosystem-based approach is needed in wetland management with various targets, including management with the goal of providing waterbird habitat. This requires integrated knowledge of the entire wetland ecosystem (including hydrology, geology, agrology, botany, aquatic biology, landscape ecology, engineering, and ornithology) with reference to multiple spatial scales, temporal variability, and the diverse habitat requirements of waterbirds [55]-[57]. Moreover, the social and economic constrains need to be adversed when evalving management strategies through the management practice in coordination with wetland management and local development. The present baseline information of the physico-chemical properties of water would form a useful tool for further ecological assessment and monitoring of this wetland of Periyakulam lake.

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