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RESEARCH ARTICLE

STUDIES ON PHYSICO-CHEMICAL PARAMETERS IN VEERANAM LAKE, CUDDALORE DISTRICT, TAMILNADU, INDIA

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ABSTRACT

The present study is aimed to analyse the physic-chemical parameters such as temperature, pH, dissolved oxygen (DO) salinity, total dissolved solids (TDS), biological oxygen demand, chemical oxygen demand and chloride and sulphate were analysed during November 2012 to March, 2013. The temperature was high in March, 2013. pH was high in January,2013. The dissolved oxygen was high in November, 2012 and salinith was more in March, 2013. TDS was more in March and BOD and COD was high in January, 2013. Chloride and sulpahate was high in February, 2013.

INTRODUCTION

Water is essential natural resource for sustaining life and environment without water life is not possible. Fish are totally dependent upon water to breathe, feed, growth, reproduction and maintain a salt balance. Fish perform all their bodily functions in water. The water quality determines the success or failure of an aquaculture operation. The physical and chemical qualities of water not only determines growth of fish, but also their survival. Some water quality factors such as dissolved oxygen, temperature, ammonia and heavy metals are directly involved with fish to kill but other factors such as pH, alkalinity, hardness and clarity are not directly toxic to fish (Joseph *et al*., 1993). The quality of water should be assessed on the basis of physico-chemical parameters in order to provide information for the purpose of water management (Kadam *et al*., 2007). Water analysis is carried out to assess the optimum and harmful limits of various parameters for survival and general health of aquatic organisms. Physico-chemical properties of a water body play a major role in its productivity process and growth of aquatic organisms under culture. Several studies have been conducted to understand the physical and chemical properties of lakes, pond and reservoirs. Analysis of physico-chemical parameters of water is essential,to assess the quality of water for the best usage like irrigation, drinking,bathing, fishing, industrial processing and so on. In India large numberof studies on limnology of lentic water bodies have been carried out in past 30 years. The physico-chemical parameters of lakes, ponds and rivers have considerable effect on the aquatic life. These parameters play a vital role in determine the productivity of a water body distributional pattern and quantitative abundance of organisms inhabiting a particular aquatic ecosystem (Kumar *et al.,* 2009). A change in the physico-chemical aspect of a water body brings about a corresponding change in the relative composition and abundance of the organisms in that water. The abundance and diversity of zooplanktons vary according to immunological features and the trophic state of fresh water bodies (Jappesen *et al.,* 2002). Analysis of physico-chemical parameters of water is essential,to assess the quality of water for the best usage like irrigation, drinking,bathing, fishing, industrial processing and so on. In India large numberof studies on limnology of lentic water bodies have been carried out inpast 30 years (Raghunathan *et al.,* 2000).

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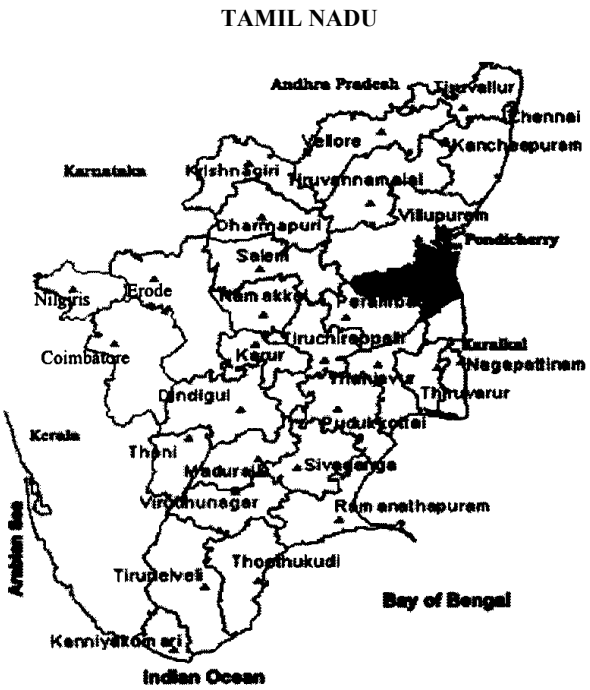
MATERIALS AND METHODS

Physiography of the study area

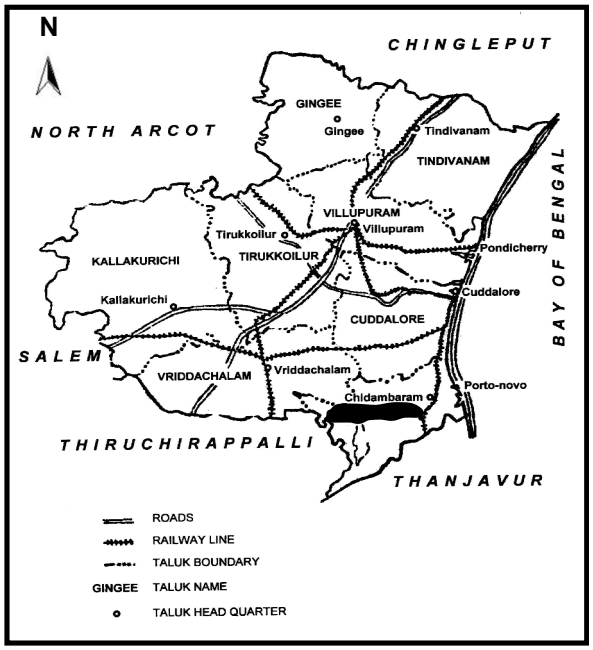
Veeranamlake is located 14 km SSW of Chidambaram in Cuddalore District in the State of Tamil Nadu in South India. [Coordinates 11°120'10" N 79°32' 40E]. The lake located 235km from Chennai, is one of the water reservoirs from where water is planned to be supplied to Chennai for drinking purpose Ayacut area of 48,000 acres irrigation and capture fisheries practices for people living around the lake.

Collection of water and soil samples

Collection of water with mud were undertaken to stations I and II at monthly intervals over a period of one year from November 2012 to March, 2013. Samples were collected from the study sites (Fig. 1), just below the surface and transferred to the pre-cleaned



CUDDALORE DISTRICT



Location of Tamil Nadu and Cuddalore district

polypropylene containers. After collection, all the samples were immediately brought to the laboratory and preserved in 4% formalin for further studies.

Physico-chemical parameters

The physico-chemical parameters such as temperature, pH, dissolved oxygen (DO) salinity, total dissolved solids (TDS), biological oxygen demand, chemical oxygen demand and chloride and sulphate were analysed by the method of APHA (1989) during November, 2012 to March, 2013. The significant difference between different groups was analyzed statistically using analysis of variance (ANOVA). This was followed by Duncan's multiple range test (DMRT).

RESULTS

Physico-chemical parameters

Temperature varied between 23 to 26°C during the study period (Fig. 1). The minimum temperature (26°C) was recorded during in November and December, 2012 and the maximum temperature (36°C) was recorded during summer in March, (Table 1). The pH values varied between 7.2 and 8.6 during the study period. The minimum value (7.2) was recorded during December, 2012. The maximum value of pH 8.6 was recorded during January, (Table 1). Dissolved oxygen level varied between 6.5 and 8.2 mg/L. The minimum value 6.5 was recorded during summer in March, 2012. The maximum value of 8.2 mg/L was recorded during November, 2012 (Table 1). Salinity values ranged between 1.5 and 1.8 mg/L during the study period the minimum salinity (1.5 mg/L) was recorded during monsoon in November, 2012. The maximum salinity value of 21.8 mg/L was recorded during March, 2013 (Table 1). Dissolved oxygen level varied between 377 and 516 mg/L. The minimum value 377 was recorded during February. The maximum value of 516 mg/L was recorded during March, 2013 (Table 1).

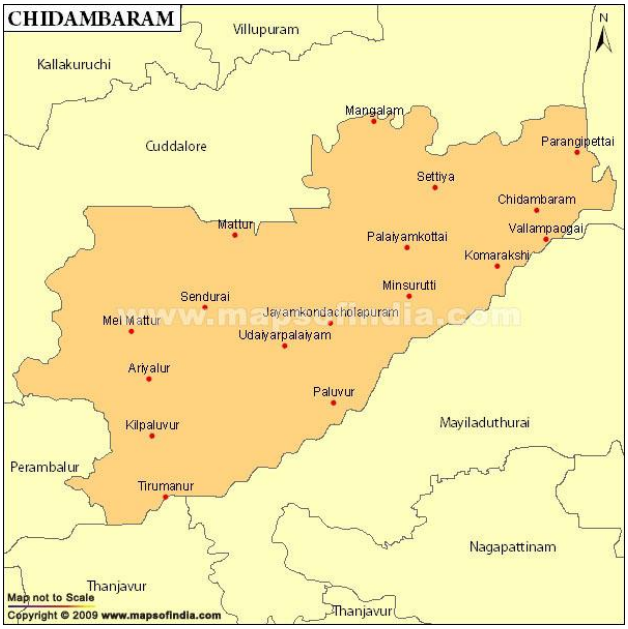


Fig. 1. Study areas of Veeranam Lake

Table 1. Physico-chemical parameter analysis of water quality from Veeranam lake during the period from Novemer, 2013to March, 2013

	November	December	January	February	March
Temperature (°C)	23	24	22	25.2	26
pH	7.6	7.2	8.6	8.4	8.3
Dissolved Oxygen(mg/L)	8.2	8.0	7.0	6.8	6.5
Salinity(mg/L)	1.5	1.7	1.6	1.7	1.8
TDS(mg/L)	442	465	379	377	516
BOD(mg/L)	16	10.8	11.2	9.8	7.1
COD(mg/L)	27.5	22.5	24.2	25	20.4
Chloride(mg/L)	65	70	62	73	71.5
Sulphate(mg/L)	20	33	32	36.4	28.5

BOD ranges from 7.1 to 16 (mg/L). The minimum BOD 7.1 (mg/L) was recorded as the lowest value during March, 2013 and the highest total dissolved solids contents 16 (mg/L) were observed during November, 2012 (Table 1). COD level varied between 20.4 and 27.5 mg/L. The minimum value 20.4 was recorded during summer in March, 2013. The maximum value of 27.5 mg/L was recorded during November, 2012 (Table 1). Chloride level varied between 65 and 73 mg/L.

The minimum value 65 was recorded during summer in November, 2012. The maximum value of 73 mg/L was recorded during February, 2013 (Table 1). Sulphate level varied between 20 and 36.4 mg/L. The minimum value 20 was recorded during November, 2012. The maximum value of 36.4 mg/L was recorded during February, 2013 (Table 1).

DISCUSSION

The physico-chemical changes in the environment may affect particular species and induce the growth and abundance of other species, which leads to the succession of several species in a course of time (Muthukumar *et al*., 2007). The crucial role of the physico-chemical parameters in the ecosystem on the distribution of algal community has been extensively analyzed in tropical and temperate fresh water ecosystem (Lund, 1965). The fluctuating physical properties and characteristics of water and their interactions bear an effect on the biological features of aquatic ecosystem (Venter *et al*., 1997). The seasonal fluctuations of the water quality parameters were possibly due to the precipitation factors. The total life of the world depends on the water. Hence the hydrological study is very much essential to understand the relationship between its different trophic level and food webs. The environmental conditions such as water movement salinity, oxygen, temperature also determining the composition of its biota (Soundarapandian *et al*., 2009). Temperature is the most pervasive of all the environmental variables, influencing life not only because of its different structural and functional effects (Hochsachka and Somero, 1973), but also because if modulates the effect of almost all other environmental parameters. It affects the physical property of water quality including density, viscosity, vapor pressure, surface tension, gas solubility and gas diffusion and also it affects the longevity of aquatic animals as well as their reproduction (Ananthakrishnan and Kutty, 1974). In the present study, the physicochemical parameters ware analyzed in Lake Veeranam during November, 2012 to March, 2013.

Temperature varied between 23 to 26°C during the study period. This may be due to optimal temperature for the growth of plankton. The temperature of lake water varied with seasons. It corresponds to the prevailing climatic condition. During winter season water temperature was found to be low due to frequent clouds, high humidity, high current velocity and high water level (Jain *et al*., 1996). Higher temperatures were observed during summer due to clear atmosphere, greater solar radiation and low water level (Swaranalatha and NarsingRai, 1998; YogeshShastri and Pendse, 2001). At temperature above or below optimum, fish growth is reduced and if extremes, fish mortalities occur (Joseph *et al*., 1993). Takami *et al*. (1989) presented a simple scheme for evaluating the daily mean water temperature under a plant canopy by using a simplified heat balance equation. Similar models have been developed by Maruyama *et al*. (1998) and Ohta and Kimura (2007) to estimate the daily mean paddy water temperature under various weather conditions. Chunleuchanon (2003) reported that the average high temperature might increase the rate of decomposition of organic matter.Choudhury and Kennedy (2004), DeLuca *et al*. (1996) reported that the cyanobacteria grew rapidly in the rice fields that contained ample organic matters in the soil and water as well as conditions such as pH, temperature, organic sources in various rice fields. The low temperature in the month of January to March was may be due to cloudy sky and rainfall brought down the temperature to the minimum (Kannan and Kannan, 1996). pH is an essential parameter for the determination of water character and to differentiate the medium. It is a variable, influencing biochemical relations and possibly affecting species distribution (ThamizhSelvi and Sivakumar, 2011). It also affects the concentrationand potentially influences the toxicity and limitation in the environment (Campell and Stoker, 1985). The pH of the lake water varied between 7.2 (June) to 8.6 (January) indicating the alkaline nature of water. The pH of water was relatively high in the winter months and low in the monsoon and summers. The lower pH during monsoon is due to high turbidity, and in summers, the high temperature enhances microbial activity, causing excessive productivity leads to increase production of CO_2 and reduced pH (Khan and Khan, 1985). The higher value of pH recorded during winter months could be attributed to increased primary productivity. Higher value of pH can be attributed to higher growth rate of algal population which utilized CO_2through photosynthesis (Chaterjee and Raziuddin, 2006). The pH is one of the most important factors that serves as an index for pollution. The pH of the lake water ranges from 7.2 to 8.6 in all the months. Valladolid *et al*. (1954) observed that among the physico-chemical factors of pH between 7.3 to 8.4 is suitable for growth of fishes. As per report of Ellis (1937) water pH ranging between 6.5 to 9.0 is most suitable for better fish growth. Ananthan (1994) has stated that the higher value of pH during summer was due to the uptake of CO_2 by photosynthesizing of microorganisms. The lower pH value observed during the month of January to march may be due to the influence of fresh water influx, low temperature and organic matter decomposition as described by Ganesan (1992). Kamle*et al*. (2009) observed that the reduced rate of photosynthetic activities reduces the assimilation of carbondioxide and bicarbonates which are ultimately responsible for increase in pH. The recorded high value in summer may be due to the solar radiation, penetration of water into the soil and high biological activity.

Soundarapandian *et al*. (2009) observed that the high salinity was observed during April to June due to low rainfall, decreased fresh water inflow, land drainage and agriculture runoff. Sankar*et al*. (2010) observed that the salinity was found to be high during summer season and low during monsoon season. Srithar *et al*. (2006) and Asha and Diwakar (2007) have reported that the recorded higher value could be attributed to the low amount of rainfall, higher rate of evaporation. Govindasamy *et al*. (2000) and Bhave and Borse (2001) reported that the changes in the salinity level may relate with salinity and pH. Chunleuchanon (2003) reported that the average high temperature might increase the rate of decomposition of organic matter.Choudhury and Kennedy (2004), DeLuca *et al*. (1996) reported that the cyanobacteria grew rapidly in the rice fields that contained ample organic matters in the soil and water as well as conditions such as pH, temperature, organic sources in various rice fields. The low temperature in the month of January to March was may be due to cloudy sky and rainfall brought down the temperature to the minimum (Kannan and Kannan, 1996). Sankar *et al*. (2010) observed that the salinity was found to be high during summer season and low during monsoon season. Srithar *et al*. (2006) and Asha and Diwakar (2007) have reported that the recorded higher value could be attributed to the low amount of rainfall, higher rate of evaporation. Govindasamy *et al*. (2000) and Bhave and Borse (2001) reported that the changes in the salinity level may relate with salinity and pH.

In the present study the level of salinity, dissolved oxygen and total dissolved solids were observed during Novembe, 2012toMarch, 2013. The salinity ranged from 1.5 to 1.8 mg/L during the study period in the study area. The present study shows that the lower amount of salinity (1.5 mg/L) observed in November, 2012. This may be nature of the salt accumulated in the soil and also input of rainwater in flooded condition. The dissolved oxygen was observed in the present study during November, 2012 to December, 2013. The present study shows the dissolved oxygen was high (8.2 mg/L) in November, 2012I. This may be due to cultivation of plankton, which produces oxygen present in the dissolved form of water. The low amount of dissolved oxygen was observed in March, 2012.This result may be due to the increased temperature salinity and total dissolved solids. This stratification allows microbial degradation of organic matter to deplete dissolved oxygen and reaction of water (Kolar and Rahal, 1993). In the present study, it is shown that the rate of dissolved oxygen is more in the November, 2012. The influx offreshwater may be the cause for the high rate of dissolved oxygen content. The rate of dissolved oxygen is controlled by various factors such as temperature, salinity and dissolved solids (Patnaik and Misra, 1990). The lower dissolved oxygen in summer is due to increase in temperature and duration of bright Sunlight has influence on the % of soluble gases (O_2 and CO_2). The long days and intensive sunlight during

summer seem to accelerate photosynthesis by phytoplankton, utilizing CO_2 and giving off oxygen. Soundarapandian *et al.* (2009) observed that the dissolved oxygen was low due to consumption of oxygen more by microalgal population. The total dissolved solids was observed in the present study during November, 2012 to March, 2013. The present study shows the total dissolved solids was high (377 mg/L). The present result suggests that the maximum total dissolved solids maybe due to animal waste and agricultural runoff. Soundarapandian *et al.* (2009) stated that the total dissolved solids was more during April to June in due to anthropogenic activity, animal waste, agricultural waste and also caused by evaporation and less rainfall. Verma rved that the large amount of total dissolved solids may result in high osmotic pressure. A high content of TDS elevates density of water, influences osmoregulation, reduces gas solubility and utility of water for drinking (Manivasakam, 2003). The high concentration of TDS may be due to addition of solids from the runoff water.Biological oxygen demand (BOD) test was found to be more sensitive test for organic pollution. The BOD values vary between 6.9 mg/L to 17.5 mg/L (October). Since BOD is a measure of biodegradable material in water, increase in the organic matter causes increase in the BOD level. Greater the BOD values, the more rapidly oxygen is depleted in the water. The low value of BOD clearly indicate that the low level of biodegradable material. The highest BOD was due to the highest biological activity at high temperature, although the water level got reduced, but the level of pollutants from the nearby domestic or industries added was the same throughout the year. This view was in agreement with the work of Paramasivam and Sreenivasan (1981).Chemical oxygen demand (COD) was found to be in the range of 20.4 mg/L (March) to 29 mg/L (June). COD is a measure of oxidizable impurities. High BOD and COD are noticed along with high fish mortality by interfacing with respiratory metabolism (Venkataraman, 1996).

In the study area chloride (Cl) ranges from 62.5 mg/L (October) to 87 mg/L (June). The presence of chloride in the lake water was mainly due to domestic sewage and its concentration is an indicator of organic pollution (NEERI, 1979; Kumara, 2002). High chloride values may be due to organic wastes of animal origin and domestic wastes, the higher concentration of chloride during summer months may be associated with reduced water level. The range of the concentration of sulphate from 20 mg/L (October, November) to 37.1 mg/L (August). A few studies have reported sulphate toxicity to some aquatic organisms. In the present study all the samples are within the tolerable limits

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