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RESEARCH ARTICLE

SEASONAL VARIATIONS OF PHYSICO CHEMICAL PARAMETERS FROM WILLINGTON LAKE, CUDDALORE DISTRICT OF TAMIL NADU, INDIA

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ABSTRACT

The present study was carried out Seasonal variation of physico chemical parameters from Willington Lake (Latitude: 11° 20' 10" N; Longitude: 79° 32' 40" E), Tittagudi taluk, Cuddalore district of Tamil Nadu, India. The sampling was carried out for a period of one year from January 2016 to December 2016. The Mean (± SD) value of the Physico chemical parameters viz. Atmospheric Temperature, Water Temperature, Turbidity, Total Dissolved Solid, Electrical Conductivity, pH and Salinity was observed. The maximum value was observed during summer season and the minimum was observed in Monsoon season. The Dissolved Oxygen, Total Alkalinity, Calcium, Nitrate, Nitrite, Phosphate and Silicate were also observed. The maximum value was recorded during Monsoon season and the minimum was investigated in summer season. It was concluded that the seasonal variation of physico chemical parameters to be governed by rainfall and the quality of water generally refers to the component of water present at the optimum level of for suitable growth of plants and animals.

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INTRODUCTION

The quality of water may be described according to their physico chemical characteristics. Freshwater ecosystems are one of the most common and stable habitats of biosphere and have their own physical, chemical and biological characteristics which are molded by local conditions and physiographic feature (Goel, 1997). It is considered to be the elixir of life and is consumed in the greatest quantity throughout the world and play in socio-economic development of human population (Park, 1997). Water quality is affected by a wide range of natural and human influences. The most important of the natural influences are geological, hydrological and climatic, since these affect the quantity and quality of water available. Ponds, reservoirs are very large natural or artificial lakes that provide habitat and food for many species of fish and wildlife (Dinar *et al.,* 1995). The productivity of freshwater community that determines the fish growth is regulated by the dynamics of its physico chemical parameters along with its biotic environment (Agarwala, 1996). The physico-chemical parameters and nutrient status of water body play an important role in governing the production of plankton which is the natural food of many species of fishes, especially zooplankton constitute important food source of many omnivorous and carnivorous fishes and also support the necessary amount of protein for the rapid growth of larval carps (Rahman and Hussain, 2008).

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This factors which influence the biological productivity of the water body is very essential (Nazir and Deka, 2016). They respond quickly to aquatic environmental changes (water quality, such as pH, Colour, Odour and Taste, etc.) for their short life cycle and are therefore used as indicators of overall health or condition of their habitats (Thorpe and Covich, 1991). They are constructed for domestic use where large natural lakes are sparse and unsuitable for human exploitation, enhancement of fisheries and improvement of water transport. Freshwater ecosystems have been used for the investigation of factors controlling the abundance and distribution of aquatic organisms (Esenowo and Ugwunba, 2010). Changes in the physicochemical parameters may positively or negatively affect the biota of water bodies in a number of ways such as their survival and growth rate and these may eventually result in disappearance of some species of organisms or its reproduction (Edward and Ugwunba, 2010). The light penetration, temperature, water current and salinity affect the distribution of plankton and other organism (Mir *et al*., 2007). Planktonic communities are influenced by the prevailing physico-chemical parameters and these determine their abundance, occurrence and seasonal variations (Rothhaupt, 2000). 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 portable water affecting the human health. Recent reviews indicate that land degradation, forest loss, biodiversity and habitat degradation, scarcity and pollution of freshwater are increasing hence this limnological study is important.

In India, many of the lakes and reservoirs have been studied in physico chemical parameters. In Tamil Nadu limited works from various place were carried out by Senthil Kumar and Sivakumar (2008); Amsha Devi *et al.* (2013); Dhanalakshmi *et al*. (2013); Manickam *et al.* (2015); Rajesh *et al*. (2015), Mohamed Sihabudeen *et al*. (2016) and Tamizhazhagan & Pugazhendy (2016a). But, there is meager reference for the seasonal variations of physico-chemical parameters with respective Willington Lake, Cuddalore district, Tamil Nadu. Hence, in the present study an attempt was made to find out the seasonal variations to influence of physico-chemical parameters.

MATERIALS AND METHODS

Surface water samples were collected from Willington Lake (Reservoir), Keezhachcheruvai (Latitude: 11° 20' 10" N; Longitude: 79° 32' 40" E), Tittagudi taluk, Cuddalore district of Tamil Nadu, India. The water samples were collected from January 2016 to December 2016, at the time of morning hours 6.30 am to 8.30 am in monthly intervals to estimate the physico chemical parameters and Nutrients. Temperature was recorded on the spot with the help of digital thermometer; the remaining parameters were analyzed with the help standard methodology (APHA, 2005).

RESULTS

Seasonally variations of physico chemical parameters viz. Atmospheric Temperature, Water Temperature, Turbidity, Total Dissolved Solid (TDS), Electrical Conductivity (EC), pH, Salinity, Dissolved Oxygen (DO), Total Alkalinity, Calcium (Ca), Nitrate (NO3), Nitrite (NO2), Phosphate (PO4) and Silicate (SiO3) of water was reported from the period of January 2016 to December 2016. In general, few variations were noted in the physico chemical parameters during the study period.

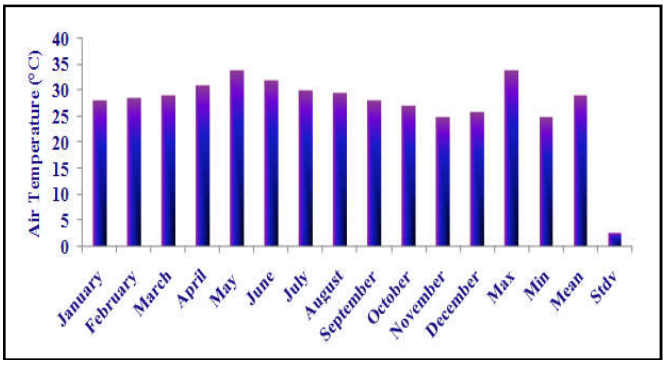

Fig. 1. Seasonal Variations of Atmospheric Temperature

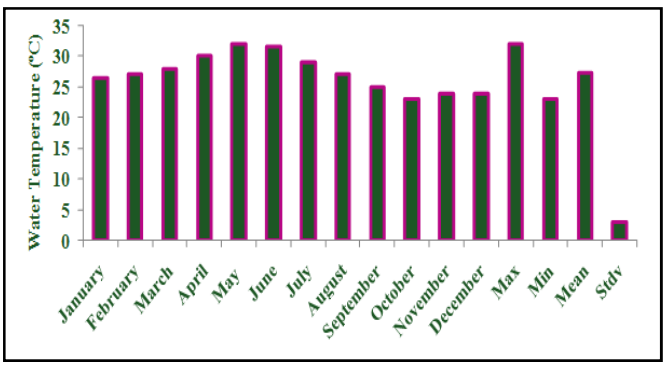

Fig. 2. Seasonal Variations of Water Temperature

The seasonal variations of Atmospheric Temperature (25°C to 34°C; mean 29°C ± 2.531), Water Temperature (23°C to 32°C; mean 27.25 °C ± 2.965), Turbidity (1.5 to 2.5; mean 2.062 ± 0.309), Total Dissolved Solid (TDS) (435 mg/l to 569 mg/l; mean 496.5± 48.520), Electrical Conductivity (EC) (643 to 735; mean 681.33 ± 28.211), pH (7.2 to 8.5; mean 7.8 ± 0.478) and Salinity (1.1 to 3.5psu; mean 2.13 ± 1.002) was observed during ht study period. The maximum was observed during summer season and the minimum was observed during Monsoon season (Fig 1 – 7).

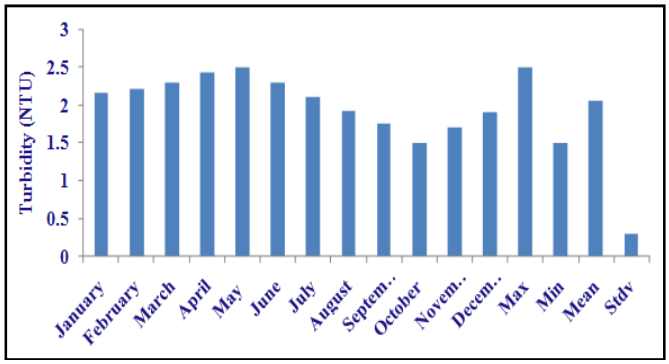

Fig. 3. Seasonal Variations of Turbidity of Water

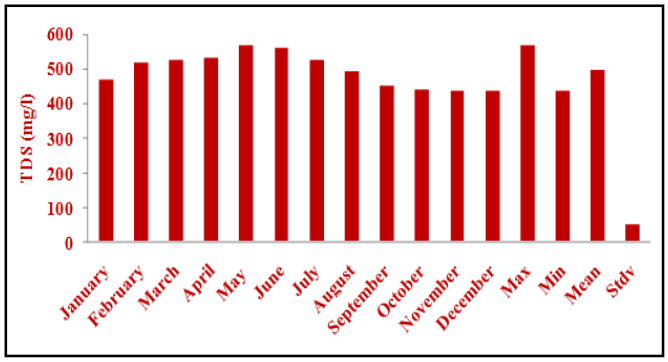

Fig. 4. Seasonal Variations of Total Dissolved Solid (TDS)

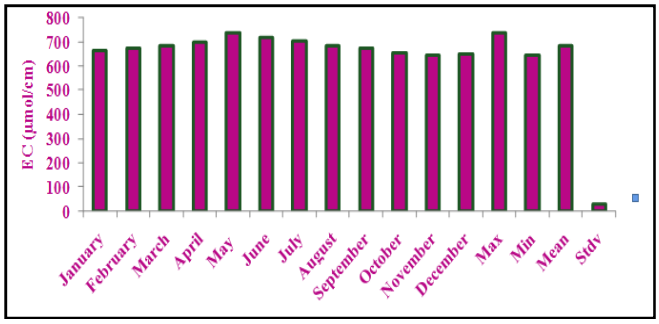

Fig. 5. Seasonal Variations of Electrical Conductivity (EC)

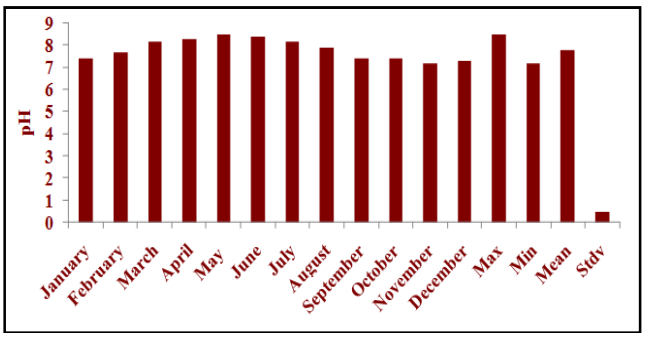

Fig. 6. Seasonal Variations of pH

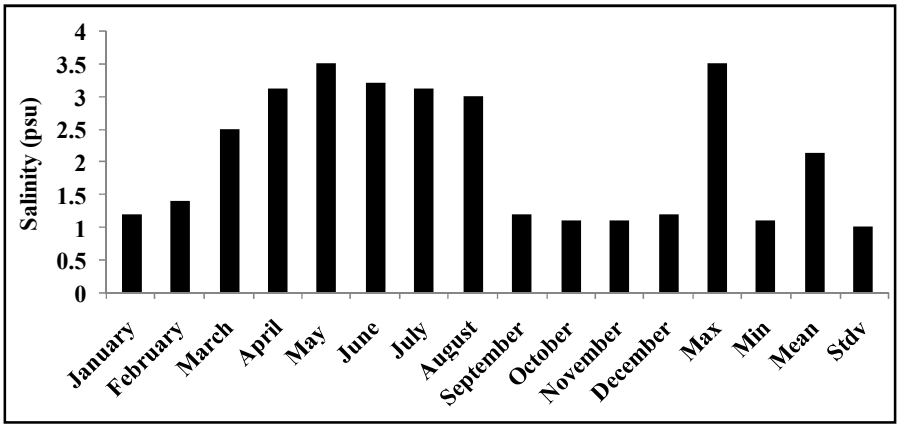

Fig. 7. Seasonal Variations of Salinity

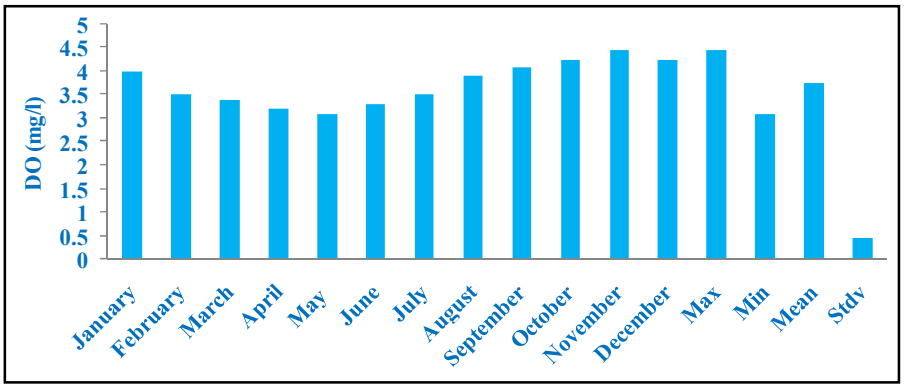

Fig. 8. Seasonal Variations of Dissolved Oxygen

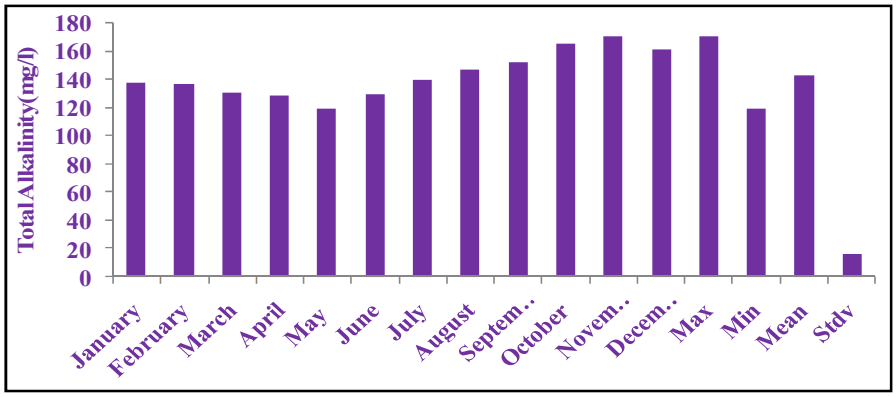

Fig. 9. Seasonal Variations of Total Alkalinity

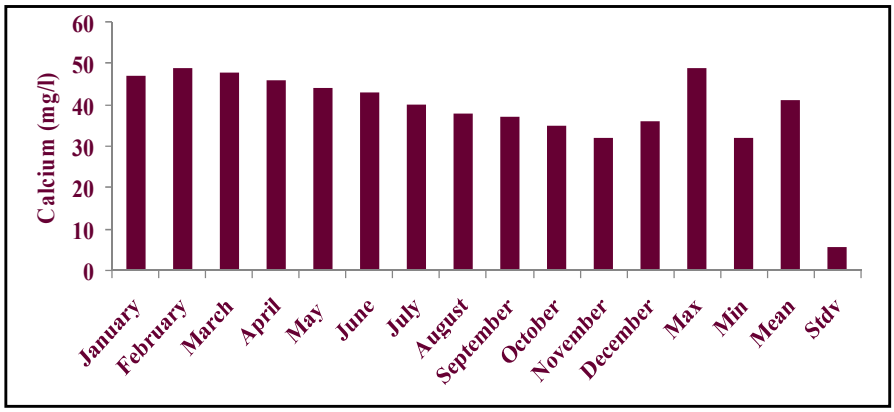

Fig. 10. Seasonal Variations of Calcium

Total Alkalinity (119 to 170 mg/l; mean 142.66 ± 16.216), Calcium (32 to 49 mg/l; mean 41.25 ± 5.674), Nitrate (0.98 to 1.8 mg/l; mean 1.346 ± 0263), Nitrite (0.11 to 0.31 mg/l; mean 0.059) and Silicate (1.49 to 1.85 mg/l; mean 1.653 ± 0.124) was also observed. The maximum was recorded during Monsoon season and the minimum was investigated during summer season (Fig 8 – 14).

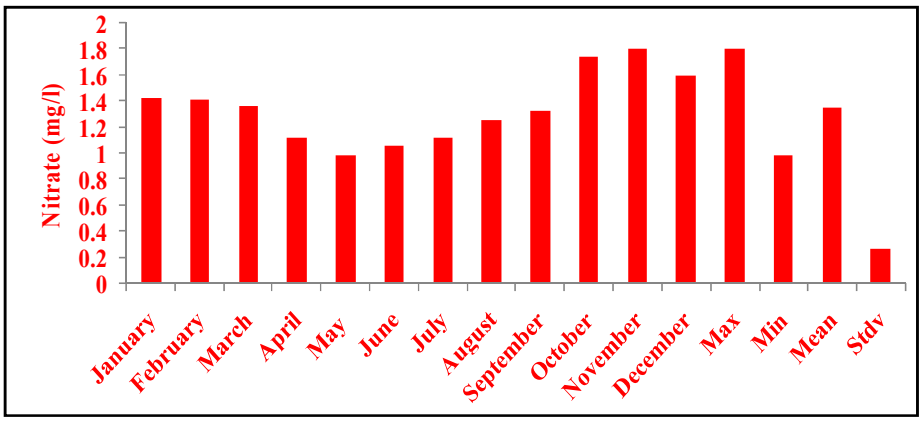

Fig. 11. Seasonal Variations of Nitrate

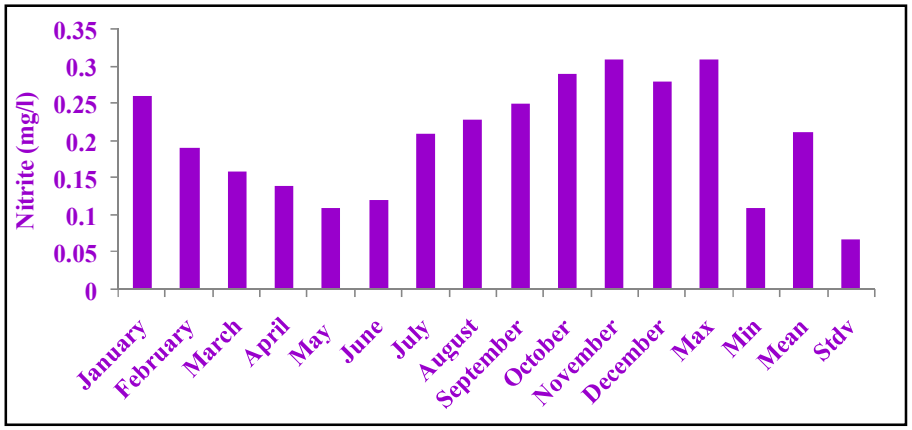

Fig. 12. Seasonal Variations of Nitrite

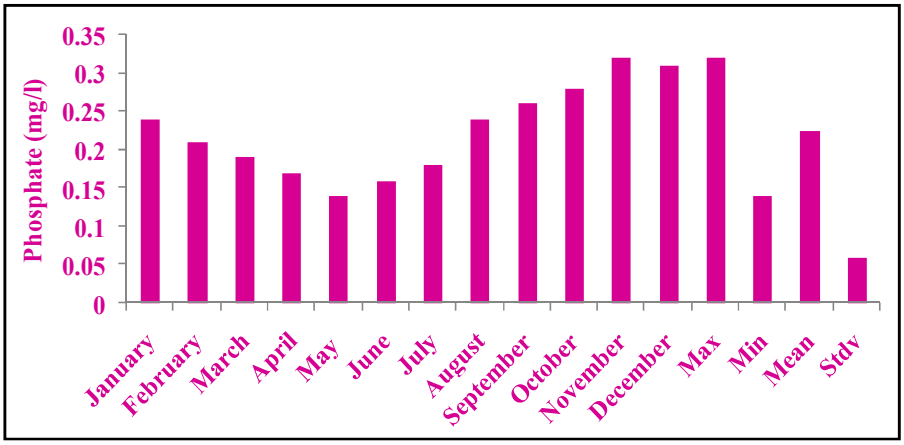

Fig. 13. Seasonal Variations of Phosphate

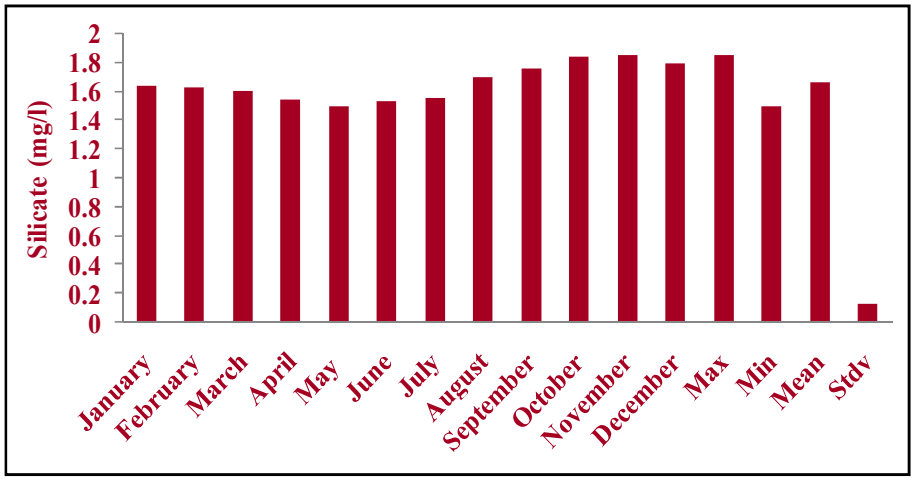

Fig. 14. Seasonal Variations of Silicate

DISCUSSION

Temperature is one of the most important external factors which have a profound influence and direct and or indirect effect on biota of an ecosystem. The high temperature was noticed in the present study during summer season which could be related to increased concentration of dissolved solids at high temperature and due to entry of huge amount of suspended, colloidal matter, silt and clay in to the water body suggested by Rajagopal *et al.* (2010). The observed variation in water temperature in present investigation may be due to the clear sky besides high air temperature, to the difference in sampling time and effect of season. Similar observation has been reviewed by Jayaraman *et al.* (2003); Tiwari, (2004) and Manickam *et al.* (2015). Dhanalakshmi *et al.* (2013) was suggested that maximum temperature present in summer season is associated with decreased solubility of gases in the lake. Kumar and Kakrani (2000) were all so obtained that the rise in temperature of water elevates the metabolic activity of organisms. It also influences the growth and distribution of plankton (Amsha Devi *et al.,* 2013). Lower temperature was observed during monsoon which may be due to cloudy sky and heavy rainfall brought down the temperature to the minimum. Similar observation has been reported by Senthilkumar and Sivakumar (2008). All metabolic and physiological activity and life processes such as feeding, reproduction, movements and distribution of aquatic organism are greatly influenced by water temperature Welch (1952). It depends on the climate, sun light and depth and does not undergo drastic changes during the year in lacustrine environments (Gupta and Gupta, 2006). Water temperature influences plankton production of ecosystem (Gupta and Sharma, 1993).

Salinity acts as major ecological factor controlling the plankton population of freshwater as well as brackish water species, which appeared or disappeared depending upon the salinity condition. The range of salinity during the present study was maximum in summer season could be attributed to the low amount of rainfall, higher evaporation, to variation in temperature and other environment factors and minimum in monsoon season due to heavy rainfall similar findings has been reported by Senguptha and Dalwani (2008). Similar observation have been reported by Dhanalakshmi *et al.* (2013)
pH is the one of the most important factors that serve as an index of the pollution. Aquatic organisms are affected by pH because most of their metabolic activities are pH dependent (Wang *et al.,* 2002). The earlier studies investigated by Ranjan (2007) and Manickam (2012). Lendhe and Yeragi, (2004) was suggested that the pH of the water body showed alkaline in nature 7.4 to 8.5. This range is good for growth of aquatic organisms. Jhingran (1991) was reported that pH ranges between 6.0 and 8.5 indicates medium productivity, more than 8.5 highly productive and less than 6.0 low productive nature of water body. In present study, pH range was slightly alkaline nature. The earlier reports were supports of our investigation. The Dissolved oxygen content of natural water varies with temperature, salinity, turbulence, the photosynthetic activity of algae and higher plants and the atmospheric pressure. High Dissolved oxygen was observed in monsoon season due to input of detergents found to be mainly due to higher turbidity and low transparency values (Rajagopal *et al.,* 2010). Vetriselvi *et al.* (2011) were reported that the highest DO might be due to accumulation of the anthropogenic activity of cloths washing which hampered the quality of water. Periyanayagi (2015) was reported that highest values of DO due to frequent turbulence caused by Paddled boats which resulted in proper mixing of water. Lowest value of DO in the summer season was observed due to affected by the photosynthesis activity and aeration rate (Gautam *et al.,* 1993). Mustafa and Ahmad (1985) obtained the partial of O2 dissolved in water depends upon the partial pressure of gas in the air close to water, rate of photosynthesis and oxygen holding capacity of water. Iqbal *et al.* (2003) was all so reported could be attributed to the reduction of the collection zone to isolated pools and thus decrease in water level.

Variations in the amount of DO occur over a day. This is due to photosynthetic and respiratory processes of algae and higher plants. In the present study, the recorded high DO content is sufficient to maintain aquatic life forms. High DO content is an indication of healthy system in a water body (Fakruzzaman and Zaman, 1996). The present findings are supported by Manickam *et al.* (2012 and 2015). Electrical Conductivity (EC) is a good indicator of the overall water quality (Abbassi, 1996). EC value of is a good measure of the relative difference in water quality between different aquifers (Dee, 1989). EC of water is a numerical expression of the ability of water sample to carry an electric current. It depends of the nature and concentration of ionized substances (or) electrolytes dissolved in water (Rani and Sivakumar, 2012). The lowest in monsoon as dilution of water during the rains causes a decrease in electrical conductivity revealed that changes in conductivity were clearly associated with the addition of pollutant in the system (Tiwari *et al.,* 2004). Highest electrical conductivity might be due to high temperature at less solubility and high degradation of organic substances. According to Gaikward *et al.* (2008) the dilution of solid substances in turn reduces the EC value, alkalinity and zooplankton production. The conductivity values were above the permissible limits as per WHO. Conductivity levels below 50 µmhos/cm are regarded as low; those between 50-600 µmhos/cm are medium while those above 600 µmhos/cm are high conductivity (Singh and Gupta, 2014). Similar result found that the conductivity of open pond could be regarded as intermediate by Needham and Needham (1972). In our result was observed of EC above 600 µmhos/cm. A sudden rise in conductivity in water indicates addition of some pollutants suggested by Trivedy and Goel (1984) and Kadam (1990).

The total dissolved solids (TDS) in water were minimum in monsoon and maximum in summer. The recorded highest average value for total dissolved solids might be due to accumulation of the anthropogenic waste which hampered the quality of water and decrease of TDS in transparence may be due to the increase in turbidity of water as a result of runoff carried in the reservoir. This agree with some scientists who reported that the pattern of change of transparency various inversely with that of turbidity and rainfall and that higher transparency leads to deeper light penetration and consequently a wider depth of photosynthesis activity of phytoplankton (Bhatt *et al.,* 1999). TDS indicates the total amount of inorganic chemicals dissolved in water samples. The TDS values were above the drinking water standards as Prescribed by WHO and BIS. The desirable and permissible value is 1500 – 2000 mg/l. (RMC. 1990) the present observation has found the TDS values are lower than that of permissible limit for drinking water. The lakes showed very high amounts of TDS and alkalinity during summer season this can be attributed to human influences and disturbances suggested by Sharma *et al.* (2010). The total alkalinity was

ranged from 92.5 to 255 ppm. In the water body, the alkalinity is imparted by number of bases viz., carbonates, bicarbonates, hydroxides, phosphates, nitrates, silicates, borates etc., (Kumar and Kakrani, 2000). Baskaran *et al.* (1988) was observed a decreasing trend of total alkalinity from 115 ppm to 80 ppm. The minimum level of total alkalinity was recorded during summer season and the maximum level were recorded monsoon seasons during the study period. Total alkalinity of water is due the presence of mineral salt present in it. It was primarily cause by the carbonate and bicarbonate ions observed by (Unnai, 1984 and Baskar *et al.,* 2013). The values of alkalinity were also high and hence indicated pollution in the lakes (Das *et al*., 2009). Calcium value was not with the desirable limit of BIS and WHO standard. The desirable and permissible value of calcium 75-.200 mg/l. The calcium and magnesium contributes to the hardness of water as their carbonate magnesium is always considerably lower than of calcium component excessive concentration of magnesium is undesirable in domestic water because of the problems of scale formation of pitting (APHA, 2000). The minimum level of calcium was recorded during monsoon months and maximum was recorded during post monsoon. The present study agrees earlier worker (Griffiths *et al.,* 1991).

The maximum nitrate (NO_3) values were recorded during monsoon and minimum levels were recorded during summer seasons. The present study agrees earlier reported by (Kamat and Sima, 2005). The high amounts of nitrates and phosphates in the water bodies indicate higher levels of eutrophication in the lakes (Thakur *et al.,* 2013). These nitrates and phosphates prove to be the key to excessive algal blooms in the water bodies, thus increasing the pollution levels. The maximum phosphate, content was recorded in monsoon and minimum level recorded during summer season in study area. Increase and decrease in the phosphate in the water bodies' depend upon the adsorption and release of phosphorus by the pond bottom sediments (Abdol-Salar, 2001). Similar instance was early reported by Pazhanisamy, 2005). Maximum value may be due to the rain washing from the catchment through river discharges and flood water as well as seepage from paddy fields (Krishnamoorthi and Selvakumar (2012). Earlier studies revealed such low levels of phosphate content in many of the Indian rivers (Devaraj *et al.,* 1998). The algal blooms can be observed at values starting from 0.03 mg/l of phosphates in the water (Sheela *et al.,* 2011). The greenish blue waters observed by the plain eye during sample collection also support the interpretation of excessive algal growth in these fresh water lakes. The phosphate content was an essential nutrient, play a vital role in biological activities of aquatic organisms. The Silicate content maximum was observed during Monsoon season and minimum was observed during summer season. The observed results are in agreement with the results recorded earlier reported by Venkatesharaju *et al.* (2010).

Conclusion

These lakes are very important for ecosystem. The present study has revealed that, the electrical conductivity of water fluctuated much above the limit required for the aquatic organisms whereas; the dissolved oxygen (DO) of Lake was high. From the above results and discussion it has been clear that, the lakes are not as much productive as expected in case of DO and conductivity. The commercial fish culture May exert bad effect on physico-chemical parameters of these water bodies. Still it has the time to conserve the water quality and is very much necessary to conduct more research on these lakes and to take proper steps to maintain the physico-chemical parameters of water at healthy state. As also urbanization increases around the world, many of these reservoirs are being created to hinder in controlling runoff. There is considerable need for additional quantitative data and a better understanding of these small impoundments so they may be managed more effectively. Based on the present study, it may be concluded that the physicochemical characters vary in each month according to the ecological influence.

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REFERENCES

Abbassi, SA., Arya, DS., Hameed, AS and Abbassi, N. 1996. Water quality of a typical river of Punnurpuzha, Kerala. *Pollution Research,* 15: 163–166.

Agarwala, N K. 1996. Limnology and fish productivity of Tamranga wetland in productivity indicators. Ph.D. Thesis, Gauhati University, 200.

Amsha Devi, V., Baskaran, S and Suresh Kumar, R. 2013. Physico-Chemical Parameters and Zooplankton Diversity of A Temple Pond in Virudhunagar, Tamil Nadu *Int. J. Sci., Environ. & Tech*, 2(2): 250 – 257.

APHA. 2005. Standard methods for the examination of water and waste water (21st ed.). Washington, DC.

Baskar Narasimhan, N., Swamidass Daniel. G., Ravichelvan. R., Sukumaran, M. and Anandaraj, T. 2013. Seasonal Variations in physico-chemical parameters of river Cauveri, Thanjavur, Tamil Nadu, India. *In. J. Res. Bio. Sci.* 3(1): 8-11.

Baskaran, S., Isaiarasu, L. and Thangamani, A. 1988. Observations on Diurnal variations in physical, chemical, and zooplanktonic components of a pond in Sivakasi. *Oikoassay*, 5 (2): 51-55.

Bhatt, LR., P. Lacoul, HD., Lekhak and Jha, PK. 1999. Physico –chemical characteristics and phytoplanktons of Taudaha lake, Kathmandu. *Poll. Res*., 18 (4): 353-358.

Das, SK., Biswas, D. and Roy, S. 2009. Study of hydrophytes in some lentic water bodies in West-Bengal, India. *Ecological Society* (ECOS), Nepal. 16: 9-13.

Dee, AK. 1989. Environmental Chemistry. 2nd Edition. pp. 164-272.

Devaraj, KV., Mahadeva, MZ. and Pazal, AA. 1998. Hydrobiology of the HemavathyResevoir, In: M. Mohan Joseph (Edn.). The first Indian Fisheries Forum, Proceedings. *Asian Fisheries Society,* Indian Branch, Mangalore, 323 - 327.

Dhanalakshmi, V., Shanthi, K.and Remia, K M. 2013. Physicochemical study of eutrphic pond in Pollachi town, Tamil Nadu, India. *Int. J. Cur. Micro. App. Sci*., 2(12), pp: 219-227.

Dinar A., Seidi, P., Ole, H., Jorden, V., Dada, A. and Johnson, R. 1995. Restoring and Protecting the Worlds Lakes and Reservoirs, World Bank Technical Paper No. 289. The World Bank Washington, DC., 85

Edward, JB. and Ugwumba, AAA. 2010. Development trends and evaluation of egbe reservoir water nutrient status in Ekiti State Nigeria, *J. Life Sci.,* 4(1): 26.

Esenowo, IK. and Ugwunba AAA. 2010. Composition and abundance of Macrobenthes in Majidun River Ikorodu Lagos State, Niger, *Res. J. Biol. Sci.,* 5(8): 556-560.

Fakruzzaman, M. and Zaman, M. 1996. Preliminary investigation on the physico–chemical characteristics of some ponds in Central Barind regions, Bangladesh. *Limnologia*; 3: 18-22.

Gaikwad, SR., Ingle, K.N. and Thorat, S.R. 2008. Study of zooplankton patter and resting egg diversity of recently dried water bodies in north Maharashtra region. *J. Environ. Biol*., 29: 353-356.

Gautam, A., Joshi, VP. and Sati, OP. 1993. Physico-chemical characteristics of sewage and its impact on water quality of Alkananda at Srinagar (Garhwal). *J. Ecotoxicol. Environ. Monit.,* 3: 61-63.

Goel, PK. 1997. Water pollution: cause effects and control. New age international (P) Ltd. Publishers.

Griffiths, RW., Thornley, S., Edsall, TA. 1991. Limnological aspects of the St. Clairriver *Hydrobiologia,* 219: 97 - 123.

Gupa, MC and Sharma, LL. 1993. Diel variation in selected water quality parameter and zooplankton in a shallow pond of Udaipur, Rajasthan. *Journal of Ecobiology*; 5: 139-142.

Gupta, SK, Gupta, RC. 2006. General and Applied Ichthyology (Fish and Fisheries) S. Chand and Campany Ltd. Ram Niger, New Delhi. 1130.

Iqbal, F., Ali, M., Abdus, S., Khan, BA., Ahmad, S., Qamar, M. and Umer, K. 2003. Seasonal variation of physico-chemical characteristics of River Soan water at Pathan Bridge (Chakwal), Pakistan. *Int. J. Agri. Biol.,* 1560-8530.

Jayaraman, PR., Gangadevi, T and Vausdevan Nayar, T. 2003. Water quality studies on Karamana river, Thiruvananthapuram district, south kerala. *Industrial Poll. Res.,* 22: 89 -100.

Jhingran, VG. 1991. Fish and fisheries of India, Hindustan Publishing Corporation, Delhi, 954 pp.

Kadam, SD. 1990. Environmental study of lake Rankala, Jaynati nala and lake Kotitirth from Kolhapur city. *Environ. Ecol.,* 8: 95-97.

Kamat, S. and Sima,V., 2005. Hydrobiological studies of two temple ponds in PondaTaluka Goa. *Ecol. Environ. Cons.,* 6: 361 - 362.

Krishnamoorthi, A. and Selvakumar, S. 2012. Seasonal fluctuation of zooplankton community in relation to certain physicochemical parameters of Veeranam lake in Cuddalore district, Tamil Nadu, *Iner. J. Resea. Enviro. Scie. Tech.,* 2(2): 22-26.

Kumar, U. and Bhanu Kakrani. 2000. Water environment and pollution. *Agrobios*, India. Pp 1-258.

Lendhe, RS. and Yeragi, SG. 2004. Physico-chemical parameters and zooplankton Diversity of Phirange Kharbav lake. Dist. Thane, Maharastra. *J. Aqua. Biol*, 19 (1): 49-54.

Manickam, N., Saravana Bhavan P., Santhanam, P., Muralisankar, T., Vijayadevan K. and Bhuvaneswari, R. 2015. Biodiversity of freshwater zooplankton and physico-chemical parameters of Barur Lake, Krishnagiri District, TamilNadu, India. *Malaya Journal of Biosciences,* 2(1):1-12

Manickam, N., Saravana Bhavan, P., Santhanam, P., Chitrarasu, P and Jawahar Ali, A. 2012. Zooplankton diversity in a perennial freshwater lake. Diversity and Physiological Processes: Ed. Desai PV, Roy R, *Goa University*. ISBN: 978-81-908791-3-2; 25-37.

Mir, AR., Wanganeo, A., Yousuf, AR. and Wanganeo, R. 2007. Plankton dynamics in relation to fish in Wular lake of Kashmir, *Poll. Res.,* 26(4): 733–743.

Mohamed Sihabudeen, M., Abbas Ali, A. and Zahir Hussain, A. 2016. Assessment of Physico-Chemical quality of Ground Water samples in and around Trichy Town, Tamilnadu, India *Arc. App. Sci. Res.,* 8 (4): 31-34.

Mustafa, S. and Ahmad, Z. 1985. Environmental factor and planktonic communities of Baigul and Nanaksagar reservoir, Nainital, BNHS, 82: 13-23.

Needham, J G. and Needham, PR. 1972. A guide to the study of Fresh Water Biology Holden day Ins. San- Francisco, U.S.A. 108.

Park, K. 1997. Parks Text Book of preventive and Social Medicine. Banasidas. *Bharat Publishers*, Jabalpur.

Pazhanisamy, S. 2005. Reservoir ecology of lower anaicut Thanjavur District, Tamil Nadu, Ph.D. Thesis, Bharathidasan University, p. 136.

Periyanayagi, R. 2015. Seasonal Variation of Phytoplankton Community In Relation To Certain Physico-Chemical Parameters of Veeranam Lake in Cuddalore District, Tamil Nadu, *Int. J. Modn. Res. Revs.,* 3(11): 1038-1043.

Rahman, S and Hussain, AF. 2008. A study on the abundance of zooplankton of a culture and non-culture pond of the Rajshahi University campus. *Uni. J. Zoo.*, Rajshahi University, 27: 35-41.

Rajagopal, T., Thangamani, A., Sevarkodiyone, SP., Sekar, M., Archunan, G. 2010. Zooplankton diversity and physico-chemical conditions in three perennial ponds of Virudhunagar district, Tamilnadu. *J. Environ. Biol*., 31: 265-272.

Rajesh, P., Kesavan Muthu, S., Seshadri, A., Manikandan, T., Gnanasambandan and Gunasekaran. S. 2015. Physico-chemical charactereristics of ground water at pappankuppam, Tamil Nadu, India. *Int. J. Curr. Res. Aca. Rev.,* 3(10): 234-238.

Rani, R. and Sivakumar, K. 2012. Physico chemical parameters and phytoplankton richness in certain ponds of Chidambaram, Cuddalore district of Tamil Nadu, *Inter. J. Res. Environ. Sci. & tech.,* 2 (2): 35-44.

Ranjan, C.P, Chinmoy, C and Raziuddin, M., 2007. Impact of human activity on water quality of lentic water body in asansol. *Nature Environment and Pollution Technology*; 5: 59-62.

Rothhaupt, KO. 2000. Plankton population dynamics: Food web interactions and abiotic constraints, *Freshwater Biol.,* 45: 105-109.

Sengupta, M. and Dalwani, R. 2008. Determination of water quality index and sustainability of an urban water body in Shimoga town, Kornataka, Proceedings of Taal 2007: The 12th World Lake Conference: 342-346

Senthikumar, R. and Sivakumar, K. 2008. Studies on phytoplankton diversity in response to abiotic factors in Veeranam lake in the Cuddalore Dist. of Tamil Nadu. *J. Environ. Biol*., 29: 747-752.

Sharma, K., Verma, K. and Shvetambri, P. 2010. Phytoplankton diversity and seasonal fluctuations in surinsar wetland , jammu (J&k) - A Ramasar site. *Int. J. App. Env. Sci.* 22: 267-276.

Sheela, AM., Letha, J., Joseph, S., Ramachandran, KK., Sanalkumar, SP. 2011. Trophic state index of a lake system using IRS (P6-LISS III) satellite imagery. *Environ. Monit. Assess.* 177 (1–4): 575–592.

Singh, M. and Gupta, KC. 2004. Physico -chemical studies of water of river Yamuna at Mathura, *Ecol. Envi. & Cons.,* 10(2): 193-196

Singh, S. and Gupta, BK. 2014. Status of Biomonitoring and Potability with strategy of its Mitigation of Ground water

of Town Deeg (bharatpur) Rajasthan: Correlation with Hydro-Biochemical Profile. *Proc. of national con. on environment*: Ancient and modern perspectives(NCE-2014) held at haratpur, Rajasthan on 4-6 .

Tamizhazhagan, V and Pugazhendy, K. 2016a. Physico-chemical parameters from the manappadaiyur and swamimalai fresh water ponds. *Indo american J. pharm. Sci.* 3(5): 444-449.

Thakur, RK., Jindal, R., UdayBhan Singh and Ahuwalia, AS. 2013. Plankton diversity and water quality assessment of three freshwater lakes of Mandi (Himachal Pradesh, India) with special reference to planktonic indicators, *Environ. Mon. Ass.*185: 8355-8373

Thorpe, HJ and Covich, PA. 1991. Ecology and classification of North American *Freshwater invertebrates. Academic Press*, San Diego, California: 911.

Tiwari, S., Dixit, S and Gupta, SK. 2004. An evauation of various physico-chemical parameters in surface waters of Shahpura lake. Bhopal. *Poll. Res.,* 23: 829-832.

Trivedi, MK. and Goel, PG. 1984. Chemical and biological methods for pollution studies. Environmental Publication, Karad. p. 247.

Unnai, KS. 1984. Limnology of Sewage polluted pond in central India. *Int. Revue. Ges. Hydr. Berlin*., 69: 553 - 566.

Venkatesharaju, K., Ravikumar, P., Somashekhar, RK., Prakash, KL. 2010. Physico - chemical and bacteriological investigation on the river Cauvery of Kollegal stretch in Karnataka. Kathmanadu University *J. Sci. Engineer and Tech* 6(1): 10 - 15.

Vetriselvi, A., Sivakumar, K. and Poonguzhali, TV. 2011. Seasonal variation of hydrographic parameters and distribution of nutrients in the Perumal lake, Tamil Nadu. *Int. J. Res. Environ. Sci. Tech*., 1: 34-42.

Wang, W., Wang, A., Chen, L., Liu,Y and Sun, R. 2002. Effects of pH on Survival, Phosphorus Concentration, Adenylate Energy Charge and Na+-K+ ATPase Activities of Penaeus chinensis Osbeck Juveniles. *Aqu. Toxi.,* 60: 75-83.

Welch, TS. 1952. Limnology (2nd Ed). McGraw Hill Book Co. New York, p. 538.

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