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WATER QUALITY OF THIMMAPUR FRESH WATER LAKE IN WARANGAL DISTRICT, TELANGANA STATE, INDIA - AN ASSESSMENT FOR FISHCULTURE USING PHYSICO-CHEMICAL PARAMETERS

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ABSTRACT

The present study is an attempt that has been made on the physicochemical characteristics of the Thimmapur Lake, a fresh waters tank located in Warangal district of Telangana State. The study was carried out for a period of one year from February2015 to January 2016. Water samples were collected and analyzed using the Standard laboratory methods and procedures. The results of the analysis of water samples have shown that there is a variation in these parameters at the different sampling stations and some of these parameters vary during different seasons too. The Temperature was ranging from 22.2 to 29.6^{o}C, pH was ranging from 6.8 to 7.5, DO content was from 7.2 to 8.6 mg/l, BOD ranged from 3.8 to 6.32 mg/l, Total Alkalinity was 39.4 to 65.28 mg/l, TDS varied from 37.24 to 64.82 mg/l, Turbidity was ranging from 19.0 to 56.11 ppm, Free CO2 from 1.31 to 3.0 mg/l, EC was from 135.06 to 437 µmhos/cm, Chlorides from 36.0 to 59.3 mg/l, Phosphates from 1.76 to 3.01 mg/l, Sulphates from 34.82 to 53.43 mg/l, Nitrates from 0.30 to 0.64 mg/l, Ammonia content from 1.01 to 1.58 ppm, Sodium from 3.8 to 7.3 ppm, and Potassium from 1.73 to 2.21 ppm. Results of water quality assessment clearly showed that most of the parameters are slightly higher in the wet season than dry season. This study observed that Ammonia, BOD & Electrical Conductivity levels were fairly high. The high content of BOD has depleted the Dissolved Oxygen levels which will eventually be harmful to aquatic life. Therefore there is a need for the proper assessment, monitoring and precautionary measures to be initiated to overcome the pollution load in this Lake for the proper utilization of these waters for other purposes such as Fishculture.

KEYWORDS: Thimmapur Fresh Water Lake, Physico-Chemical Parameters & Fishculture

INTRODUCTION

Water as a universal solvent has the capability to dissolve many substances including organic and inorganic compounds. This outstanding property of water can be ascertained to the inconceivability to take in water in its pure form Benjamin *et al.*,(1996). The quality of water generally refers to the component of water present at the optimum level for suitable growth of plants and animals. Aquatic organisms need a healthy environment for their sustainable live and adequate nutrients for their growth. The productivity depends on the physicochemical characteristics of the water body (Agbaire and OBI :2009, Verma *et al.*,2012). The maximum productivity can be obtained only when the physical and chemical parameters are at the optimum level. Water for human consumption must be free from organisms and chemical substances and such large concentrations may affect health (Uduma, 2014). The pollution of water is increased due to the human population, industrialization, the use of fertilizers in agriculture etc. Water parameters such as temperature, transparency, turbidity, Electrical Conductivity, Total Dissolved Solids, Dissolved Oxygen, Biological Oxygen Demand, Nutrients, Hardness, Alkalinity, Chlorides, etc. are some of the important factors that determine the growth of living

organisms in a water body (Smitha, 2013). Hence, water quality assessment involves the analysis of physicochemical, biological and microbiological parameters that reflect the biotic and abiotic status of the ecosystem **(**Verma *et al*., 2012). As it was mentioned by the World Health Organisation (1986) approximately 36% of urban and 65% of rural Indian's was without access to safe drinking water (Ibandarisuk Lyngdoh and Highland kayang, 2012) Fresh Water is essential to the existence of life. The water of acceptable quality is essential not only for drinking and domestic purposes but also for agriculture, industrial and commercial uses (Trivedi *et al*., 2012). India has been facing a serious problem of natural resource scarcity, especially the water in view of population growth and economic development. Most of fresh water bodies all over the world are getting polluted, thus decreasing the availability of potable water. All life depends on water and it exists in nature in many forms such as Oceans, Rivers, Lakes etc. (Sulekh Chandra *et al.*,2012). Due to overgrowth of Population, advancement in agriculture practices, urbanization and industrialization have made the surface water get polluted to a great extent and resulting from the decrease in the availability of drinking water. Many parts of the world have been facing the scarcity of water. Most of the wastewaters are dumped straight into rivers, lakes, and estuaries without any treatment. Lakes are the important feature of the Earth"s landscape which are not only the source of precious water but provide valuable habitats to plants and animals, moderate hydrological cycles, influence microclimate, enhance the aesthetic beauty of the landscape and extend many recreational opportunities to human beings (Ramesh and Krishnaiah,2013). Most of the fresh water bodies such as ponds, lakes, tanks, and streams in and around Warangal town have become polluted as a consequence of increasing industrialization, urbanization and developmental activities for the past decade. Owing to all these facts, keeping in view it is thought that a water body in this area must be studied to understand its physical status, whether to fit this water for fish culture practices or not. The objective of the present study is to Assess the Physico-Chemical parameters of Thimmapur Lake in Warangal District.

STUDY AREA

An important fresh water lake in Warangal district has been identified to assess its water quality. This lake located at Thimmapur village. The objective of the study is to take up fish culture in this lake. This lake is located 69°26′ 43″ longitude and 15°37′ 18″ latitude. The submergence area is 23 Acres. Length of Bund is 1100 Million Cubic Feet. Weir and Sluice are present in this lake. To assess the water quality, water samples have been analyzed for a period of one year from February 2015 to January 2016.

Figure 1: Satillite Image of Thimmapur Fresh Water Lake

MATERIAL AND METHODS

In order to collect the water samples from the Thimmapur, four sampling stations were fixed and a composite sample was prepared in order to minimize the error in the water quality if any. The water samples have been analyzed for a period of one year from February 2015 to January 2016. Water samples were collected in every month on specific dates. Only surface water samples were collected by using a clean plastic container to study various physicochemical and biological parameters. The water samples were always collected during the early hours of the day. Prior to sample collection, all the sampling bottles were thoroughly washed, sun-dried and rinsed with the same water to be collected in the pond. The sampling bottles were labeled with dates and collection sites. Until analysis, the collected water samples were kept in a cool container maintaining the temperature below 25˚C. Water temperature was measured at the pond itself using a mercury-in-glass thermometer graduated in Degree Celsius (0-100°C). The transparency of water was measured by the Secchi disc. The pH, ammonia, total alkalinity and total hardness were determined with Hach's Model FF-2 Aquaculture test kit. Dissolved Oxygen (DO) and BOD were determined by Winkler's method (Singh, and Ram,1971). CO2 is a normal component of natural water. In polluted water, it is formed by the decomposition of the organic matter. It was measured by the Titrometric method. The Turbidity was determined using a Hach ratio Turbidimeter as described by APHA (2000). The electrical conductivity was measured with a conductivity meter (Lovibond US meter, type CM-21). The Total Dissolved Solids (TDS) were measured by filtering the water sample to remove the particulate matter, the filtrate evaporated to dryness and the residue weighed. The TDS was calculated as described by Boyd (1979). The exact amount of sulphate was measured from the standard curve of standard sulphate solution. Phosphates were measured by Ammonium Molybdate Stannous Chloride Method. Nitrate is the most highly oxidized state of the element found in the water. It was measured by Brucine method. Sodium and potassium ions were estimated by the flame photometric method.

Statistical Analysis

The data obtained were subjected to Analysis of Variance using the Statistical Analysis System User's Guide (SAS, 1999). Duncan's Multiple Range Test (Duncan, 1955) was performed to compare the means of the stations at $P = \leq 0.05$ level of significance**.**

RESULTS AND DISCUSSIONS

To evaluate the water quality an attempt has been made to investigate the physicochemical properties of water in Thimmapur lakes in Warangal district. Water plays a vital role in the ecology of flora and fauna. Quantity and quality are the two major issues involved in the use of water. The main purpose of analyzing physical and chemical characteristics of water is to determine the ecological status of a water body. The physicochemical characteristics of water quality may be affected by rainfall, temperature, availability of light. The physicochemical parameters of water enable all life process in a water body and these factors decides that the water is desirable to utilize for human consumption. Therefore any change in any one of the factor directly or indirectly influence the other parameters and in turn the whole water body. The study was carried out for a period of one year from February2015 to January 2016 and the monthly variations in physico-chemical parameters were presented in Table (1&2). The results show the seasonal variation in various parameters in three different seasons such as Premonsoon, Monsoon, Postmonsoon seasons. It is observed that different regions receive variable precipitation and hence meteorological factors governing the physicochemical properties of the pond (Venktesh *et al.,* 2009). Water temperature is an important parameter which influences the onset of fish spawn, the growth

of aquatic vegetation and the BOD of the pond water. The water temperature observed in this lake was normal and suitable for the survival of aquatic life and it is in agreement with the earlier reports (Boyd, 1982) and this is a favorable condition for fish production. Water pH affects the metabolic and physiological processes of fish and also exerts considerable influence on the toxicity of ammonia (ICAR, 2006). The pH of water of Thimmapur Lake was within the desirable limits (Table 1). It is a common feature that the pond water in all areas in india appeared slightly acidic and may need an application of lime although its effect may be minimum on acidity (Ehiagbonare and Ogundiran, 2010 and Huct, 1986). This observation was thoroughly applicable here as no lime has been used in this pond to regulate the pH levels which was ranging from 6.8 to 7.5, which is good for fish production, hence the pond water at Thimmapur was appeared to be more conducive for fish culture. The water transparency was at the range of 20.00 to 63.00cm. The transparency was minimum in the month of August and maximum in January. Bhatnagar Chayya *et al.,* (2007) have reported the minimum transparency (70.5cm) in during the August and maximum (155.6cm) in February. The depletion of transparency might be due to turbidity caused by eroded soil and higher values during post-monsoon period, maybe lesser due to turbulence and decantation of suspended particles. Because Kadam *et al.,* (2007) and Manjare *et al.,* (2010) have noted similar observations from different water bodies in Maharastra. Ammonia is the second gas of its importance in fish culture and it significantly contributes to the good fish production is overwhelming. Ammonia is introduced into the pond through dead phytoplankton, leftover feed, dead and decayed organic matter. Fishes are very sensitive to un-ionized ammonia and they need an optimum range of 0.02 to 0.05mg/l (ICAR, 2006). Robinette (1976) reported that 0.12mg/l ammonia caused reduction of growth and gill damage in Channel Catfish. From the present study, it is observed that the ammonia levels of this Lake water were higher than the desired range which may affect the growth of fish. The rise of ammonia levels may have resulted from overfeeding, protein-rich excess feed, a decay of leftover feed generally liberates toxic ammonia gas, which in conjunction with the fishes and the excreted ammonia may accumulate and ammonia rises to dangerously high levels. The higher ammonia content formed in the water may be attributed to the decomposition of various components in the pond water adding to the enhancement of ammonia content. Oxygen is a basic component for the body activities of the fish. It is induced into the pond mainly through photosynthesis by aquatic green plants and from the air. The dissolved oxygen in water is essential to all chemical and biochemical processes which occur in natural waters, and it is necessary for the survival of fish and other aquatic organisms. Thus it is the main indicator of the ecosystem (Ilijevic *et al.,* 2012). Dissolved oxygen is an important indicator of water quality and its productivity. The dissolved oxygen content in water is the consequence of the equilibrium between oxygen consumption and supply (Svobodová *et al.,* 1993). The levels of dissolved oxygen depend upon the temperature and the time of contact. A dissolved oxygen content of the water is measured as the amount of gaseous oxygen dissolved in an aqueous solution that plays a vital role in the fish culture system as described by Dhawan and Karu (2002) and Ehiagbonare *et al., (*2010). The mean DO values obtained in the present study was 7.2 to 8.5 mg/l and which can sustain aquatic life. These values are in agreement with Saloom and Duncan (2005) who reported the minimum (5.0mg/l) dissolved oxygen for tropical fishes. Limited light penetration and increased DO consumption in the bottom may cause significantly lower DO compare to the top layers of the water column. If this causes depletion of DO to lower than critical levels, a disastrous effect on the aquatic animals include fish may happen. However, no such condition has been observed in this study. Biological oxygen demand indicates a potential parameter for reducing the Dissolving Oxygen content in water and this could result in organisms being stressed, suffocated and eventually leads to the death APHA (1992). The BOD was higher than the desirable levels as reported by (Boyd, 1990). The higher BOD values and their magnitudes may depend upon temperature, a density of plankton,

a concentration of organic matter and the other related factors. Alkalinity is a measure of the total concentration of bases in pond water and It water's ability to resist changes in PH. Alkalinity value provides the presence of natural salts in water and it is a measured as buffering capacity (Gawas *et al.,* 2006), which may be caused due to an evolution of Co_2 during decomposition of organic matter (Venkatesh *et al.,* 2009). A total alkalinity of at least 20ppm is necessary for good pond productivity. As a matter of fact, the Water with high alkalinity and similar hardness levels has a neutral or slightly basic pH and does not fluctuate widely. The values obtained in the present study are appreciable and fall within the desirable range (Boyd, 1979). Turbidity levels in natural waters seldom exceed 20,000mg/l (Irwin, 1945). Turbidity occurs due to organic and inorganic constituents. In fish ponds, water turbidity can result from planktonic organisms or from suspended clay particles. Turbidity restricts light penetration limits, photosynthesis, and production of undesirable macrophysics in ponds (Boyd, 1979). Higher turbidity can cause temperature and DO stratification in ponds. Planktonic organisms are desirable when not excessive, but suspended clay particles are undesirable. It can cause clogging of gills or directly damages tissues of fish. The turbidity of the pond water in the present investigation is within the desirable range and is above the lower limit. Turbidity relates to the amount of materials present in the water. Water from the various ponds vary in solids concentrations depending on the degree of mineralization, amount of suspended clay and abundance of plankton (Boyd, 1982). Excessive organic manuring and accumulated waste feed reported to increase TDS and often leads to poor water quality. In the present investigation, the total dissolved solids were between 37.24 mg/l to 64.82 mg/l. Choudhari *et al.,* (1991) studied the water quality of Chatrilake in Amaravathi city and observed the high (40-80mg/l) TDS values. Total solids ranged between 458-940mg/l. TDS were high in rainy followed by summer and comparatively low in the winter season. High TDS values in rainy season may be attributed to leaching of soil and silt carried in the lake by the ingression water lake from the catchments area. Water hardness is a measure of the alkaline earth metals such as Calcium and Magnesium concentration in water (Ehiagbonare and Ogundiran, 2010). Optimum hardness for aquaculture is in the range of 40 to 400 ppm. Hard waters have the capability of buffering effects of heavy metals such as Copper or Zinc which are in general toxic to fish. The hardness is a vital factor in maintaining good pond equilibrium. Calcium and Magnesium are essential to fish for metabolic reactions, especially in bone and scale formation. Additional hardness and total alkalinity can affect PH through interaction with the carbon dioxide cycle. Hard water has a higher concentration of alkaline earth metals, Thus the water of Timmapur was not hard but softer. The Electrical Conductivity (EC) was an average of 115.06 to 163.18 µmhos/cm. These values show the extent to which the ponds contain dissolved solids and which enter the pond water through pollutants. This Could be detrimental to the survival of aquatic life in the pond (Boyd,1982) who stated that Specific Conductivity for fresh water often ranges from <25 to >500µmhos/cm, but in some polluted waters it may reach 10,000 µmhos/cm. and the Specific Conductivity of Thimmapur pond is within the acceptable limits. It is observed that the all the parameters of the pond waterfall within the permissible limits (FEPA, 1991 and WHO, 1986) and it standards good for fish culture. Chloride anion is generally present in natural waters. Chloride concentration is higher in organic wastes and its higher concentration in natural water is a definite indication of pollution of water by the domestic sewage. The ecological significance of chloride lies in its potential to regulate salinity of water. Most of the water soluble salts in a pond environment generally remain in Cl^- form and hence the amount of Cl^- ions in pond water indicates very closely the amount of soluble salts present in it. The optimum concentration of chloride ion in fresh water aquaculture are not thoroughly studied, however, it is reported that1-100ppm concentrations are usually considered to be favorable (Chattopadhyay, 1998). The higher content of chlorides was recorded in summer and lower in rainy (Sarma *et al*., 2007) recorded the range of chlorides as in between 13.5-24mg/l. High chloride content in summer could be due on their

concentration as a result of evaporative water loss. Lowering of chlorides in the rainy season could be attributed to the dilution effect and renewal of water mass after summer stagnation. However, the standard limit set by WHO is 250ppm. This pond has recorded less than the WHO standards. Sodium and Potassium is one of the major cations in water and soil. Fishponds are usually considered to be fairly well supplied with potassium (Dwivedi *et al*.,2002). High clay and organic matter content of productive fish pond soils (Singh and Mathur, 2005) associated with alkaline pH values usually tend to maintain moderate to the good amount of potassium (K) in pond soil and water (Chattopadhyay, 1998). However, with increasing use of N and P fertilizers, potassium is gradually becoming the limiting nutrient, and estimation of potassium ion in pond water is becoming important (Chattopadhyay, 1998). The potassium ion concentration did not show significant concentration with any other parameter. Generally, sodium (Na) is not included in the regular analysis of pond water. However, in brackishwater ponds Na occurs in **very** high concentration and determination of this element may be felt necessary. In the present study, the sodium ion content was low ranging from 3.8 ppm to 7.3 ppm.

CONCLUSIONS

Present work was carried out on Thimmapur Fresh water lake in Warangal district, Telangana State, India for a period of one year i.e. 2015 to 2016. The results on physico-chemical parameters of water clearly indicate that the lake is highly productive in nature. The water quality parameters were high during post-monsoon compared to pre-monsoon and monsoon seasons. The results were showed significant seasonal variations in some physicochemical parameters and the water is good for fish culture practices.

Table 1: Seasonal Variations in Physico-Chemical Parameters of Thimmapur Fresh Water Lake

Month	SO4 mg/l	Nitrate mg/l	Ammonia (ppm)	Na (ppm)	K (ppm)	EC (µmhos/cm)	Cl mg/l	PO4 mg/l
PRE MONSOON								
Feb-15	34.82 ±2.88	0.30 ±0.03	1.002 ±0.04	3.8 ±0.03	1.73 ±0.01	115.06 ±6.54	40.5 ±1.67	1.87 ±0.13
Mar-15	38.56 ±1.17	0.35 ±0.02	1.09 ±0.31	4.1 ±0.21	1.84 ±0.21	123.42 ±3.08	45.6 ±±4.1	1.91 ±0.12
Apr-15	43.49 ±2.37	0.39 ±0.01	1.17 ±0.24	4.8 0.21	1.88 ±0.17	129.74 ±4.21	48.2 ±2.8	2.03 ±0.98
May-15	46.11 ±3.11	0.42 ±0.02	1.28 ±0.15	5.4 ±0.13	1.95 ±0.81	136.91 ±5.17	59.3 ±6.1	2.37 ±0.32
MONSOON								
Jun-15	48.36 ±1.50	0.51 ±0.01	1.35 ±0.18	6.1 ±0.23	2.08 ±0.42	149.39 ±5.12	44.8 ±4.2	2.89 ±0.74
Jul-15	52.14 ±2.16	0.54 ±0.02	1.47 ±0.54	6.7 ±0.14	2.14 ±0.28	151.66 ±5.18	47.8 ±5.6	3.01 ±1.09
Aug-15	53.43 ±1.97	0.57 ±0.04	1.52 ±0.11	7.3 ±0.11	2.21 ±0.31	158.82 ±6.59	39.3 ±3.8	2.60 ±0.65
Sep-15	48.31 ±2.97	0.64 ±0.05	1.58 ±0.21	7.0 ±0.01	2.20 ±0.16	163.18 ±5.98	36.0 ±4.3	2.40 ±0.44
POST MONSOON								
Oct-15	41.56 ±3.85	0.60 ±0.02	1.32 ±0.24	6.2 ±0.10	2.08 ±0.31	154.11 ±8.15	49.4 ±3.2	2.10 ±1.0
Nov-15	37.69 ±2.67	0.55 ±0.01	1.28 ±0.14	5.9 ±0.16	1.91 ±0.19	160.32 ±43.98	46.5 ±4.6	1.84 ±0.23
Dec-15	36.99 ±1.19	0.54 ±0.01	1.10 ±0.24	5.4 ±0.21	1.88 ±0.09	149.37 ±5.25	42.1 ±3.2	1.81 ±0.89
Jan-16	36.00 ±2.59	0.48 ±0.01	1.09 ±0.08	4.7 ±0.13	1.81 0±.1	142.92 ±3.87	40.9 ±1.6	1.76 ±0.32

Table 2: Shows Seasonal Variation in the Physico-Chemical Parameters of Thimmapur Fresh Water Lake

Month	Temp °C	Turbidity (ppm)	Total Dissolved Solids (mg/l)	Transparency (cm)	pH	DO (mg/L)	BOD (mg/l)	Free CO2 Mg/L	Alkalinity mg/l
PRE MONSOON									
Feb-15	26.8 ±2.90	24.00 ±1.00	37.24 ±4.16	63 ±5.1	7.10 ±1.66	7.2 ±0.3	3.89 ±0.074	1.31 ±0.03	39.40 ±2.80
Mar.14 Mar-15	26.2 ±1.13	34.1 ±2.43	43.18 ±2.87	48 ±4.0	6.90 ±0.46	7.4 ±0.1	4.98 ±0.14	1.33 ±0.89	42.35 ±4.86
Apr-15	27.4 ±1.68	44.5 ±3,60	59.42 ±4.15	56 ±2.8	7.1 ±0.96	7.5 ±0.4	5.32 ±1.11	1.36 ±0.46	44.28 ±3.74
May-15	29.6 ±1.70	56.11 ±2.87	62.31 ±5.84	63 ±3.9	7.3 ±1.09	7.8 ±0.3	5.74 ±0.91	1.89 ±0.88	48.59 ±3.84
MONSOON									
Jun-15	28.9 ±2.14	48.31 ±3.54	64.82 ±4.94	51 ±2.4	7.5 ±0.96	8.2 ±0.4	5.91 ±1.09	2.0 ±0.88	51.72 ±5.37
Jul-15	28.4 ±2.40	42.74 ±3.42	59.11 ±3.83	49 ±1.8	7.2 ±0.87	8.4 ±0.3	6.1 ±1.34	2.2 0.67	54.86 ±4.72
Aug-15	28.0 ±2.10	35.78 ±1.50	52.37 ±6.81	25 ±1.0	7.0 ±0.91	8.5 ±0.3	6.32 ±1.51	2.4 0.67	60.24 ±4.39
Sep-15	27.8 ±1.43	28.44 ±2.56	49.69 ±5.48	29 ±3.5	6.8 ±0.31	8.2 ±0.4	5.57 ±0.95	2.45 0.65	65.28 ±4.57
POST MONSOON									
Oct-15	27.4 ±3.18	25.56 ±3.11	46.88 ±3.72	43 ±1.7	6.8 ±0.52	8.1 ±0.4	5.39 ±0.76	2.68 ±0.66	58.76 ±4.11
Nov-15	26.9 ±4.11	22.41 ±1.32	41.93 ±4.22	49 ±3.2	7.1 ±0.67	8.0 ±0.2	5.31 ±0.67	2.77 ±0.54	52.36 ±5.28
Dec-15	24.5 ±1.60	19.00 ±2.60	40.25 ±4.86	60 ±2.3	7.3 ±0.64	7.5 ±0.3	5.28 ±0.60	2.88 ±0.67	51.94 ±2.86
Jan-16	22.2 ±2.11	20.10 ±1.90	39.00 ±5.12	72 ±1.9	7.5 ±0.61	7.4 ±0.2	5.21 ±0.78	3.0 ±0.44	47.36 ±3.49

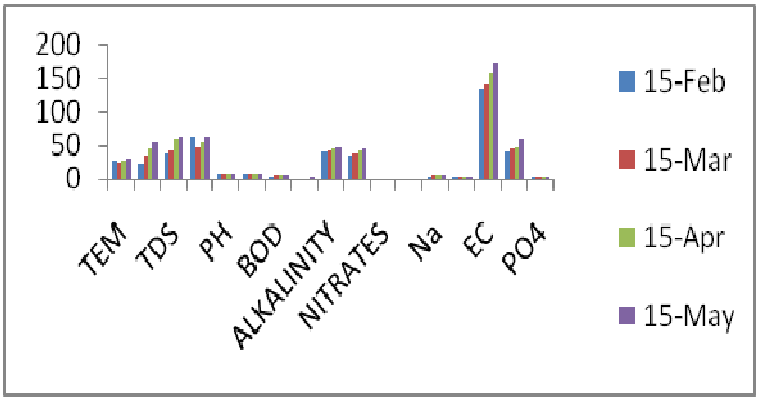

Figure 1: Physico-Chemical Parameters of Thimmapur Fresh Water Lake in during Pre-Monsoon Period

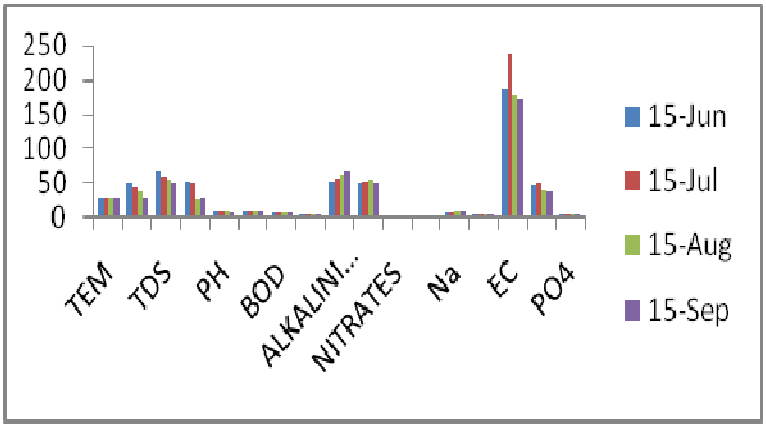

Figure 2: Physico-Chemical Parameters of Thimmapur Fresh Water Lake during Monsoon Period

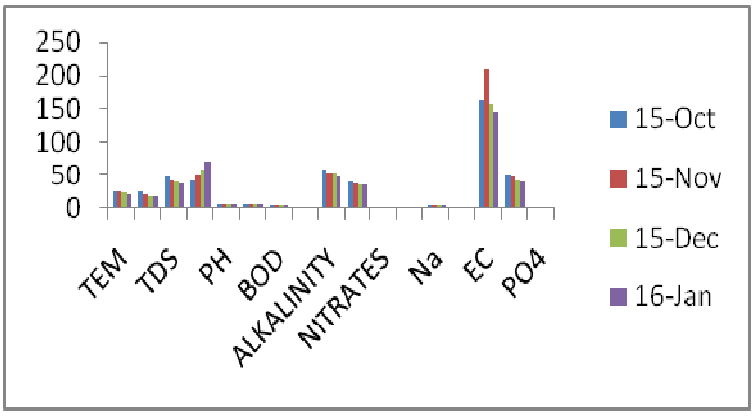

Figure 3: Physico-Chemical Parameters of Thimmapur Fresh Water Lake during Post-Monsoon Period

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