International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: SJIF: 5.995
Available Online at www.journalijcar.org
Volume 6; Issue 11; November 2017; Page No. 7602-7606
DOI: http://dx.doi.org/10.24327/ijcar.2017.7606.1189

Research Article

STUDIES ON SEASONAL VARIATIONS OF PHYSICO-CHEMICAL PARAMETERS IN A FRESH WATER LAKE AT UPPARAPALLE, WARANGAL DISTRICT, TELANGANA, INDIA

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A R T I C L E I N F O

Article History:
Received 11th August, 2017
Received in revised form 4th September, 2017
Accepted 3rd October, 2017
Published online 28th November, 2017

Key words:
Freshwater Lake, Physico-chemical parameters, Fish culture.

A B S T R A C T

In order to comprehend the complex biological interactions occurring within an aquatic ecosystem, an assessment of its physico -chemical conditions hold a momentous position. Any changes that occur in these parameters have a direct impact on the biota inhabiting therein. The present study is an investigation that was carried out on the seasonal variations in the physico-chemical parameters of the Upparapalle fresh water fish pond in Warangal District. The study has been carried out for a period of one year i.e., from February, 2015 to January, 2016. The Temperature was ranging from 23.2 to 29.40°C, pH was ranging from 6.90 to 7.40, DO content was from 7.6 to 8.4 mg/l, BOD ranged from 2.5 to 6.1 mg/l ,Total Alkalinity was 39.0 to 61.29 mg/l, TDS varied from 31.65 to 49.11 mg/l, Turbidity was ranging from 27.8 to 50.2 ppm, Free CO2 from 1.26 to 2.4 mg/l, EC was from116.0 to 154.62 µmhos/cm, Chlorides from 38.48 to 59.36 mg/l, Phosphates from 1.76 to 2.15 mg/l, Sulphates from 29.1 to 56.17 mg/l, Nitrates from 0.27 to 0.63 mg/l, Ammonia content from 0.95 to 1.57 ppm, Sodium from 4.0 to 6.9 ppm, and Potassium from 1.86 to 3.1 ppm. were analysed. These parameters vary from month to month and in three different seasons in an year i.e., Summer, Rainy and Winter seasons. The results showed that the variation in these parameters in four at the different sampling stations. The influence driven by these results showed that, This Fresh water fish pond is quite suitable to take up fish culture in Warangal district. That's how the fish culture practices taken up in this pond certainly is an economical one, however the conclusion is drawn.

INTRODUCTION

Water is life. No life can exist without water. Water resources are of critical importance to both natural ecosystem and human development. It is absolutely essential for domestic purposes such as cleaning, cooking, bathing, carrying away wastes, and for irrigation, power generation, industries, navigation, propagation of wild life, fisheries, recreation, aesthetics etc. Manifold increase in population has resulted in a rapid decrease of the ground water levels,it is also adversly affected by the population explotion. Water, the matrix of life is exposed to pollution, unhealthy environment, resulting in human affliction and diseases transmission due to rapid industrialization and population. Acquiring potable water is a day to day struggle for most of the people in the Warangal district. Hence, water quality monitoring is essential for the assessment of water pollution. Regular monitoring of different water bodies is essential to assess fitness of water for human utility. The healthy aquatic ecosystem is dependend on the physico-chemical and biological characterstics of water (Venkatesharaju *et al.,* 2010).

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There has been a talk on pollution everywhere as the natural fresh water bodies in many areas are being turned into polluted water bodies due to several reasons , especially due to human activity including discharge of urban and rural sewage , effluents from industries, detergents, organic matter, solid wastes, thermal pollutants and disposal of dead bodies etc. Fish production is also hampered since the aquatic organisms constitute a vital link in the food chain in the aquatic ecosystem and its productivity, which directly depends on physico-chemical factors of the water body. All living organisms have tolerable limits of water quality parameters in which they perform optimally. The Optimum fish production is totally depends on the physical, chemical and biological qualities of the water body. Hence, successful pond management requires an understanding of water quality. Water quality is determined by variables like Temperature, PH, Electrical Conductivity, Total Dissolved Solids, Dissolved Oxygen, Biological Oxygen Demand, Turbidity, Free Carbondioxide, Alkalinity, Carbonates, Bicarbonates, Hardness, Chlorides, and Sulphates, Nutrients like Nitrates, Phosphates Primary productivity and Plankton population etc. These parameters vary from month to month and also in three different seasons in an year i.e., Summer, Rainy and Winter in an year. However, the present chapter would provide the basic

guidelines for the fish farmers in order to obtain high fish yield in low inputs through maintaining water quality parameters.

Study Area

Most of the fresh water bodies in Warangal district have become polluted for the past several years. To evaluate the water quality an effort was made to investigate the water body i.e Upparapalle lake in the district. It is located 79° 37' 13" longitude and 17° 49' 18" latitude. The Submergence area is 36 Acres; Length of Bund is 1400 Million Cubic Feet. Weir and Sluice are present in this lake. This lake shows good diversity of Icthyofauna along with other fauna.

MATERIAL AND METHODS

Sampling Programme

To assess the water quality parameters and the suitability of water for fish culture, the water samples were collected at four identified sampling stations and a composite sample was prepared in order to minimize the error. The water samples have been analysed for a period of one year from February, 2015 to January, 2016.The water samples were collected during early hours of the day and usually in the first week of every month. 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 and they were kept in a cool container maintaining temperature below 25˚C till the analysis completed. For the analysis of chemical parameters the water samples were collected in plastic cans and brought to the laboratory, physico-chemical parameters were analysed as the procedure given in APHA(2000), Kodarkar (1992), Bhalerao (1998) and Khana (2004).

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 = ≤ 0.05 level of significance.

RESULTS AND DISCUSSION

The physico-chemical parameters of the water samples collected from Upparapalle Lake in Warangal District were presented (Table 1 & 2) and its variations across the seasons were graphically presented in Figure 1,2&3

Fig 1 Satillite Image of Upparapalle Lake

The temperature plays an important role for controlling the physico-chemical and biological parameters of water and considered as one among the most important factors in the aquatic environment particularly for freshwater (Singh and Mathur, 2005). In the present study, the minimum water temperature was 23.2°C ± 1.50 which was recorded minimum in the month of December and maximum was 29.4°C ± 1.60 recorded in the month of May. pH is the indicator of fertility and potential productivity. Water pH affects the metabolic and physiological processes of fish and also exerts considerable influence on toxicity of ammonia (ICAR 2006). This observation was thoroughly applicable here as no lime has been used in this pond to regulate the pH levels which is from 6.9 ± 1.08 to 7.4 ± 0.58 which is good for fish production, therfore the water of Upparapalle lake was seems to be more conducive for fish culture. Because the acceptable range would be 6.5 to 9.0. Fish can become stressed in water with a PH ranging from 4.0-6.5 and 9.0-11.0. Fish growth is limited if the pH of the is <6.5, reproduction ceases and fry can die at pH<5.0 (Boyd , 1982). While PH is more than 9.0 it is unsuitable for fish growth (Swingle, 1967 and Manjare *et al*., 2010) and they also mentioned that the minimum PH value was recorded during winter and maximum during summer season, which was case in the present study too. The water transparency was estimated, which was ranging from 25 ± 1.2 to 50 ± 1.4.cm. The low transparency rate recorded in the present study might be due to turbidity caused by eroded soil and it was high during post monsoon period, which may be due to turbulence and decantation of suspended particles. Kadam *et al.,* (2007) and Manjare *et al.,* (2010) have also reported similar observations from different water bodies in Maharastra. Electrical Conductivity is the numerical expression of waters ability to conduct the electrical current. Most dissolved inorganic substances are in the ionized form in water and contribute to conductance. EC was ranging between 116.0 ± 4.98 and 154.62±5.76µmhos/cm. Ammonia is introduced into the pond through dead phytoplankton, left over feed, dead and decayed organic matter. Fishes are very sensitive to un-ionized ammonia and needs an optimum range of 0.02-0.05mg/l (ICAR, 2006). (Robinette, 1976) reported that 0.12mg/l NH3 caused reduction of growth and gill damage in Channel Catfish. From the values of present study, It is observed that the levels of Ammonia in this pond water was higher than desired range which may adversely affect the growth of fish. The Dissolved Oxygen (DO) content of the water body is an important parameter to be determined, since the existence of aquatic life intimately linked with the availability of oxygen for their survival. The level of dissolved oxygen depends on the temperature and the time of contact. 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 biology of fish culture (Dhawan and Karu 2002 and Ehiagbonare *et al.,*2010). The mean DO values obtained in this ponds range from 7.6 ± 0.2 to 8.4 ± 0.3 mg/l and which can sustain aquatic life. The BOD values were higher than the desirable levels as reported by (Boyd, 1990). The higher BOD values and their magnitudes may depend on temperature, density of plankton, concentration of organic matter and the other related factors. Biological oxygen demand indicates as a potential parameter for reducing the Dissolving Oxygen content in water and this could result in organisms being under stress, suffocated and eventual leads to the death (APHA, 1992). Alkalinity is a measure of the total concentration of bases in pond water and it is the water's ability to resist changes in pH.

Table 1 Seasonal Variations of some Physico-Chemical Parameters of Fresh water Lake Upparapalle

Month	Temp (0 C)	Turbidity (ppm)	Total Dissolved Solids(mg/L)	Trans parency (cm)	pH	DO (mg/L)	BOD (mg/L)	Free CO2 (mg/L)
Premonsoon								
Feb-15	27.00 ±2.90	27.80 ±1.89	36.00 ±1.66	53 ±1.0	6.90 ±1.08	7.6 ±0.2	2.5 ±0.09	1.26 ±0.01
Mar-15	27.10 ±1.00	34.82 ±1.85	38.52 ±1.50	44 ±1.5	7.10 ±0.50	7.8 ±0.2	4.98 ±0.16	1.28 ±0.18
Apr-15	27.5 ±1.50	38.79 ±2.15	40.25 ±2.59	47 ±2.1	7.25 ±0.44	7.7 ±0.3	2.9 ±0.80	1.31 ±0.45
May-15	29.40 ±1.60	45.26 ±1.66	43.51 ±1.49	49 ±1.8	7.20 ±1.50	7.9 ±0.2	3.1 ±0.59	1.37 ±0.38
Monsoon								
Jun-15	29.20 ±1.00	49.55 ±1.10	47.93 ±2.06	50 ±1.9	7.36 ±0.55	8.2 ±0.3	3.6 ±0.33	1.43 ±0.36
Jul-15	29.00 ±2.00	50.20 ±1.40	49.11 ±1.59	50 ±1.4	7.40 ±0.58	8.3 ±0.4	6.1 ±0.50	1.57 0.46
Aug-15	28.50 ±2.15	43.88 ±1.58	45.50 ±2.85	45 ±2.1	7.15 ±0.37	8.4 ±0.3	3.9 ±0.62	1.63 0.41
Sep-15	27.5 ±1.65	41.80 ±1.00	39.56 ±2.44	36 ±2.7	7.09 ±0.50	8.4 ±0.2	4.3 ±0.51	1.72 0.33
Postmonsoon								
Oct-15	27.00 ±1.00	38.64 ±2.00	35.20 ±1.50	44 ±1.5	6.95 ±0.65	8.2 ±0.2	4.7 ±0.42	1.76 ±0.30
Nov-15	26.20 ±1.50	35.80 ±1.40	34.28 ±2.36	50 ±1.3	7.09 ±0.46	8.0 ±0.3	4.9 ±0.15	1.85 ±0.25
Dec-15	25.5 ±1.53	32.76 ±1.58	33.75 ±2.05	58 ±1.5	7.18 ±0.26	7.7 ±0.2	5.4 ±0.32	1.89 ±0.21
Jan-16	23.2 ±1.50	30.05 ±1.42	31.65 ±2.00	65 ±1.2	7.27 ±0.36	7.9 ±0.4	5.5 ±0.65	2.4 ±0.50

Table 2 Seasonal Variations of some Physico-Chemical Parameters in Fresh water Lake Upparapalle

Month	Alkalinity mg/l	Cl mg/l	PO4 mg/l	SO4 mg/l	Nitrates mg/l	Ammonia (ppm)	Na (ppm)	K (ppm)	EC (µmhos/cm)
Pre Monsoon									
Feb-15	39.00 ±4.50	38.48 ±2.45	1.76 ±0.10	29.10 ±1.52	0.27 ±0.01	0.95 ±0.05	4.0 ±0.16	1.86 ±0.02	116.0 ±4.98
Mar-15	43.15 ±1.40	41.53 ±1.9	1.78 ±0.13	34.17 ±2.85	0.34 ±0.03	1.00 ±0.15	4.6 ±0.19	1.94 ±0.41	119.20 ±2.52
Apr-15	46.23 ±1.58	45.80 ±1.4	1.79 ±0.41	38.85 ±2.39	0.37 ±0.01	1.17 ±0.14	5.1 0.41	2.07 ±0.22	123.72 ±2.68
May-15	49.72 ±2.75	49.38 ±5.1	1.84 ±0.11	41.64 ±2.63	0.46 ±0.05	1.13 ±0.23	5.4 ±0.25	2.17 ±0.35	129.30 ±3.81
Monsoon									
Jun-15	53.82 ±2.76	52.72 ±2.2	1.89 ±0.25	45.66 ±1.58	0.58 ±0.06	1.19 ±0.28	5.8 ±0.19	2.24 ±0.26	132.98 ±4.10
Jul-15	56.95 ±3.17	55.68 ±2.4	1.95 ±0.51	49.53 ±1.16	0.61 ±0.03	1.29 ±0.10	6.1 ±0.20	2.12 ±0.35	139.21 ±2.70
Aug-15	58.11 ±1.50	59.36 ±1.8	2.07 ±0.36	56.17 ±1.25	0.63 ±0.03	1.47 ±0.22	6.8 ±0.25	2.29 ±0.16	141.54 ±4.82
Sep-15	61.29 ±1.93	53.52 ±1.5	2.15 ±0.23	51.68 ±1.58	0.58 ±0.16	1.53 ±0.28	6.9 ±0.38	3.10 ±0.52	154.62 ±5.76
Post Monsoon									
Oct-15	58.57 ±2.15	50.34 ±1.8	2.10 ±0.21	50.07 ±2.60	0.54 ±0.10	1.57 ±0.24	5.7 ±0.51	2.25 ±0.31	139.47 ±3.90
Nov-15	51.20 ±2.30	49.19 ±2.7	2.09 ±0.14	47.95 ±1.34	0.48 ±0.08	1.45 ±0.19	5.9 ±0.23	2.11 ±0.14	129.85 ±6.48
Dec-15	48.45 ±1.62	48.88 ±2.6	1.93 ±0.18	46.42 ±1.27	0.43 ±0.04	1.36 ±0.24	5.17 ±0.48	2.05 ±0.15	127.36 ±5.00
Jan-16	45.00 ±1,35	46.60 ±1.9	1.87 ±0.15	41.39 ±1.00	0.45 ±0.02	1.24 ±0.17	4.97 ±0.61	1.94 0±.11	125.00 ±4.67

Alkalinity provides natural salts to the water and it is a measure of buffering capacity (Gawas *et al.,* 2006). It may be caused due to 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 have a neutral or slight basic pH and does not

fluctuate much (Boyd ,1979). Hard water has a higher concentration of alkaline earth metals, Thus the water in this lake under study was not hard but softer, thus the values obtained in this study are within desirable range. Turbidity occurs due to organic and / or inorganic constituents. In fish ponds, water turbidity can result from planktons or from suspended clay particles.

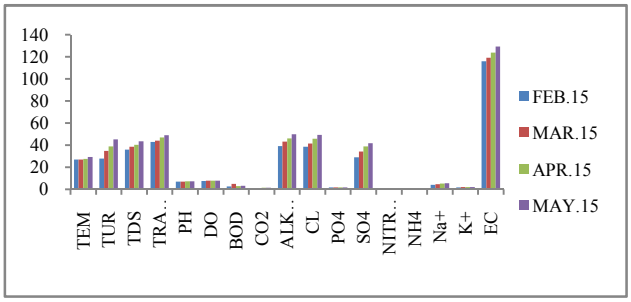

Fig 1 Physico-Chemical Parameters in Fresh water Lake Upparapalle during Pre monsoon period

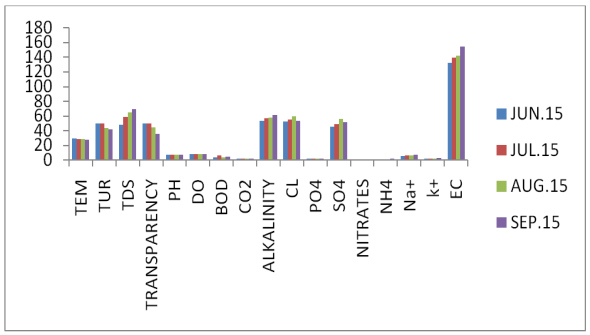

Fig 2 Physico-Chemical Parameters in Fresh water Lake Upparapalle during Monsoon period

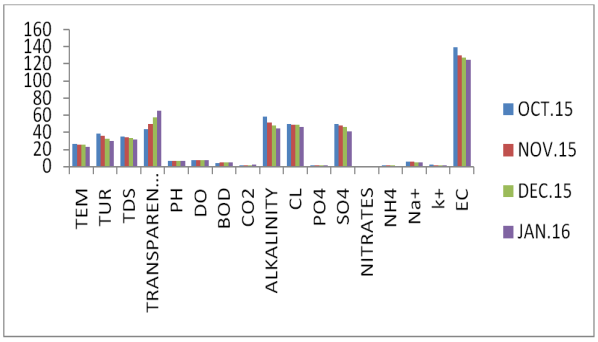

Fig 3 Physico-Chemical Parameters in Fresh water Lake Upparapalle during Post monsoon period

Turbidity restricts penetration of light and limits photosynthesis and also production of undesirable macrophytes in ponds. 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 direct injury to tissues of fish. The turbidity values obtained in this pond are within the desirable range. Excessive organic manuring and feed wastage have been reported to increase Total Dissolved Solids and often leads to poor water quality (ICAR 2006). This could have been responsible for the variation in TDS values. In the present investigation, the total dissolved solids ranged between 31.65mg/lit. to 49.11mg/lit. Choudhari *et al.,* (1991) studied water quality of Chatri lake in Amaravathi city and noted TDS values of 40-80mg/lit. Total solids ranged between 458-940mg/lit. TDS were high in rainy season followed by summer and comparatively low in winter. High TDS v in rainy season may be attributed to leaching of soil and silt carried in the lake by ingression waterlake from the catchments area. The content of the electrical conductivity was at average levels of 116.0±4.98 to 154.62±5.76 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 these ponds. (Boyd, 1982). stated that specific Conductance for fresh water often range from <25 to >500µmhos/cm, but in some polluted waters it may reach 10,000 hs/cm. hence values obtained in this study fall within the acceptable limits. In comparison, the observed values of the parameters fall within FEPA(1991) and WHO(1986) (Venkatesharaju *et al*., 2010). Standards for good water for pond fish culture. Chloride is considered to be an important factor as it is one of the essential ions in assessing the status of natural water bodies (Hutchinson, 1957). He also pointed out that chloride has considerable importance among the halides in the aquatic environment. Chlorides occur in most freshwater, as the salts of Sodium or Calcium, Chloride ions are essential for plants and animals. In the present investigation values of chlorides ranged between 38.48 ±2.45 to 59.36 ± 1.8 mg/lit. Generally unpolluted water contents low concentration of chloride i.e lower than 10mg/lit. Natural sources of chloride in waters are the dissolution of salt deposits such as Magnesium Chloride (MgCl), Potassium Chloride (KCl), Sodium Chloride (NaCl) and weathering of sedimentary rocks. . Sodium and Potassium is one of the major cations in water and soil. Fish ponds 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 good amount of potassium (K) in pond soil and water (Chattopadhyay, 1998). Sulphates found in the range of 29.10 ± 1.52 mg/l to 56.17 ± 1.25 mg/l, at all the sampling stations. Nitrates and phosphates are essential in small quantities but harmfull in excess. In the present investigation nitrates were ranging between 0.27 ± 0.01 and 0.63 ± 0.03 mg/lit. phosphates were ranging between 1.76 ± 0.10 and 2.15 ± 0.23 mg/lit.

CONCLUSION

The statistics obtained from the physico-chemical analysis of the water samples in the Upparapalle lake, Warangal District clearly indicates that all the physico-chemical parameters are at nearly permissible limit at all the 4 stations. Results of water quality assessment clearly shows that most of the water quality parameters slightly higher in the wet weather conditions rather than the dry. This study observed that fish farmers in the investigated areas used slightly acidic water for fish production while ammonia, BOD and electrical conductivity levels were fairly high. The high content of BOD will deplete the DO amount which will eventually be harmful to aquatic life. This present situation may drastically affect the aquatic life and their growth. This is a clear indication that significant amounts of pollutants are entering into the pond and this may pose threat to the water quality in the near future. It is suggested that the lake water needs to analyze at regular intervals. Farmers should be educated on better management practices. It is therefore concluded that this baseline data generated would

be help further planning and future management to develop fresh water ponds for better water quality and production of fish. To sustain the ecology and aquatic life in the lake, certain measures must be taken by the civic bodies to combat the pollution rate in the lake.

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How to cite this article:

Sandhya K and Benarjee G (2017) 'Studies on Seasonal Variations of Physico-Chemical Parameters in A Fresh Water Lake at Upparapalle, Warangal District, Telangana, India', *International Journal of Current Advanced Research,* 06(11), pp. 7602-7606. DOI: http://dx.doi.org/10.24327/ijcar.2017.7606.1189

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