



SEASONAL VARIATIONS IN WATER QUALITY AND MAJOR THREATS TO NELLORE CHERUVU (TANK), NELLORE DISTRICT, INDIA

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Abstract

Water is the most vital resource for the living beings to survive. India has a vast and varied inland water resource which is considered to be richest in world's nature lakes. The physico-chemical characteristic of Nellore tank has been studied for monsoon, pre-monsoon, post-monsoon in the year. From the results water body was found to be well in the permissible limit of BIS (1998, except pH, DO, BOD and turbidity in some seasons, which may be due to anthropogenic activities in the area, and input of nutrients and other organic and inorganic substances through runoff water from agricultural fields.

Key Words: Water Quality, Degradation, Nellore tank

Introduction

Water pollution is one of the most serious problems faced by man today. The total available water for use in India is estimated to be 1900 billion cubic meters per annum (Sindhu, 2002). About 86% of the water is in the form of rivers, lakes, ponds, streams, dams, and reservoirs. The importance of fresh water resources in maintaining a healthy and prosperous nation in a healthy environment is amply understood from the very existence of the civilizations. On this earth, out of the total global water 3% is in the form of fresh water. Important abiotic factors in an aquatic habitat are pressure, density, light, current temperature, oxygen, carbon dioxide, other gases, dissolved solids, microorganisms, benthos (bottom biota) and nekton (active swimmers) (Maruthi et al., 2013). The life cycle and behavior of these organisms are closely associated with the various environmental conditions to which each organism must be adapted before they can occur and then to exist degradation of aquatic ecosystem has become a universal phenomenon under onslaught of ever increasing anthropogenic activities. The degradation of lentic water body is mainly attributed to

discharge of wastes generated by numerous anthropogenic activities. Environmental factors such as temperature, pH, O₂, CO₂, , nitrate, phosphate and chloride, influence plankton diversity (Ahamed and Sing 1993; Suresh Kumar, 2002) The physico-chemical characteristics of water play a significant role to assess the quality of water for its best usage (Sharma and Saran, 2004). In the present study Physico chemical characteristic of Nellore tank has been studied for monsoon, Pre-monsoon, post-monsoon in the year.

Materials and Methods

Sampling collection and preservation

Water samples were collected on monthly basis from sampling stations (April 2011 to 2012). The sub-surface water was collected in triplicate during first week of each month in the early hours of the day (7 a.m. to 9 am). The polyethethlene bottles were used for collection of water samples bottles, were kept in ice bucket and brought to the laboratory for analysis as per A P H A 2005 Procedure (APHA, 2005).

Results and discussion

Ecological status of any water body depends upon the healthy interaction of abiotic and biotic components lentic water bodies, which are characterized by a continual movement of dissolved substances and suspended material result in dynamic interaction between components of ecosystem. Physico-chemical analysis is of immense importance to assess the quality of water for use in drinking, bathing, fishing and industrial process, etc. The physico-chemical characteristics of the four lentic water bodies have been analyzed and discussed as per their monthly and seasonal variations, their relationship etc. (Table-1, 2 & Fig.-1)

Table : 1 Physico-chemical parameters at various season of Nellore Cheruvu (tank)

Except pH and EC all parameters are in mg/l

Sl. No	Parameters	Monsoon	Pre-monsoon	Post-monsoon
1	Air temperature	26.20	31.13	26.73
2	Water temperature	26.06	30.76	26.64
3	pH	7.7	6.84	7.78
4	Turbidity	36.48	25.82	20.55
5	Electrical conductivity	65.03	92.41	53.22
6	Total solids	804.66	1382.33	843.16
7	Total dissolved solids	39.52	57.23	36.06
8	Chlorides	16.66	19.96	15.97
9	Total hardness	132.33	230.83	174.50
10	Total alkalinity	363.16	424.50	402.33
11	Total acidity	12.10	20.08	11.80
12	Nitrate	0.23	2.33	0.97
13	Sodium	16.50	29.55	8.14
14	Potassium	1.56	16.58	2.43
15	DO	4.65	3.93	7.53
16	BOD	2.07	2.81	2.20
17	Phosphate	0.14	0.34	0.25

18	Calcium	5.17	9.2	8.94
19	Magnesium	13.6	14.83	27.56
20	COD	498.66	156.85	70.01
21	Iron	0.13	0.32	0.02
22	Sulphate	179.94	285.68	105.93
23	Free CO ₂	9.98	16.52	10.30

Temperature: The temperature of water is one of the important physical parameter, which directly influences some chemical reactions in aquatic ecosystems. It is also an important parameter for fish and other organisms.

The present study of the atmosphere temperature in the selected tank fluctuated between yearly average of 26.02⁰ C in monsoon, 31.13⁰ C pre-monsoon and 26.73⁰ C in post monsoon. However slight lower temperature value were recorded during monsoon compares to other season and the correlation matrix pooled were showed as 1.00.

The significant correlation between ambient temperature and water temperature was also observed by Power and Pulle (2005).

The pH: pH is an indicator of acid base equilibrium achieved by various dissolved compounds in water i.e. if free H⁺ are more it is expressed acidic (i.e. pH < 7). The pH of the pond water is influenced by the monsoon, temperature and soil conditions (Saksena et al., 2006).

The present study of the pH in the selected tank fluctuated between yearly average of 7.7 in monsoon, 6.84 pre-monsoon and 7.78 in post monsoon. However slightly lower temperature value were recorded during pre-monsoon compared to other season and the correction matrix pooled were shown as Table-2.

The statistical data revealed that pH exhibited significant positive (correlation matrix pooled) and with physico-chemical characteristics such as total alkalinity, phosphates nitrates and sulphates (correlation matrix pooled +05).

Table : 2 Correlation Matrix of Pooled Physico-chemical Parameters versus Physico-chemical Parameters of Nellore Cheruvu (tank)

	AT	WT	PH	EC	TDS	TUR	DO	BOD	FREE (CO ₂)	CL	CA	MG	TH	T.ALK	T.AGI	PO ₄	NO ₃	S ₀ ₄	NA	K
AT	1.00																			
WT	0.97	1.00																		
PH	0.50	0.56	1.00																	
EC	0.86	0.84	0.83	1.00																
TDS	0.92	0.91	0.86	0.95	1.00															
TUR	0.24	0.29	0.13	0.16	-0.6	1.00														
DO	0.38	0.35	0.66	0.21	0.47	0.17	1.00													
BOD	0.67	0.63	0.52	0.37	0.51	0.20	0.43	1.00												
Free Co ₂	0.69	0.68	0.58	0.84	0.79	0.12	0.16	0.01	1.00											

CL	0.23	0.53	-	0.23	0.61	0.52	-	0.03	-	0.04	0.48	0.73	1.00									
CA	0.32	0.32	-	0.25	0.27	0.23	0.29	0.07	-0.39	0.47	0.49	1.00										
MG	0.03	0.05	-	0.13	0.36	0.20	-	0.93	0.71	0.11	-0.05	0.13	0.41	1.00								
TH	0.90	0.90	-	0.77	0.64	0.79	-	0.57	0.14	0.71	0.56	0.28	0.34	0.35	1.00							
T.ALK	0.79	0.80	-	0.57	0.42	0.60	-	0.70	0.59	0.31	0.37	0.13	0.42	0.53	0.95	1.00						
T.ALI	0.86	0.84	-	0.82	0.92	0.92	-	0.09	0.48	0.84	0.50	0.41	0.37	-0.14	0.77	0.62	1.00					
PO ₄	-	-	-	0.44	0.80	0.99	-	0.26	0.21	0.75	0.72	0.65	0.58	0.67	-0.56	0.17	-0.32	1.00				
NO ₃	-	-	-	0.63	0.67	0.58	-	0.91	-0.05	0.41	-	0.72	0.56	0.81	-0.26	0.05	-0.39	-0.38	1.00			
SO ₄	0.04	0.29	-	0.63	0.67	0.71	-	0.32	0.57	0.53	0.66	0.30	0.24	-0.48	0.61	0.33	-0.35	-0.35	0.17	1.00		
NA	0.16	0.40	-	0.59	0.22	0.92	-	0.18	0.71	0.56	0.61	0.50	0.64	0.58	0.67	-0.72	0.58	-0.72	0.68	0.72	1.00	
K	0.98	0.96	-	0.89	0.90	0.94	-	0.24	0.50	0.65	0.72	0.45	0.34	-0.02	0.90	0.77	0.92	0.76	-0.64	0.88	0.89	1.00

Electrical conductivity: Pure water is a poor conductor of electricity, conductivity (specific conductance) of a substance or isolation is the measure of its capacity to conduct electric current. Most of the salts in water are present in the ionic forms, capable of conducting electric current (Maruthi et al., 2013).

The present study of the electrical conductivities in the selected tank fluctuated between yearly average of 65.03 µmhos/cm in monsoon, 92.41 µmhos/cm pre-monsoon and 53.22 µmhos/cm in post-monsoon. however, slightly lower turbidity value where recorded during pre-monsoon compare to other season, and the correlation matrix pooled were showed as Table-2, similar result was reported in extension of higher values of EC which may be attributed to the agriculture run off entering these tanks, similar results were reported by Pati et al. (1986) and Sankaran Unni (1985) who also concluded that conductivity was influenced by agriculture run off.

Total dissolved solids: The compositions of salts are present in natural water body mainly depends upon the nature of bedrocks and soil developed from it. The common lys occurring natural salts are carbonated, bicarbonate, chlorides, sulphates, phosphate and nitrates of calcium, magnesium, sodium, potassium etc. Excessive dissolved solids in drinking water may lead to objectionable taste, and corrosion or encrustation in water distribution system at concentrations approximately in water distribution system. At concentrations approximately greater than 1000 mg/l, the taste of water becomes increasingly unpalatable (Varma and Sharma, 2002).

The present study of the total dissolved solids in the selected tank fluctuated between yearly average of 39.52 mg/l in monsoon, 57.23 mg/l pre-monsoon and 36.06 mg/l in post-monsoon) .However slightly lower TDS value were recorded during post-monsoon and the correlation matrix pooled were shown in table-2. This is in conformity's with the findings of Sreenivasan (1969), Varma and Sharma (2002).

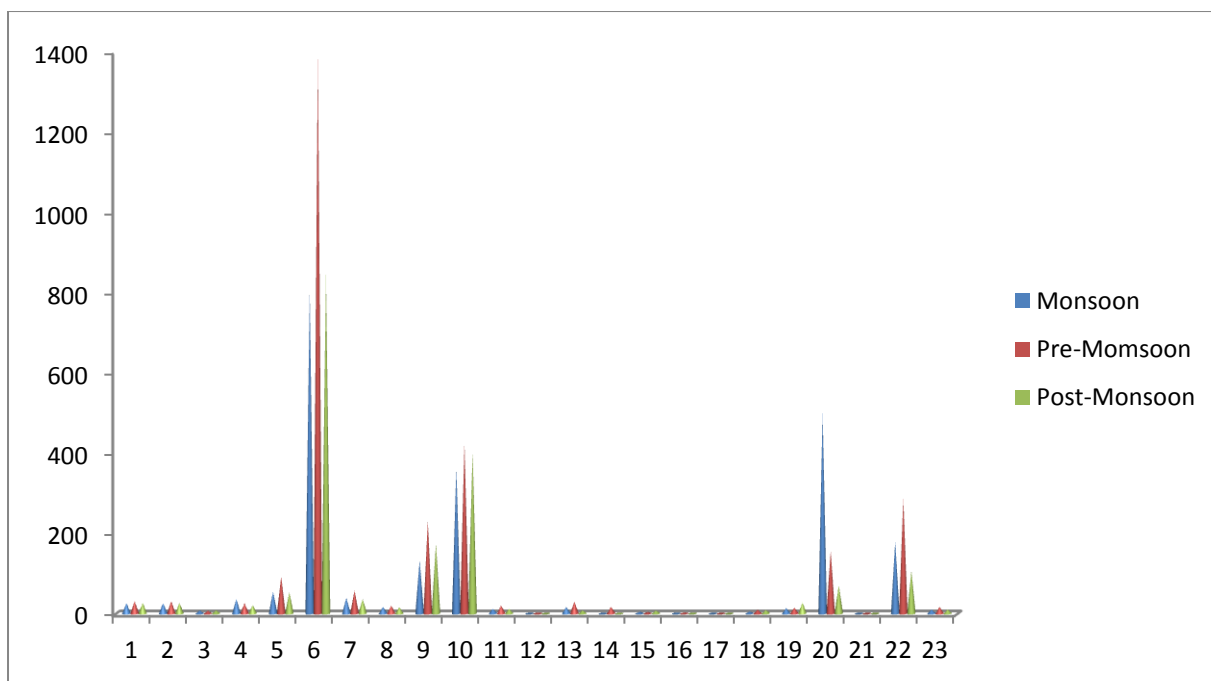


Fig.1 Graphical representation of physico-chemical parameters at various season of Nellore Cheruvu (tank)

Turbidity: Turbidity in natural water bodies is mainly caused by sand, silt, clay, phytoplankton, microorganisms, and organic materials suspended or dissolved in it turbidity affects light scattering, absorption properties and aesthetic appearance in water bodies (Varma and Sharma, 2002).

The present study of the turbidity in the selected tank fluctuated between yearly average of 36.81NTU in monsoon, 25.82 NTU pre monsoon and 20.56 NTU in post-monsoon however, slightly lower turbidity value were recorded during pre-monsoon compare to other season, and the correlation matrix pooled were shown as Table-2.This is in conformity with the findings of Meera and Sultana, (2004) and Mathivanam et al., 2005.

Dissolved oxygen: The dissolved oxygen (DO) is one of the most important factors in any aquatic eco systems. All living organisms are dependent of Oxygen in one form or the other to maintain their biological process that produce energy for their growth and reproduction dissolved oxygen also plays a major role in dissolution and precipitation of inorganic substances in water. The main sources of dissolved oxygen are dissolution from atmosphere and the photo synthesis. The former depends on factors like temperature salinity and density of phytoplankton (Maruthi et al., 2013).

The present study the turbidity in the selected tank fluctuated between yearly average of 4.65 mg/l in monsoon, 3.93 mg/l pre-monsoon, and 7.52 mg/l in post-monsoon. However, slightly lower dissolved oxygen value was recorded during pre-monsoon compare to other season, and the correction Matrix polled where showed as table-2. Swarnalatha and Narasinga Rao (1993) have pointed that polluted water bodies contain less amount of dissolved oxygen, which was witnessed in various report, due to rapid depletion in water level and increased load of organic compounds.

Biological oxygen Demand: The biological oxygen demand (BOD) denotes the pollution strength of the water body; it is a measure to know the organic load in the water. The presence study of the BOD in the selected tank fluctuated between yearly average of 2.07 in monsoon, 2.81 pre-monsoon, and 2.20 in post-monsoon. However, slightly lower BOD values were recorded during monsoon compare to other season and the correlation matrixes pooled were showed as Table-2.

As per the BIS standard 3 mg/l of B O D is permissible in drinking water, considering this only Erannan Kere tank showed BOD less than 3 mg/l, However all the other bodies exhibited BOD values more than 3 mg/l, Hence these water bodies are considered to have comparatively more amount of organic matter.

The BOD was recorded during the month of August and October and relatively high during April and May. This may be attributed to the highest biological activity at high temperature. Similar results were expressed by Ponday et al., 1993 and Maruthi et al., 2012 a, b & c.

Nitrate: Nitrate is the highly oxidized form of nitrogen compounds that is usually in natural waters, nitrate is the end product of decomposition of organic nitrogenous matter. The source of nitrates are drainage from line stock feeds, chemical fertilizers from cultivated land, as well as from domestic and industrial sources, Natural waters in their un-polluted state contain only minute quantities of nitrates, perhaps high concentration of nitrates in drinking is harmful for infants because it causes methenoglobinemia but nitrate is also an essential nutrient for plants and planktons, which they convert in to cell protein (Ponday et al., 1993).

The present study of the nitrate in the saluted tank fluctuated between yearly average of 0.23 mg/l in monsoon, 0.0026 mg/l, pre-monsoon and 0.97 mg/l in post-monsoon. However slightly lower temperature value were recorded during pre-monsoon compare to other season and the correlation matrix pooled were shown as Table-2.

Venkateswarlu (1969) also recorded comparatively higher values of nitrates during monsoon and post-monsoon, and lower concentration were recorded during pre-monsoon season, which is due to the nutrient demand of the growing planktons during pre-monsoon (Pandey and Anuyavarms, 2004), a greater portion of nutrients could be absorbed by rapidly growing species making the water body nutrient poor, this seemed to be the reason why low concentrations' of nitrates and phosphates coin wide with high phytoplankton density during summer, similar variations were also observed by Sukumaran (2002).

Total Hardness: Traditionally water hardness is measured as the capacity of water to react with soap, hard water require more amount of soap to produce leather than soft water, the hardness of water is predominantly caused by divalent cations such as calcium, magnesium and alkaline earth metals such as iron, manganese, strontium etc. (Ponday et al., 1993).

The present study of the total hardness selected tank fluctuated between yearly average of 132.33 mg/l in monsoon, 230.83 mg/l pre-monsoon and 174.5 mg/l in post-monsoon. However slightly lower temperature value were recorded during monsoon compare to other season and the correlation matrix pooled were shown as Table-2.

Seasonal fluctuations of total hardness were recorded low during monsoon season and maximum during post-monsoon and pre-monsoon seasons, however total hardness exhibited a bimodal annual charge with low values in monsoon season. Sunkad and Patil (2004) and Rathor et al., (2006) also reported similar results, whereas Khabade and Mule (2003) reported maximum hardness during summer season.

Sodium: The sources of sodium in natural waters are weathering of rocks and mineral assemblages in the surrounding areas, the principal one being rock salt – sodium chloride, sodium is a cationic composition of water Sunkad and Patil (2004) and Rathor et al., (2006). The present study of the sodium in the selected tank fluctuated between yearly average of 16.50 mg/l in monsoon, 29.55 mg/l pre-monsoon and 8.14 mg/l in post-monsoon. However slightly lower temperature value were recorded during post monsoon compare to other season and the correction matrix pooled were shown as table-2. Season wise the concentration of sodium was high during post-monsoon and low during monsoon season, Reddy (1989) also reported similar trend.

Potassium: Potassium is also a commonly occurring cationic natural salt and is the seventh most abundant element in order of its abundance and found lower than sodium Sunkad and Patil (2004) and Rathor et al., (2006).

The present study of the potassium in the selected tank fluctuated between yearly average of 1.56 mg/l in monsoon, 16.58 mg/l pre-monsoon and 2.43 mg/l in post-monsoon. However slightly lower temperature value were recorded during monsoon. Compared to other season and the correlation matrix pooled were showed in table-2 seasonally the concentration of potassium was low during monsoon and high during pre-monsoon season, similar changes also observed by Khabade and Mule, 2003.

Conclusion

The physico-chemical characteristics of these water body was initiated to be well in the permissible limit of BIS (1998), except pH, DO, BOD and turbidity in some seasons, which may be due to anthropogenic activities in the area, and input of nutrients and other organic and in-organic substances through runoff water from agricultural fields.

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