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Assessment of Water Quality of Singanamala Tank (Sri Rangarayalu Cheruvu), Singanamala, Anantapuramu District, Andhra Pradesh, India

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Abstract: *Various parameters in Singanamala Tank (Sri Rangarayalu Cheruvu), Singanamala were investigated from May 2011 to April 2013 to assess the water quality. The different Physico-chemical parameters like Temperature, pH, TDS, conductivity, salinity, dissolved oxygen, turbidity, alkalinity, free carbon dioxide, chloride, total hardness, calcium, magnesium, phosphates, sulphates, silicates, nitrites, nitrates, BOD and COD were carried out by standard methods. These parameters showed either positive or negative correlation between each other. This analysis reveals these parameters are interrelated with each other. From the data it can be said that water of this tank is not a good quality for culture of fish as well as drinking for animals.*

Keywords: *Singanamala Tank, water quality, Physico-chemical parameters.*

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I. Introduction

The word "tank", is defined as a container for storing water. The need for a water tank is as old as civilization, providing storage of water for drinking, irrigation, agriculture, fire suppression, chemical manufacturing, food preparation as well as many other applications (1). Tank is loosely defined and often used in common parlance to refer to some of the small irrigation reservoirs. Thus, a large number of small man-made lakes are also called tanks in Andhra Pradesh and are thereby excluded from reservoir list. Tanks in Andhra Pradesh are further classified as perennial and long seasonal (2). Andhra Pradesh has (2937 water bodies) 98 small reservoirs, 2800 Tanks, 32 Medium reservoirs and 7 large reservoirs with total surface area of 4,58,507 hectors. Anantapuramu district has (27 water bodies) 22 tanks and 5 reservoirs 6048 hectors (3).

The tank is regularly used for fishing by the local people besides water is used for washing animals, tractors and cloths. Natural calamities are completed beside the tank and dumping of domestic solid waste. Due to this the water of Singanamala tank has become polluted. In India much research has been carried out with regards to assessment of water quality of different tanks some of them are fish pond conservation in Tanjavur (4), Kolong river (5), River Mahanadi (6), Bolinj Ram mandir talao (7), Selected fresh water ponds in relation to fish production in Warangal area (8), Kadamba Tank (9), Urban Pond in Thiruvantapuram district (10), Athiyanoor panchayat (11), Fish pond of Shahdol (12), Eutrophicated costal lake (13), Lalpur pond (14), Two temple ponds of Karnataka (15), Ponds in Anand Panchayath (16) and different pond water of Bilaspur district (17).

Analysis of physico-chemical parameters of water is essential to assess the quality of water for the best usage like drinking, irrigation, fishing, bathing and so on (18). Water quality parameters provide current information about the concentration of various solutes at a given place and time basis for judging the suitability of water for its designated uses and to improve existing conditions (19, 20). In order to assess water quality index, we have carried out the physico- chemical analysis of water and to find the relationship between different physico-chemical parameters in Singanamala tank. There is no information available on this till now.

II. Materials And Methodology

Study area: Singanamala Tank (Sri Rangarayalu Cheruvu) located at Singanamala, Anantapuramu District of Andhra Pradesh. It is about 3 km from Singanamala village and 20 km from Anantapuramu Town. It is largest tank in the district and geographically is located at 14°48’00” N Latitude and 77°43’00” E longitude. Elevation of this tank is 287 meters (944 fts) the Catchment area is 3436.00 acres and existing ayakut is about 5000 acres. The storage capacity of this tank is 0.5 TMC with the depth of 5-9 fts. The main source of water for this tank is rain fall and receives through surface run off during monsoon from Tadakaleruvagu, Erravanka, Vadiyampeta canal and Narasapuramvanka.

Sample Collection and Analysis: Water samples were collected during second week at monthly interval for a period of two consecutive years from May 2011 to April 2013 for the analysis of Physico-chemical parameters. Water samples were collected in acid washed 10 liters' polythene containers below the depth of 5-10 centimeters and collection was usually completed during morning hours between 08 AM and 10 AM. Colour and odour of water was noticed and recorded. For each sample Temperature, pH was monitored at the sampling site using mercury thermometer and digital pH meter. Immediately after arrival into the laboratory the conductivity of the water was measured using the help of conductivity meter.

All parameters were analyzed by following standard methods. The chemicals used in the present investigations were procured from Merck India. All glass ware used was of corning grade manufactured by Borosil India Ltd. Spectrophotometer used for our research work was ELICO double beam, SL210, UV VIS Spectrophotometer. Systronics Water Analyser 371 used with a micro controller was used for measuring pH, Dissolved oxygen (DO), Conductivity, Total Dissolved Solids (TDS), Salinity and Turbidity in water sample. Six replicates of each sample were analyzed for each parameter. Mean of the six replicates were taken for data analysis.

III. Results And Discussion

Temperature: The temperature of water varied between 22.0±0.00°C (January, 2012) 30.0±0.00°C (May 2012) "Fig. A". Temperature showed significant positive correlation with pH, Turbidity, Carbon dioxide, Chlorides, Total hardness, Calcium, Silicates, Phosphates, Nitrates, BOD and COD. It had negative correlation with conductivity, TDS, Salinity, DO, Alkalinity, Magnesium, Nitrites, Sulphates (Table 1,2). Rise in temperature in the month of May was a result of clear atmosphere, high temperature, high rate of evaporation causing decline in water level (21), (22). In January month the temperature remains low due to cold low ambient temperature and short day light (23), (24).

pH: Measurement of pH of was minimum (8.44±0.00) recorded in February and maximum in August (9.46±0.05) "Fig. B". Positive significant relation of pH was noticed with Conductivity, Turbidity, DO, Alkalinity, Chlorides, Total hardness, Nitrates, BOD and negatively correlated with TDS, Salinity, Calcium, Magnesium, Phosphates, Nitrites and COD (Table 1,2). The reduced rate of photosynthetic activity, the assimilation of CO_2 and bicarbonates which are ultimately responsible for increase in pH in the month of August (20), (25).

Conductivity: The monthly variability in conductivity of water has fluctuated between 1.7±0.01 mS (June 2011) and 4.69±0.01 mS (April 2012) "Fig. C". Conductivity showed positive significant relation with TDS, Salinity, Carbon dioxide, DO, Alkalinity, Calcium, Silicates, Nitrates, BOD, COD and showed negative significant correlation with Turbidity, Chlorides, Total Hardness, Magnesium, Nitrites and Sulphates (Table 1,2). The high value of conductivity was recorded during the month of April, because of high rate of evaporation due to high temperature result increase in the concentration of salts whereas, low value was recorded in the month of June due to dilution of water in the rainy season decreases the concentration of salts (26).

TDS: Analysis of Total Dissolved Solids (TDS) of water in this study varied between 808.3±9.83 mg/L (May 2011) and 7250.0±42.4 mg/L (July 2013) "Fig. D". TDS showed positive correlation with Salinity, Turbidity, Chlorides, Total Hardness, Magnesium, Phosphates, Nitrates, Nitrites, Sulphates, and showed negative significant correlation with DO, CO_2, Alkalinity, Calcium, Silicates, BOD, COD (Table 1,2). The high values of TDS in the month of July may be due to addition of domestic waste water garbage and sewage etc., in the natural surface runoff into water body (23), (27).

Salinity: The seasonal fluctuation in the Salinity values ranged from 773.3±5.16 ppm (June 2011) and 2613.3±8.1 ppm (April 2012) "Fig. E". Carbon dioxide, Alkalinity, Total Hardness, Phosphates was shown to have significant positive correlation with Salinity and Turbidity, DO, Chlorides, Calcium, Magnesium, Silicates, Nitrates, Nitrites, Sulphates, BOD, COD was shown to have negative significant correlation (Table 1,2). High values of salinity in the month of April is due to increase in the evaporation rate because high temperature in summer and low values in the month of June is due to dilution of salts with the influx of rain water (28).

Turbidity: The monthly fluctuation of Turbidity of water varied between 7.65±0.20 NTU (November 2011) and 62.33±3.72 NTU (March 2012) "Fig. F". Turbidity showed positive significant correlation with Alkalinity, Chlorides, Total Hardness, Calcium, Magnesium, Silicates, Nitrates, Nitrites, BOD, COD and showed negative significant correlation with DO, CO_2, Chlorides, Phosphates, Sulphates (Table 1,2). The high turbidity in the month of March (summer) might be responsible for the higher water temperature because suspended particles absorb heat from the sunlight making the water warm (29) and during winter season (November) settlement of slit, clay resulting low turbidity (30).

DO: The monthly variation of Dissolved Oxygen (DO) of water was as low as 3.01±0.04 mg/L in March 2012 and as high as 8.71±0.04 mg/L in January 2012 "Fig. G". Dissolved oxygen showed positive significant correlation with Total Harness, Magnesium, Silicates, Phosphates, Nitrites, Sulphates, COD and showed negative significant correlation with Carbon dioxide, Alkalinity, Chlorides, Calcium, Nitrates, BOD

(Table 1,2). The maximum DO in January might be due to low atmospheric temperature and intensive photosynthetic activity (18) and minimum DO is due to losses of oxygen include respiration, decay of aerobic bacteria and decomposition of dead decaying sediments in the month of March (31).

Free CO_2: The concentration of Free Carbon dioxide of water ranged between 3.30±1.20 mg/L (February 2012) and 8.23±0.9 mg/L (December 2011) "Fig. H". Free Carbon dioxide showed positive significant correlation with Alkalinity, Total hardness, Magnesium, Phosphates, Nitrates, Nitrites, BOD and showed negative significant correlation with Alkalinity, Chlorides, Calcium, Silicates, Sulphates, COD (Table 1,2). The fluctuations in free carbon dioxide values correspond directly with standing crop of phytoplankton increases through winter and summer months the free CO_2 disappears because of greater utilization of free CO_2 for photosynthetic activity (32).

Alkalinity: Determination of Alkalinity of water during 2011-12 fluctuated between 60.5±0.54 mg/L (August 2011) and 175.1±0.75 mg/L (April 2012) "Fig. I". Alkalinity showed positive significant correlation with Chlorides, Total hardness, Calcium, Silicates, Phosphates, Sulphates, BOD and showed negative significant correlation with Magnesium, Nitrates, Nitrites, COD (Table 1,2). The degradation of plants, living organisms and organic waste might also be one of the reasons for increase in a carbonate and bicarbonate result an increasing in alkalinity value in the month of April (33). Low bicarbonate alkalinity in the month of August may be attributed to the decreased role of evaporation coupled with influx of the large volume of water responsible for dilution of carbonates (34), (19).

Total hardness: Our analysis showed the Total hardness of water was minimum in September 2012 (179.6±1.03 mg/L) and maximum in March 2013 (370.6± 2.06 mg/L) "Fig. J". Total hardness showed positive significant correlation with Calcium, Magnesium, Silicates, Phosphates, BOD and showed negative significant correlation with Nitrates, Nitrites, Sulphates, COD (Table 1,2). Total hardness of water bodies may be high in the month of March which may be became higher temperature causes evaporation of water and decrease in volume of water increase the concentration of salts. Low values of Total hardness noticed in September because low temperature and less evaporative rate and dilution of water during rainy season (35), (36).

Calcium: The seasonal variability in the Calcium content of water was lowest in February 2012 (22.71±1.57 mg/L) and highest in August 2011 (85.5±8.27 mg/L) "Fig. K". Calcium showed positive significant correlation with Silicates, Phosphates, Nitrates, Sulphates, BOD, COD and showed negative correlation with Magnesium, Nitrites (Table 1,2). The high values of Ca in water bodies may be due to addition of lime and pesticides in an objective for better production (21). The decrease the level in water may be due to absorption by the phytoplankton and macrophytes (37).

Chlorides: The Chloride content of the water had a low level of 406.5± 10.3 mg/L in August 2012 and high level of 668.8±1.1 mg/L in April 2012 "Fig. L". Chlorides showed positive significant with Total hardness, Magnesium, Silicates, Sulphates, BOD and showed negative significant correlation with Calcium, Phosphates, Nitrates, Nitrites, COD (Table 1,2). Concentration of higher chlorides in April could be due to increased temperature and evaporation of water (38).

Magnesium: Water samples collected from Sri Rangarayalu Tank were analyzed for Magnesium can varied between 6.36±0.8 mg/L (July 2012) and 296.1±9.2 mg/L (May 2013) "Fig. M". Magnesium showed positive significant correlation with Silicates, Phosphates, Nitrites and showed negative significant correlation with Nitrates, Sulphates, BOD, COD (Table 1,2). Magnesium was lower than calcium due to lesser occurrence of Mg minerals in bottom strata of water body (39).

Phosphate: Phosphate value obtained in this study ranged between 0.136±0.02 mg/L (September 2011) and 0.624±0.09 mg/L (April 2012) "Fig. N". Phosphates showed positive significant correlation with Sulphates, BOD, COD and showed negative significant correlation with Nitrates, Nitrites (Table 1,2). Maximum value of phosphate in April may be due to rapid evaporation and mineralization of decomposed material in water bodies (26). The decrease in phosphate values in September was due to absorption by planktons (40).

Nitrates: The seasonal variability in the Nitrate concentration was as low as 0.018±0.09 mg/L in March 2013 and as high as 2.25±0.1 mg/L in September 2012 "Fig. O". Nitrates showed positive significant correlation with Nitrites, Sulphates, BOD and negative significant correlation with COD (Table 1,2). In March lesser nitrates are due to algal assimilation and other biochemical mechanisms and nitrate higher values in September are due to surface runoff and domestic sewage and specially washing activities (19).

Nitrites: Monthly variation of Nitrites content of water in the present study ranged between 0.133±0.00 mg/L (June 2011) and 1.667±0.17 mg/L (September 2011) "Fig. P". Nitrites showed positive significant correlation with Sulphates and showed negative significant correlation with BOD, COD (Table 1,2). Similar trend of nitrites in respective months was also noticed earlier by researchers who measured nitrites in fish pond water bodies (41).

Silicates: The fluctuation in Silicate concentration of water was between 0.001±5.1 mg/L (August 2012) and 0.005±0.00 mg/L (April 2013) "Fig. Q". Silicates showed positive significant correlation with Nitrates, Nitrites, Sulphates, BOD, COD and showed negative significant correlation with Phosphates (Table

1,2). In the support of this similar trend was noticed that the average value of silicate ranged from 0.2 to 0.75 mg/L in pond water of Thiruchunapalli (41).

Sulphates: We observed that Sulphate content of water in the present study was minimum in August 2011 (0.01±0.001 mg/L) and maximum in April 2012 "Fig. R". Sulphates showed positive significant correlation with COD and negative significant correlation with BOD (Table 1,2). High concentration of sulphates in April may be due to biodegradation of organic matter by the microorganisms. Whereas dilution and utilization of sulphate by the aquatic plants and phytoplankton gradually brings down the sulphate concentration in August (26), (19).

BOD: Monthly variation of Biological Oxygen Demand (BOD) of water was between 5.0±0.0 mg/L (August 2011) and 9.0±0.0 mg/L (April 2012) "Fig. S". BOD showed positive significant correlation with COD (Table 1,2). High concentration of BOD observed in April is due to huge load of sediments sewage water from the discharges and various types of pollutants mixed with water (42), (18).

COD: Range of COD value of water in present study was between 49.47±7.78 mg/L (June 2011) and 837.7±359.82 mg/L (December 2011) "Fig. T". The higher values are due to higher decomposition activities and low level of water. However minimum COD values are due to low temperature, low decomposition activities and dilution effect (43), (44).

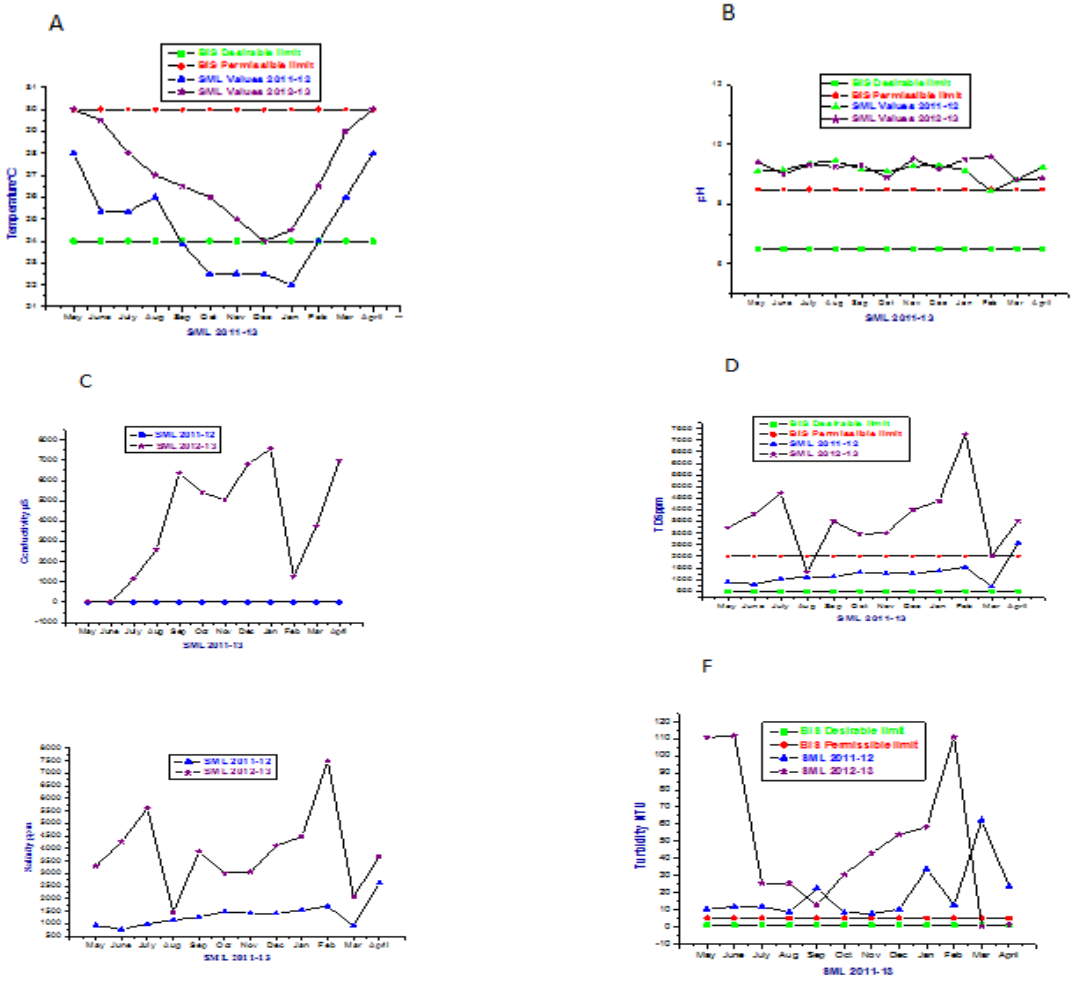
IV. Figures And Tables

Table: 1. Correlation coefficient values of water samples collected from Singanamala Tank during 2011-12

	Temp	*pH*	*Cond*	*TDS*	*Sal*	*Turb*	*DO*	*CO2*	*Alk*	*Chl*	*TH*	*Ca*	*Mg*	*Si*	*PO4*	*NO2*	*NO3*	*SO4*	*BOD*	*COD*
Temp	1																			
pH	0.09	1																		
Cond	-0.08	0.22	1																	
TDS	-0.08	-0.11	0.12	1																
Sal	-0.07	-0.16	0.1	0.29	1															
Turb	0.02	0.03	0.12	0.06	-0.07	1														
DO	-0.15	0.08	-0.15	0.1	-0.14	-0.1	1													
CO2	0.15	0.09	0.05	-0.23	0.01	-0.01	-0.64	1												
Alk	-0.02	0.2	0.08	-0.05	0.1	0.06	-0.1	-0.21	1											
Chl	0.04	0.12	-0.06	0.01	0.03	-0	-0.21	-0.04	0	1										
TH	0.07	0.07	-0.05	0.17	0.19	0.1	0.2	0.03	0.3	0.01	1									
Ca	-0.11	-0.02	0.09	-0.11	-0.04	0.02	-0.07	0.3	0.23	-0.03	-0.08	1								
Mg	-0.08	-0.16	-0.21	0.02	-0.01	0.05	0.21	-0.07	-0.05	0.1	0.15	-0.05	1							
Si	0.14	0.29	0.1	-0.01	0.12	0.03	0.16	-0.1	0.22	0.06	0.08	-0.06	-0.18	1						
PO4	0.05	-0.06	-0.06	0.12	0.28	-0.31	0.08	0.07	0.16	-0.06	0.12	-0.63	-0.08	-0.04	1					
NO3	0.64	0.09	-0.09	0.05	-0.22	0.07	-0.07	0.18	-0.03	-0.09	-0.12	-0.1	-0.15	-0.06	-0.12	1				
NO2	-0.05	-0.11	-0.13	0.14	-0.26	0.32	0.36	0.05	-0.07	-0.24	-0.03	-0.02	-0.02	0.14	-0.06	0.23	1			
SO4	-0.01	0.13	0.04	0.06	-0.03	-0.12	0.09	-0.02	0.1	0.08	-0.16	-0.04	-0.1	0.12	0	0.03	-0.09	1		
BOD	0.04	0.05	-0.05	-0.26	-0.02	0.2	-0.07	0.12	0.01	0.11	0.08	-0.04	0.16	0.11	0.04	0.06	-0.05	-0.21	1	
COD	0.09	-0.15	-0.26	-0.45	-0.05	0.02	0.01	-0.03	-0.1	-0.17	-0.14	0.13	-0.12	0.09	0.06	-0.14	-0.09	0	0.07	1

Table: 2 Correlation coefficient values of water samples collected from Singanamala Tank during 2012-13

	Temp	*pH*	*Cond*	*TDS*	*Sal*	*Turb*	*DO*	*CO2*	*Alk*	*Chl*	*TH*	*Ca*	*Mg*	*Si*	*PO4*	*NO2*	*NO3*	*SO4*	*BOD*	*COD*
Temp	1																			
pH	0.02	1																		
Cond	0.04	0.19	1																	
TDS	0.07	0.32	0.08	1																
Sal	0.03	0.29	0.02	0.49	1															
Turb	-0.09	0.3	-0.1	-0.06	0.15	1														
DO	0.13	-0.07	0.13	-0.08	0.19	0.05	1													
CO2	0.09	-0.07	0.11	-0.06	-0.03	-0.03	-0.04	1												
Alk	0.02	-0.11	-0.15	-0.02	0.17	0.02	0.12	0.29	1											
Chl	0.07	0.14	-0.12	0.18	0.17	0.02	-0.08	-0.15	-0.16	1										
TH	0.26	0.18	0.02	0.21	0	0	-0.03	-0.01	0.09	0.01	1									
Ca	0.13	0.23	0.09	0.22	0.1	-0.16	-0.19	0.03	-0.07	-0.13	0.23	1								
Mg	0.03	-0.12	-0.09	-0.07	-0.05	0.13	0.05	0.09	-0.05	0.11	-0.02	-0.16	1							
Si	-0.02	-0.27	0.06	-0.23	-0.18	0.32	0.19	0.11	0.03	-0.05	-0.12	0.32	0.05	1						
PO4	0.01	-0.04	-0.01	0.08	0.15	-0.06	0.01	0.06	0.36	-0.17	0.06	0.14	0.08	-0.1	1					
NO2	-0.18	0.22	0.08	0.22	0.13	0.05	0.04	-0.18	0.03	0.06	0.02	0.17	-0.13	-0.11	-0.08	1				
NO3	0	-0.24	-0.31	0.02	0.04	-0.09	-0.08	0.01	-0.2	0.04	-0.23	-0.09	0.31	0.08	-0.03	-0.05	1			
SO4	0.01	-0.03	-0.15	-0.04	-0.17	0.06	-0.26	-0.04	0.18	0.17	0.1	0.02	-0.15	0.15	-0.01	-0.03	0.07	1		
BOD	0.08	0.16	0.31	0.08	0.07	-0.14	0.15	-0.11	-0.09	0.06	0.03	0.36	-0.15	-0.05	0.19	0.09	-0.16	0.03	1	
COD	0.02	-0.04	0.03	0.12	0.08	-0.03	0.01	0.15	0.12	-0.03	-0.08	0.03	-0.08	0.14	-0.05	0.15	-0.06	-0.03	0.08	1



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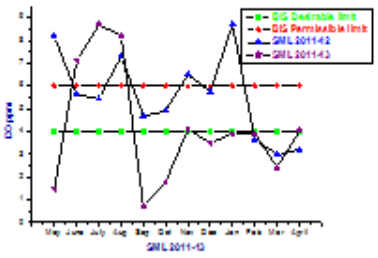
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SML 2012-13
SML 2011-13

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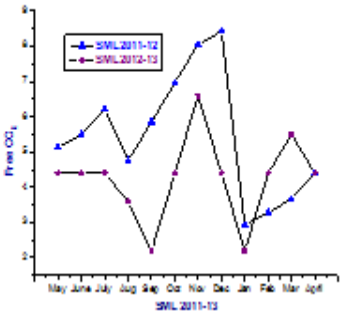
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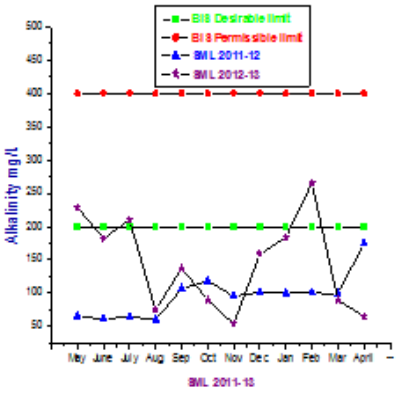
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SML 2011-12
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Alkalinity mg/L
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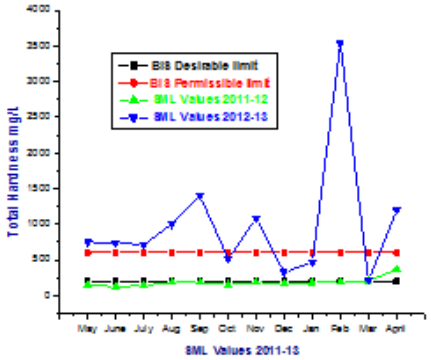
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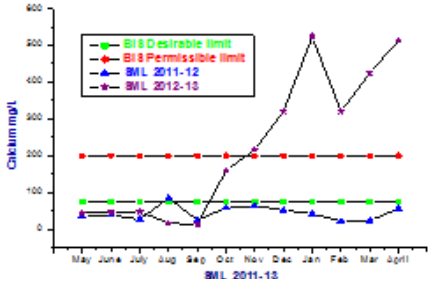
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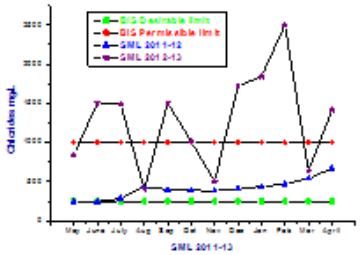
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SML 2011-12
SML 2012-13
SML 2011-13

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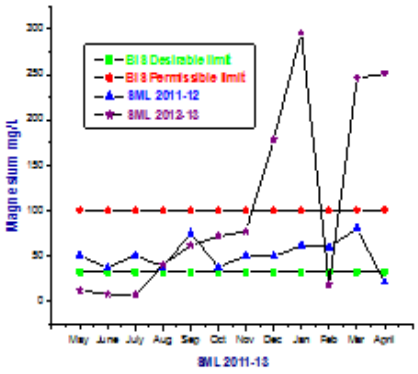
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SML 2011-12
SML 2012-13
Magnesium mg/L
SML 2011-13

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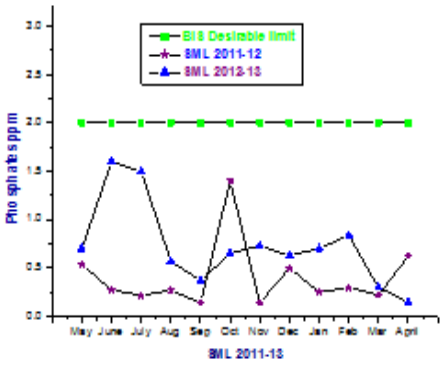
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SML 2012-13
Phosphates ppm
SML 2011-13

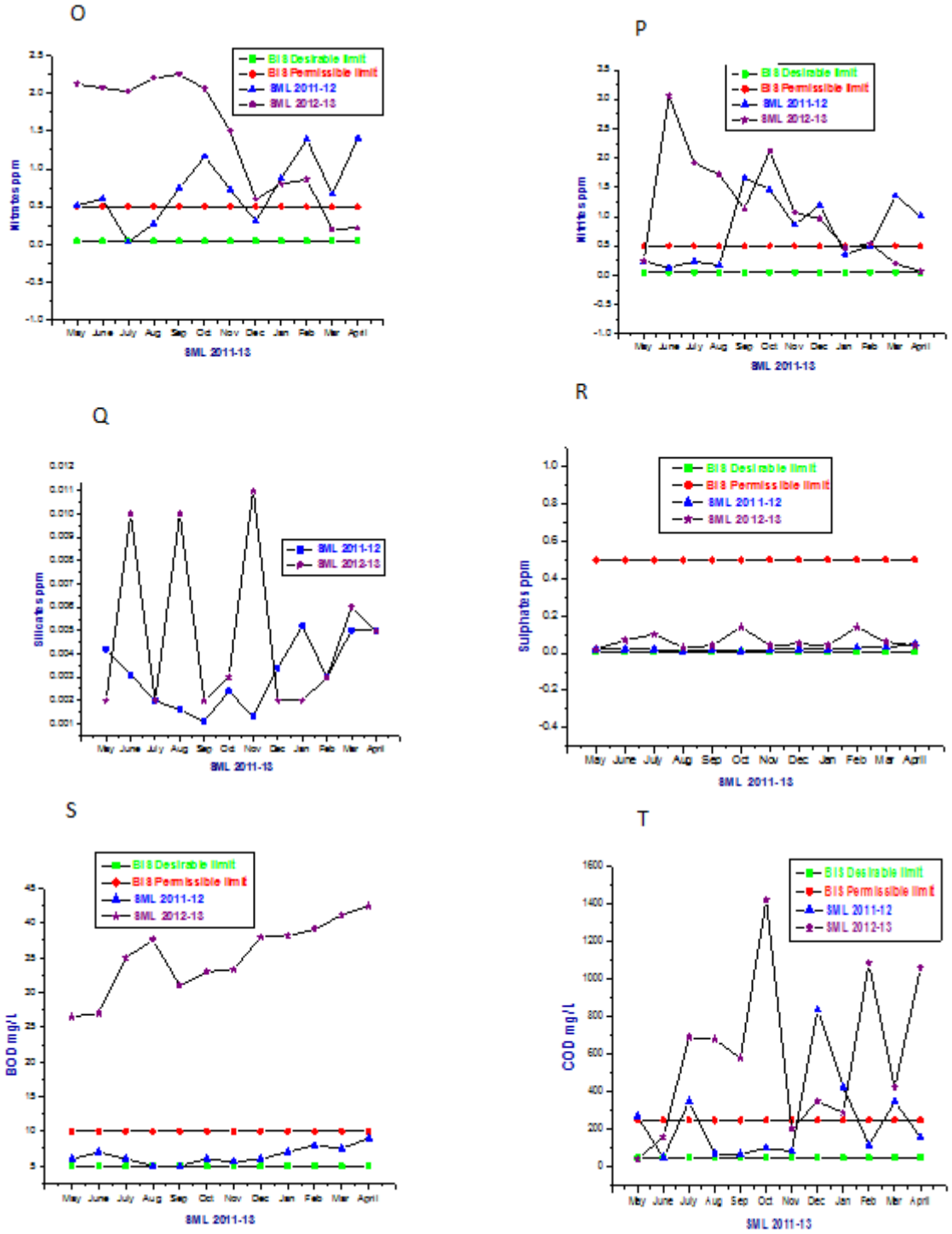

Fig. Variation in Temperature (A), pH (B), Conductivity (C), TDS (D), Salinity (E), Turbidity (F), DO (G), Free CO_2 (H), Alkalinity (I), Total Hardness (J), Calcium (K), Chlorides (L), Magnesium (M), Phosphates (N), Nitrates (O), Nitrites (P), Silicates (Q), Sulphates (R), BOD (S), COD (T) water samples collected from Singanamala Tank, Singanamala during 2011-13.

V. Conclusion

From all the above mentioned research findings, it is finally concluded that Singanamala Tank (Sri Rangarayalu Cheruvu), water was contaminated by effluents coming from runoff through the fields and canals during rainy season, fishing cleaning vehicles, washing cloths etc. So the physico-chemical parameters were beyond the permissible limits which may cause harmful effects on cultured fish. Consuming this water by animals affect their health and using this water for agriculture may drastically affects the Agricultural produce.

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