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The study of Limnological and its Physico chemical Characteristics of water of Bogolucheruvu (Tank) Andhra Pradesh, India

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Abstract

The preliminary investigation of the present paper highlights Physico-chemical characteristics of Bogolu Cheruvu (Tank), Nellore District, Andhra Pradesh, India. The surviving water body is exploited due to domestic sewage prevailed by human activities. An immediate action is required to assess Physico-chemical parameters like Dissolved Oxygen (DO), Total Suspended Solids (TSS), Phosphate, Calcium Hardness, Temperature, Free CO_2, pH, Sulphate, Total Solids (TS), Total Alkalinity (TA), Total Dissolved Solids (TDS), Carbonates, The resulted data is considered to find a conclusion about Physico-chemical parameters and the quality of water in Bogolu Cheruvu (Tank). Furthermore, the results revealed the urgency and immediate action required to restore the biological and Physico-chemical sources with feasible and immediate renovation and managing approaches in order to preserve, preserve, conserve and to avoid the natural disparity and disruption in hydro-biological and hydro-geo-chemical cycles, which affects the food web and food chain of the important pond ecosystem severely.

Keywords: Water quality, Physico-chemical parameters, Limnology and Phytoplankton.

Introduction

Water a universal solvent, occurs in different solid, liquid and gaseous forms. Lakes, rivers, ponds, pools, swamps, bogs etc., come under fresh water ecosystems. They can also be referred as fresh water, marine and estuarine, which are distinguished on the basis of differences in their salt content. Fresh water obtains a little importance to human beings and other organisms of the environment for sustenance of life and maintaining the balance of water bodies is becoming very important throughout the world because of the primary concern of man was to be meeting his basic requirements. Oceans and seas over marine ecosystems and estuary is an ecosystems in which fresh water from rivers meets ocean waters, the two being mixed by the action of tides. India has enormous and different central water resources. They are considered to be the lushest in world's natural lakes. Fresh water lakes are the very vital resources for any country. Finally a basic feature of the earth is as an plenty of water. It extends over 71% of its surface to an average depth of 3800 m. Over 99%. This gigantic hydrosphere is deposited in ocean depressions.

The Present study of Phytoplankton relationship with various environmental and Physico-chemical features[1-3]. This induces ecological imbalances, deleterious for sustained development of fisheries resources which has necessitated the suspension of the beneficial uses of these water bodies in some Places[4]. Plankton are consider indicators of the different tropic status water body, the reason of they have specific qualitative features and their capacity to reproduce in large number under environmental conditions which are favorable to them and they used for pollution surveillance . The proverb is "Fresh water is a gift of god which would continue to be available in perpetuity and in abundance" is accomplishment. Environmental factors such as temperature, pH and proper supply of O_2, CO_2, and essential elements like, Nitrate, Phosphate and chloride, influence plankton diversity[5,6]. We should aware of the need of chemicals it should be ensured that they do not spoil our environmental global chemical pollution. It has been a matter of a great worry with increase in public awareness towards the environmental problem. The main Significant abiotic factors in an water habitat are pressure, density, light, current temperature, oxygen, carbon dioxide, other gases, dissolved solids, microorganisms, benthos (bottom biodata) and nekton (active swims)[7] of anthropogenic pressure on this glacial fed tanks.The characteristics of Physico-chemical of Bogolu Cehruvu (tank) had been studied for monsoon, premonsoon and post monsoon in the year.

Study Area: Bogole is a City in Bogole Mandal in Sri Potti Sriramulu, Nellore District of Andhra Pradesh State, India. It belongs to Andhra region. It is located at Nellore around 40 KM. It is a Mandal head quarter. Bogolu cheruvu is one of the foremost water bodies of central India. Ananthavaram (4 KM), Thalluru (6 KM), Katrayapadu (8 KM), Bitragunta (8 KM), Chamadala (8 KM) are the nearby villages to Bogole. Bogole is surrounded by Dagadarthi Mandal near south, Allur Mandal to east, Jaladanki Mandal near north, Kavali Mandal towards north. Presently the water body bogolu cheruvu is used for irrigation and aqua culture practices. Every year around 35 tons of fish is caught by fishermen from this tank. Total area of Bogole is 2589 hectares.

Materials and Methods

The samples of water were collected from Bogolu Cheruvu (Tank) of Nellore town an hours of the day at 10.00 AM and its surrounding areas at monthly intervals for a period of 3 years from June 2010 to May 2013 for Physico-chemical and biological analysis. Water samples were collected in Polythene bags. Air, water, temperature and pH were recorded on the spot itself. For the guesstimate of dissolved oxygen the samples were fixed on the spot using Winkler's reagents. Later, the illustrations were go from the laboratory for the assessment of dissolved oxygen for the estimation of DO and other chemical parameters. The finally we got results that calculated by taking three consecutive readings for titrimetric analysis.

Results and Discussion

Determination of Physicochemical Parameters: Temperature and pH were strong-minded in the field by using pH meter, Model 3150. Other physicochemical parameters were gritty in the laboratory with Hach 2010 spectrophotometer using the methods of Karikari et al[8].

Sampling and Identification of Phytoplankton: Samples of Phytoplankton are taken using plankton net of mesh size 100 nm. The net is tied to a metal rod and immersed in water, towards for a fixed distance and hauled out of the water. The water (containing plankton) that is collected in the plastic bottle at the end of the net is emptied into sample bottles and preserved with 4% formation[9]. The zooplankton was indentified using keys Matagi et al[10] in numeration of the plankton was done with the method of Bugenyi and Lutalo-Bosa[11].

Data Analysis: The seasonal data was examined by one-way analysis of variance (ANOVA) Duncan's multiple range test (DMRT) was used to compare the means and Pearson's product moment correlation coefficient. It was used to determine association between the physicochemical properties and the relatively Phytoplankton.

Phytoplankton is floating microscopic autographs whose movements are more or less dependent on water currents. Phytoplankton also play alkalinity vital role in biological treatment of organic wastes in water, as during mineralization of organic matter by bacteria, the oxygen is supplied by them. The life communities in the water body are so varied that their consideration as a whole affords great difficulties. Some of phytoplankton appears for a short period while; a few others appear sporadically and then disappear completely. During the present study, periodicity and distribution of phytoplankton belonging to various groups viz., Chlorococcales, Desmids and Diatoms have been discussed in Bogulcheruvu pond (tank) Nellore district.

Chlorococcales: Pramod Kumar Singh et al.[12] recorded Chlorococcales in water bodies that they have studied and attributed the same to the temperature of water. They were of the opinion that, low range of temperature does not support the Chlorococcales. In the present study, water temperature ranged between 24.5 to 35.5^{0}C (Table-1). Nevertheless, high range of temperature triggers the maximum growth of Chlorococcales in the present water bodies. Hence, the current observations are in conformity with the Malammanavar[13] could not correlate any of the physico-chemical characteristics in their studies. Chlorococcalean members showed alkalinity increase in their growth with increase in pH. In the present investigation pH was maximum during summer months which harbored good number of Chlorococcales in the water bodies.

Table 1
Occurrence of Chlorococcales in the water bodies during 2010-13

Name of the Organisms	2010-11	2011-12	2012-13
Ankistrodesmus spiralis	+	+	+
Closteriopsis longissima	+	+	+
Scenedesmus quadricauda	+	+	+
S.bijugatus	+	-	-
S.dimorphus	+	+	+
S.armatus	+	+	-
Selenastrum westill	+	+	+
Actinastrum hantzschi	+	-	-
Selenastrum gracile	+	+	+
Micractinum pussilum	+	-	+
Pediastrum simplex	+	+	+
P. duplex	+	+	+
Coelastrum micriporum	+	+	+
Tetraedon muticum	+	-	+
Tetraedon minimum	+	R	+
Crucigenia crucifera	+	+	+
Gonatozygon kinahanil	+	+	+
Kirchneriella lunaris	-	+	-

+ = Present; - = Absent; R = Rare

Desmids: Desmids are solitary, free-floating organisms and occur in freshwater ecosystem. They are single celled microscopic organisms of great variety and beauty of form. They are by far the commonest of all the members of the conjugales and number about 23 genera. The higher is the pollution, lesser is the desmids population[14,15]. In the current study, Bogulcheruvu pond (tank) to favour the abundance of desmids. Eutrophic water body never supported the luxuriant growth of desmids.

Table 2
Occurrence of Desmids in the water bodies during 2010-13

Name of the Organisms	2010-11	2011-12	2012-13
Arthodesmus hiatus	-	-	-
Cosmarium depressum	-	+	+
C. protuberans	+	+	-
C. tumidum	+	+	-
C. contractum	-	-	+
Desmidium baileyii	-	-	+
Euastrum serratum	+	-	+
E. pseudospinolosum	-	+	-
Staurastrum longibrachiatum	-	-	+
S.sebaldi	-	-	+
Closterium gracile	-	-	+
C. lunala	+	-	-
C. remarginatum	-	-	+
C. subtrigosum	-	R	+
Micrasterias inciser	-	-	+

+ = Present ; - = Absent; R = Rare

Diatoms: Diatoms are unicellular algae and they are commonly found in fresh and marine water and cells are attached to each other by mucilage or enclosed in alkalinity common mucilage envelope. The related abundance of diatoms is alkalinity very useful indication to the type of water in which they grow. Bhargava and Alam[16], stated that alkaline pH favours the abundance of diatoms. In the present study also pH was more alkaline in Bogolu cheruvu pond (tank) which lodged more number of diatoms. This view is also supported by Vaishya and Adoni[17].

Table 3
Diversity of Diatoms in the water bodies during 2010-13

Name of the Organisms	2010-11	2011-12	2012-13
Achnanthes lanceolata	+	+	+
Cyclotella meneghniana	+	+	+
Cocconies placentula	+	+	-
Eunotia major	+	-	+
Navicula cuspidate	+	+	+
Navicula palea	+	-	+
N.cryptocephala	+	+	-
N.cocconeiformis	-	+	-
N.pupula	+	+	++
N.hustedtil	+	+	+
Melosira granulate	++	+	+
Synedra robusta	+	+	+
S.acus	+	+	+
S.ulna	+	+	+
Nitzschia	++	+	+
N.obtusa	+	+	+
N.acuta	+	+	+
N.microcephala	+	+	-
N.accularis	+	+	+
Pinnulria viridis	+	-	+
Pinnularia gibba	+	+	++
P.conica	+	-	+
P.major	+	+	+
Tabellaria flocculosa	+	-	+
Anomoeneis brachysira	+	+	+
A. sphaerophora	+	+	++
Cymbella tumida	+	+	-
C.lanceolata	+	+	++
C.affinis	+	+	+
Fragillaria Vacucheriae	++	+	-
Gomphonema lacus	-	-	+
G.accuminatus	+	+	-
G.gracile	+	-	+
Gyrosigma scalproides	+	+	-
Gyrosigma kulzingii	+	+	+
Hantzschia amphioxys	+	R	+
Amphora cofformis	-	+	-
Surirella subsalsa	+	-	+

+ = Present; - = Absent; R = Rare and + + = 100-500 (Dominant)

The Biological diversity[18-20] was predominantly controlled by the physico-chemical environment. Physico-chemical features of the Bogolu cheruvu pond (tank) were given in Table-4 to 6 and Figure-1 to 3 respectively. In the present study water of 18°C and air of 22°C temperature were observed at the sampling site. This optimum water temperature in the pond supports high biological population. The water colour of both the ponds was observed to be dark green due to the good growth of various algal species. Low transparency also indicates the eutrophic nature of pond water[21,22].

Physico-Chemical Considerations: Air Temperature: Water temperature plays a pivotal role because controls different abiotic features and biotic functions of a pond ecosystem identified by various researchers[23-26]. It also signifies the dynamics of living species like physiological and metabolic behavior of marine environment[27]. Therefore Temperature shows a straight effect on crucial issues like oxygen demand, development, diet conversion and diet requirements effectiveness of the various biotic populations spreading therein. If the temperature increases automatically the requirement of oxygen and food also increases, it results in high growth rate[28,29]. During the current examination, nominal difference was observed in bogole cheruvu sites. The maximum temperature (30.91^{0}C) was noticed on the surface of the water of all the research locations throughout the summer time. Same tendency was witnessed by Kumar et al[30]. on the surface of the water of Sabarmati river and Kharicat canal, Ahmedabad, whereas minimum value (20^{0}C) was observed in peak winter. These outcomes are wisely demonstrated with Surana et al.[31] for Chimdi Lake, Nepal.

pH: We consider the quantity of bicarbonates and CO_2 to find out the pH percentage in water. pH percentage related to the organic action of water micro flora. The most important factor regaled to pH in natural water is the carbonate[32] that involves CO_2, H_2CO_3, and HCO^-_3. Less values of pH are specified at great intelligence, and are affected by the elimination of acid-creating elements in precipitation. A heavy organic content was tending to minimize the pH due to the carbonate chemistry[33] throughout the present research work; simple instability was recorded in bogolu cheruvu. Much pH value (8.95) was identified in pre monsoon. Related findings were hardheaded by Sahni and Yadav[27] at Rewari, Bharawas Pond, in Haryana state. Subla[34] and Wani stated that the percentage of pH rate is produced above 8 in aquatic body by photosynthetic rate. It requires much CO_2 than amounts well-founded by exhalation and putrefaction, however smallest value (7.20) was identified. Uzma et al.[35] was discovered the Monsoon results on the surface of the water of Laldiggi pond, Aligarh.

Dissolved Oxygen: Liquefied Oxygen (LO) is a vital constraint of aquatic organisms. Oxygen is required for the existence and survival of all aquatic organisms[36]. Liquefied oxygen focus on higher than 5.00 mg/L helps rapid growth of flora and fauna[37]. It is one of the crucial key aspects of the water quality which directly affects the survival and dispersal of flora and wildlife in ecology. Complex amount of DO (7.59 mg/L) was detected during post monsoon. Kiran et al[38]. was distinguished same records in Bhadra Project, Karnataka state, but less value (3.94 mg/L) was detected in pre monsoon. Little value of DO can be predicted by less number of planktons[39,40] and due to the upsurge respiration. Deviations in liquefied oxygen concentration at the surface of the water are unswervingly related to the variations in phytoplankton value[41].

Total Dissolved Solids: The standards of Total Dissolved Solids (TDS) on the surface of the water of Bogolu cheruvu (75.94mg/L) was chronicled during pre-monsoon days. Similar tendency was detected by Narayan et al.[42] and Jemi et al.[43] were founded analogous developments, while it was detected minimum (49.18 mg/L) at post monsoon.

Free CO_2: Free CO_2 in water substance is generally informed when the oxygen is completely absent. It is generally because of the decomposition of organic substance by microbes in bottom. In result we find rapid improvement of free carbon dioxide[44,45]. During the research, the normal concentration of Free CO_2 was perceived highly i.e (11.19mg/L) at pre monsoon and less (8.76mg/L) at post monsoon. The nonexistence or existence of free carbon dioxide on the surface of the water is typically overseen by its usage and also finished its dispersion of air[46].

Table 4
Seasonal variation of phytoplankton (o/l) groups in Bogolu tank 2010-2013

Organisms	2010-2011			2011-2012			2012-2013		
	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer
Chlorococcales	16366	17426	20250	17750	17597	20155	11652	13072	16093
Desmids	7	10	14	2	8	10	61	59	92
Diatoms	75112	86841	82420	74750	96010	83710	7890	8979.5	16093

Alkalinity: Alkalinity is the amount of the ability of water towards neutralizes acids. Alkaline amalgams in the water are nothing but hydroxides, carbonates, and bicarbonates. It eliminates Hydrogen ions and lesser the acidity of water. Generally when combined with Hydrogen ions to find a novel compound[47]. If the new compound, acid neutralizing capacity are in absence, it may cause rapid transformation in pH. Finding out the percentage of alkalinity is very crucial in order to balance the acidic pollution which is released from rainfall or wastewater. It is the finest measure to examine the delicacy of the watercourse to acid inputs[48,49]. The major components of alkalinities are the carbonates and bicarbonates of surface water[50]. Total alkalinity is measured by measuring the amount of acid was measured total alkalinity that is (e.g. sulphuric acid) required to bring the sample to a pH of 4.2. In this pH, all the alkaline mixtures in the samples are tested. The amount of TA on the surface of the water at bogolu cheruvu was 101-300 mg/L, 107-284 mg/L and 104-228 mg/L. among these results, the maximum total alkalinity substance (17.38 mg/L) was identified at pre-monsoon, while minimum (7.98mg/L) was noticed at bogolu cheruvu at the time of monsoon. Similar implication was observed by Sahni and Yadav[27] in Bharswada Pond, Haryana state, Garg et al.[51,52] in Harsi and Ramsagar Reservoirs, Verma et al.[53] in Chandola Lake, Eastern Ahmedabad.

Total Hardness: The Hardness was observed high level (590mg/L) during January at pre-monsoon; however less value (116 mg/L) was identified in monsoon. During summer season it takes higher rate of drizzling water and was associated by reduction of hydrological system of the water body[54].

Calcium Hardness: Magnesium and Calcium play a crucial role in irritating the toxic effects of several ions in nullifying excess produced acid[55]. Calcium is identified in high abundance in all usual element in which water such as its key source is enduring the rocks into leachate[56]. In river atmosphere, calcium serves as one of the important micronutrients in organisms. The low and the huge values of calcium hardness of the surface of the water at Monsoon, Post Monsoon and Pre Monsoon were 4.63mg/L, 5.83mg/L and 7.64mg/L, respectively.

Magnesium Hardness: Magnesium is commonly found to be associated with calcium in all types of waters, but its deliberation remains generally lesser than the calcium[57]. For chlorophyll growth Magnesium is needed. It acts like a limiting factor for the considerable growth of phytoplankton[58]. In Monsoon, post monsoon and pre monsoon all study stations are tested on magnesium hardness in surface water at the lowest and highest levels, were 2.10mg/L, 3.35mg/L and 3.78mg/L, respectively.

Chloride: The pollution in the environment is calculated by the percentage of Chloride[59]. The chief anthropogenic bases of chloride on the surface of the waters are melting salt, urban and agricultural discharges, and discharges from the municipal waste water plants, industrial plants, and also from the drilling of oil and gas wells[60-62]. The changing substances of chloride in surface water of Monsoon, Post Monsoon and Pre Monsoon were 14.95mg/L, 12.65mg/L and 24.80mg/L, respectively.

Nutrients (Sulphate, Nitrate): Nitrogen is useful for all organisms in this world, because it is the basic process of life to synthesize protein for development and reproduction. The existence of nitrates in the water levels is evocative of some bacterial activities and growth[63]. The main root cause of spreading nitrate in the environment is agricultural releases and decomposition of organic matter. The crucial incursion of water and resultant land drainage cause drastic rise in nitrate existed in pond water[64]. During the research period, nitrate percentage was more (0.19 mg/L) at Bogolu cheruvu at the time of Post monsoon, where as it was less (0.049 mg/L) in pre-monsoon. This is because of high range of rainfalls, rapid growth of green fields, and encumbered microbial and bacterial activities[65]. Both the low and high contents of sulphate on the surface of the water of all sampling places were 15..52mg/L, 31.99 mg/L and 13.94mg/L, respectively., during post Monsoon the high amount (31.99mg/L) was recorded, and less content (13.94 mg/L) was identified at the time of pre monsoon. The contents of sulphate on the surface of the water of bogolu cheruvu displayed tremendous rise in winter months. Likely development was detected by Tucker[66]. Sulphate increases quickly in winter seasons and drops suddenly in monsoon. It is because of the fact that the sulphate levels of water are plagiaristic from sulphite found during organic decay in the ground level deposits, by oxidation during winter and during early spring, and that a amount of sulphates are decreased when the pond becomes anaerobic in summer season[67-68].

Sodium: Sodium is generally present in water. It is called a mono valent cation. It taste is altered with the significant amount of sodium in water and it makes the water unsuitable for agriculture purposes .It place not only a key role in water but also in human physical body. Besides it works on nervous system, and excretory system, tissue system[69]. In surface waters of monsoon, post monsoon and pre monsoon, the contents of sodium were ranged from 2.31 mg/L, 4.18mg/L and 4.06 mg/L, respectively.

Potassium: All the study sites of monsoon, Post Monsoon and Pre Monsoon the values of potassium reached from fr1.24mg/L, 1.66mg/L and 1.91mg/L, respectively which, highest amount (1.91/L) was renowned at Pre Monsoon and Monsoon during rainy days as well as the lowest level (1.24 mg/L) was perceived at all the research places through post-winter. The percentage of potassium in the waters of Bogolu cheruvu (pond) was within the accepted range (10 mg/L) as per WHO[70].

Acidity: During the post monsoon Peak concentration of acidity (10.06 mg/L) was observed and also low value (7.48mg/L) was recorded during pre-monsoon. The maximum and the minimum values of above mentioned seasons were 7.48mg/L, 10.06mg/L, 17.38 mg/L, respectively.

Table-5
Physico-Chemical parameters changes on different seasons in Bogolu Cheruvu at Nellore
2012-2013 averages

Parameters	Monsoon	Post monsoon	Pre-monsoon
Air Temperature	27.45	20.00	30.91
P^H	7.20	7.23	6.56
DO	4.65	7.59	3.94
TDS	51.89	49.18	75.94
Free Co_2	8.76	8.90	11.19
Alkalinity	7.48	10.06	17.38
Total Hardness	18.32	27.4	32.20
Calcium	4.63	5.83	7.64
Magnesium	2.10	3.35	3.78
Chloride	14.95	12.65	24.80
Nitrate	0.19	0.14	0.049
Sulphate	15.52	31.99	13.94
Sodium	2.31	4.18	4.06
Potassium	1.24	1.66	1.91
Total Acidity	**7.48**	**10.06**	**17.38**

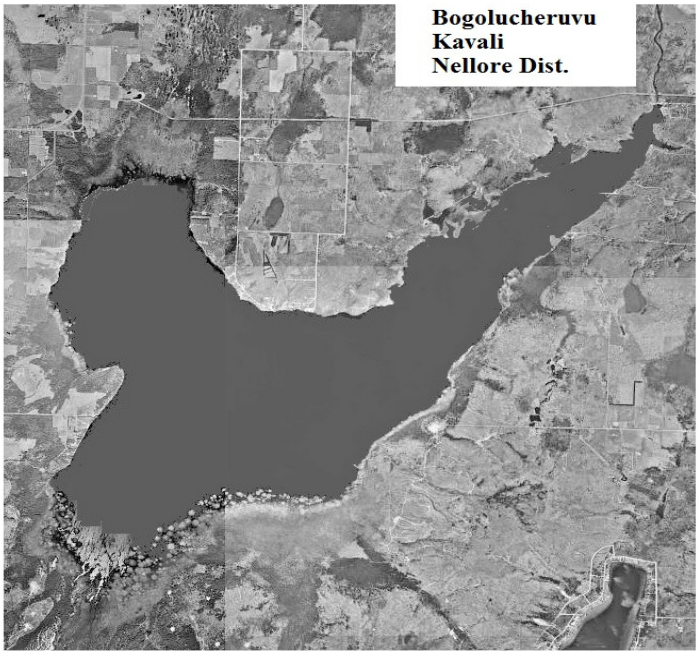

Figure-1
Geographical representation of Bogolucheruvu in Nellore Distt

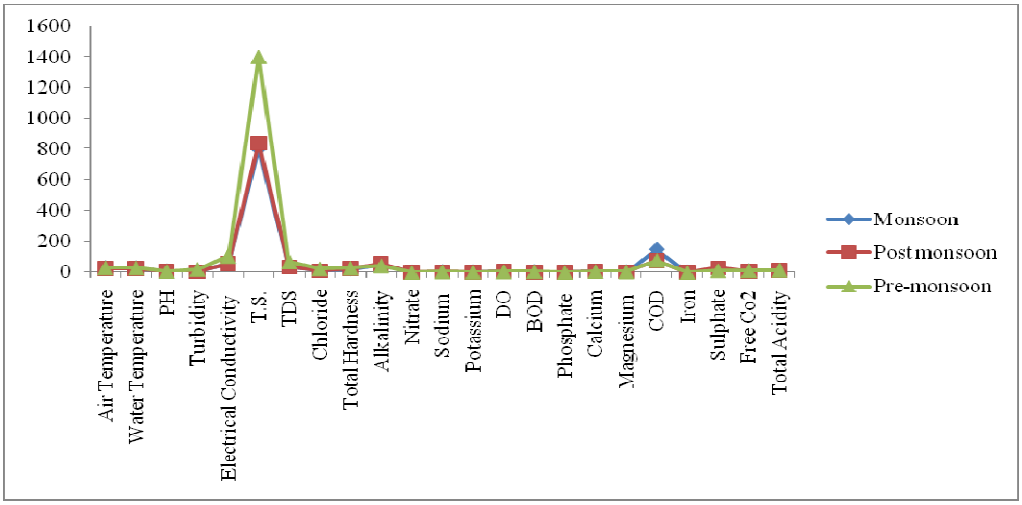

Figure-2
Graphical representation of Seasonal variations in Physico-chemical parameters of Bogulcheruvu 2010-2011

Table-6
Physico-Chemical parameters changes on different seasons in Bogolu Cheruvu at Nellore 2010-2011

Parameters	Monsoon	Post monsoon	Pre-monsoon
Air Temperature	27.12	27.37	30.50
Water Temperature	26.99	26.50	29.87
P^H	7.45	7.55	6.9
Turbidity	8.00	3.99	20.35
Electrical Conductivity	54.75	57.25	103.50
T.S.	800	840	1400
TDS	38.01	35.35	68.63
Chloride	11.94	10.32	23.93
Total Hardness	17.75	24.50	28.37
Alkalinity	51.25	56.75	43.00
Nitrate	0.20	0.13	0.05
Sodium	2.32	4.3	3.87
Potassium	1.15	1.55	1.8
DO	3.58	6.81	3.29
BOD	2.72	1.09	4.73
Phosphate	0.33	0.15	0.05
Calcium	4.21	6.53	6.61
Magnesium	1.69	3.35	4.03
COD	144.50	74.00	77.10
Iron	0.182	0.11	0.312
Sulphate	13.52	28.78	11.70
Free Co_2	7.56	8.99	11.99
Total Acidity	**8.13**	**11.77**	**14.50**

Table-7
Physico-Chemical parameters changes on different seasons in Bogolu Cheruvu at Nellore 2011-2012

Parameters	Monsoon	Post monsoon	Pre-monsoon
Air Temperature	25.25	26.87	29.75
Water Temperature	25.10	26.50	29.50
P^H	7.42	7.24	6.76
Turbidity	118.25	88.50	142.50
Electrical Conductivity	125	122.25	141
T.S.	455.25	720.00	456.74
TDS	80.64	78.06	90
Chloride	20.81	16.45	25.90
Total Hardness	18.92	32.00	38.75
Alkalinity	62	55.17	50
Nitrate	0.20	0.16	0.06
Sodium	2.52	4.27	4.52
Potassium	1.32	1.85	2.45
DO	6.36	8.76	5.37
BOD	2.53	1.33	3.64
Phosphate	0.195	0.08	0.03
Calcium	5.06	5.82	9.54
Magnesium	2.09	2.79	3.36
COD	140.75	76.00	73.10
Iron	0.186	0.14	0.318
Sulphate	20.57	39.74	18.62
Free Co_2	9.52	8.99	10.30
Total Acidity	**7.13**	**9.12**	**18.75**

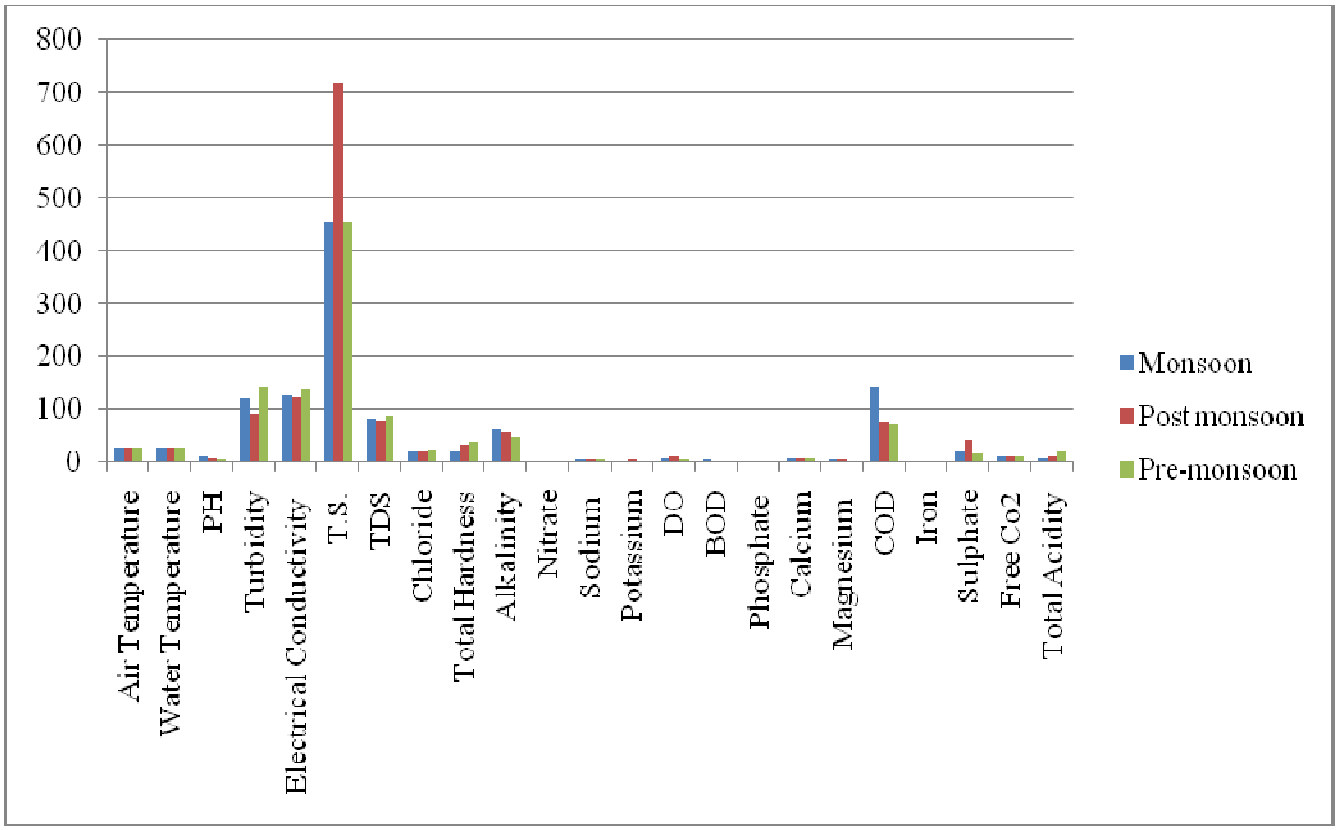

Figure-3
Graphical representation of Seasonal variations in Physico-chemical parameters of Bogulcheruvu 2011-2012

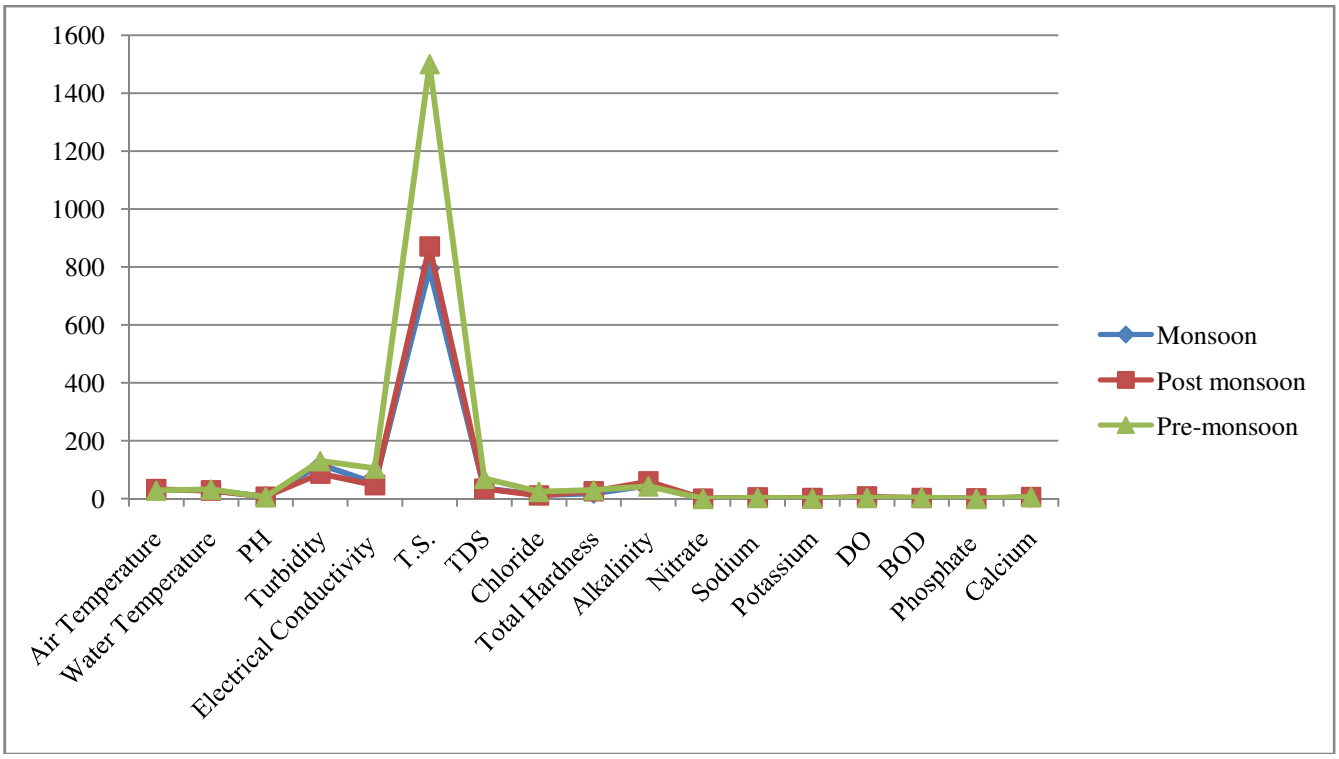

Figure-4
Graphical representation of Seasonal variations in Physico-chemical parameters of Bogulcheruvu 2012-2013

Table-8
Physico-Chemical parameters changes on different seasons in Bogolu Cheruvu at Nellore 2012-2013

Parameters	Monsoon	Post monsoon	Pre-monsoon
Air Temperature	30.00	32.5	28.50
Water Temperature	28.55	28.00	32.10
PH	6.99	6.90	6.03
Turbidity	117.25	86.50	130.20
Electrical Conductivity	53.10	46.97	104.70
T.S.	795	870	1500
TDS	37.02	34.13	69.19
Chloride	12.10	11.20	24.59
Total Hardness	18.32	25.70	29.49
Alkalinity	45.78	59.23	43.00
Nitrate	0.19	0.14	0.037
Sodium	2.10	3.97	3.79
Potassium	1.27	1.59	1.49
DO	4.02	7.21	3.17
BOD	2.90	2.10	4.50
Phosphate	0.27	0.37	0.049
Calcium	4.81	5.14	6.79
Magnesium	2.52	3.92	3.97
COD	137.20	63.79	75.90
Iron	0.23	0.17	0.45
Sulphate	12.49	27.45	11.52
Free CO_2	9.20	8.73	11.75
Total Acidity	**7.20**	**9.30**	**18.90**

Table-9
Seasonal variations of Physico-Chemical parameters Average of Bogolu Cheruvu at Nellore

Parameters	Monsoon	Post monsoon	Pre-monsoon
Air Temperature	27.45	27.58	30.91
Water Temperature	26.88	27.00	30.49
P^H	7.28	7.23	6.56
Turbidity	81.16	59.66	97.68
Electrical Conductivity	77.61	75.49	116.40
T.S.	683.41	810.00	1118.91
TDS	51.89	49.18	75.94
Chloride	14.95	12.65	24.80
Total Hardness	18.32	27.4	32.20
Alkalinity	7.48	10.06	17.38
Nitrate	0.19	0.14	0.049
Sodium	2.31	4.18	4.06
Potassium	1.24	1.66	1.91
DO	4.65	7.59	3.94
BOD	2.71	1.50	4.29
Phosphate	0.26	0.20	0.04
Calcium	4.63	5.83	7.64
Magnesium	2.10	3.35	3.78
COD	140.81	71.26	75.36
Iron	0.19	0.14	0.36
Sulphate	15.52	31.99	13.94
Free CO_2	8.76	8.90	11.19
Total Acidity	**7.48**	**10.06**	**17.38**

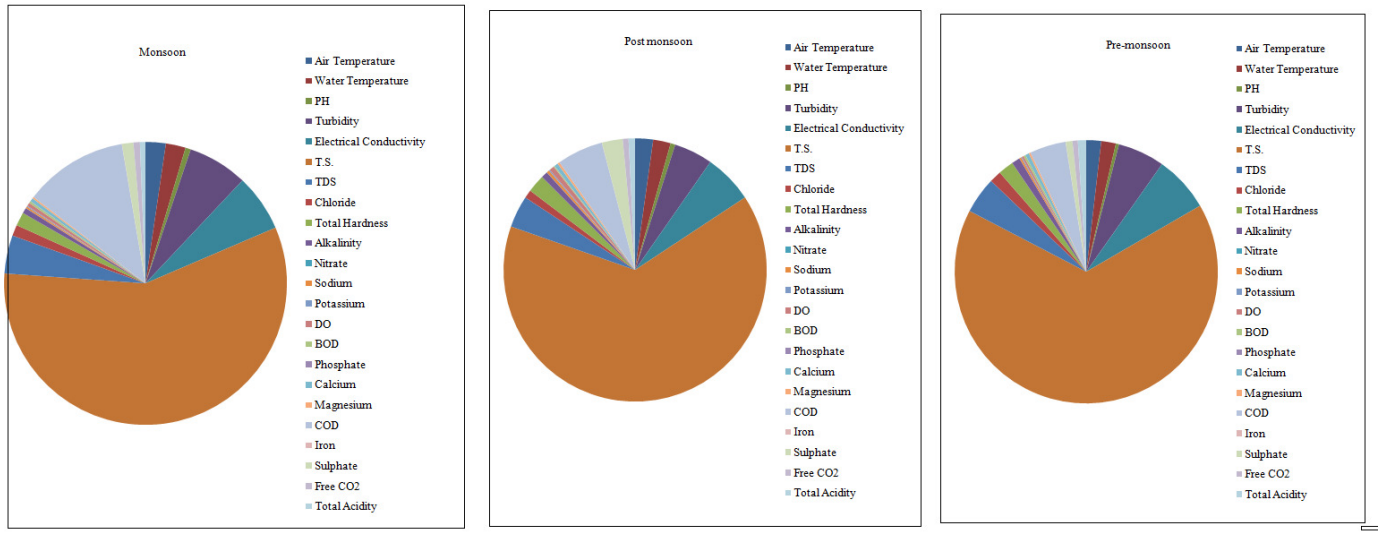

Figure-5
Graphical representation of Seasonal variations in Physico-chemical parameters Average of Bogulcheruvu

Table-10
Correlation Matrix pooled Physico-Chemical Parameters v/s Physico-Chemical parameters of Bogolucheruvu

	AT	WT	P^H	EC	TDS	TUR	DO	BOD	Free Co_2	Cl	Ca	Mg	T.H	T.Alk	T.Aci	PO_4	NO_3	SO_4	Na	K
AT	1.00																			
WT	0.86	1.00																		
P^H	-0.55	-0.55	1.00																	
EC	0.01	0.13	-0.17	1.00																
TDS	0.04	0.66	-0.80	0.94	1.00															
TUR	0.27	0.3	-0.44	0.50	0.52	1.00														
DO	-0.58	-0.58	0.45	0.20	0.16	0.13	1.00													
BOD	0.82	0.86	-0.46	0.33	0.13	0.24	0.77	1.00												
Free Co_2	0.71	0.73	-0.50	0.52	0.54	0.27	-0.15	0.75	1.00											
Cl	0.44	0.53	-0.45	0.83	0.87	0.47	-0.31	0.75	0.82	1.00										
Ca	0.44	0.53	-0.45	0.83	0.87	0.47	-0.31	0.75	0.82	0.67	1.00									
Mg	0.12	0.06	0.10	-0.01	-0.02	-0.52	0.83	0.45	-0.05	-0.40	0.65	1.00								
T.H	0.40	0.47	-0.33	0.63	0.80	0.33	0.21	0.26	0.50	0.60	0.88	0.61	1.00							
T.Alk	-0.82	-0.81	0.64	-0.05	-0.07	-0.03	0.81	-0.7	-0.6	-0.55	-0.23	-0.32	-0.2	1.00						
T.Aci	0.72	0.79	-0.55	0.49	0.47	0.24	-0.34	0.63	0.66	0.73	0.85	0.68	0.77	0.53	1.00					
PO_4	0.52	0.41	0.62	0.55	-0.38	-0.14	-0.26	0.42	0.57	0.18	0.22	-0.64	-0.25	0.15	0.45	1.00				
NO_3	0.23	0.38	0.42	0.69	0.48	-0.14	0.18	-0.27	0.26	0.09	0.18	0.22	0.40	0.13	-0.26	0.58	1.00			
SO_4	-0.55	-0.54	0.39	0.08	0.05	-0.05	0.96	-0.79	-0.41	-0.35	-0.08	-0.09	0.26	0.68	0.28	0.02	0.53	1.00		
Na	0.32	0.04	-0.70	0.37	0.34	0.21	0.43	-0.01	0.40	0.11	-0.18	0.72	0.87	0.01	0.63	-0.32	-0.01	0.50	1.00	
K	0.53	0.59	0.10	0.70	0.69	0.33	0.32	0.25	0.55	0.63	0.99	0.58	0.97	-0.09	0.67	-0.31	0.01	0.26	0.82	1.00

Conclusion

From the obtained results one can safely conclude that, different levels of anthropogenic inputs have caused wide variations in physico –Chemical parameters in various parts of Bogolu cheruvu. There was a significant seasonal and spatial variation in Physico-Chemical parameters. Human activities and other biotic factors were implicated as the reasons for the observed spatial variations in the distribution of Phytoplankton of the tank.

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