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Physico Chemical Parameters and Algal Diversity of Pedda Cheruvu Lake in Rajgopalpet, Siddipet District, Telangana, India

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A B S T R A C T

The water quality is mainly assessed using traditional water quality techniques that measures chemical parameters against established standard values. The quality of water index is used worldwide for water quality assessment. The main parameters assessed include the total dissolved solids, BOD, COD, Electrical conductivity, Carbonates, Nitrate and Nitrites etc. In this study, the physico-chemical parameters are combined with algal analysis was used to assess the water quality of the Peddacheruvu lake. The Peddacheruvu lake in Rajgopalpet is a fresh water lake located at Latitude 18°09'60"38N, Longitude 78°93'73"93E. It has an average elevation of 675 meters (2215 feet) above the mean sea level. It covers over seven villages of surrounding areas of Rajgopalpet. Physico-chemical parameter studies and algal identification of peddacheruvu Lake, Rajgopalpet, Siddipet district, Telangana State was carried out from the past two years. The physico-chemical characteristics of lake water were studied and evaluated during the period of a year. The algal diversity pattern was more or less uniform throughout the study period in Peddaceruvu lake, indicates oligotrophic nature and it is useful for human utility.

***Key words*:** Fresh water, Physico-chemical parameters, Nutrients, Algal diversity, Peddacheruvu lake

Water is a ubiquitous chemical compound consist of two hydrogen atoms and one oxygen atom and exhibit three physical states like Liquid, Gas and Solid. It is a most plentiful and essential chemical compound found everywhere on earth. It is a tasteless, odorless and color less liquid at room temperature. But water inherently has blue color caused by absorption of light at a wavelength of red color region. It has the important property to dissolve many other polar substances, indeed the versatility of water as a solvent is necessary for living organisms [1]. It is also found in other planets of the galaxy. As water cycles from the air to the land to the sea and back again, water shapes our planet and nearly every aspect of human and animal lives. Every living organism on earth needs water to survive, but more than one lakh species including human beings, need a special kind of water that can only be found in certain places and is in very rare supply. Presence of various chemical parameters like Carbonates, bicarbonates, phosphates, nitrates, nitrites, silicates, chlorides etc., and their concentrations influence the existence and growth of different kinds of water organisms and productivity of the lake.

Fresh water ecosystem varies in size, its composition and contains a large variety of both zooplanktons and phytoplanktons. Microalgae are vast group of procaryotic and eucaryotic photosynthetic organisms found in many different forms viz. individual cells, colonies or extended filaments and exhibit vast diversity in the ecosystem [2].

A captivating thing about fresh water lakes is that they provide variety of chemical substances which influence the growth of phytoplanktons of diverse range. As a limnologist we should measure and interpret this discrepancy whether it concerns physical, chemical, biological phenomena, altitude, geology of the catchment areas and the depth of water. Increased use of lakes and reservoirs for amusement, water storage for irrigation, fisheries, and electric power generation as well as urbanization, has emphasized the need for intensive water quality studies and maintenance. The physical and chemical limnology of a lake is distinguished by hydrological impact, autogenic nutrient dynamic and biological aspects. These factors combine with each other to estimate the water quality and consequently lake community. Seasonal variations at three different stations of the lake were observed. Sewage drains, clothes washing, bathing of animals, agro-waste with pesticides residues and ritual waste can change the physico-chemical characteristics of water. Contamination can notably change the chemical behavior of water, compromising the overall balance of the lake ecosystem, causing economic losses, and making its consumption impractical. Some parameters like pH, temperature, dissolved oxygen, hardness, nitrate, silicates and Phosphates etc. studied throughout year. The most common causes of compromised rivers and lakes is the demographic and industrial growth that has occurred in past few years and the inappropriate use of these resources. The public desires water

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that is low in hardness total solids, non-corrosive and non-scale-forming [3].

The phytoplanktonic species are present in all the standing water bodies as well as in the middle and lower reaches of rivers. Phytoplanktons are ecologically significant as they trap radiant energy of sunlight and convert it to chemical energy i.e., organic materials. Many herbivores, mostly zoo plankton, graze upon the phytoplankton thus, passing the stored energy to its subsequent tropic levels [4]. The phytoplankton float passively and spread uniformly and extend down to various depths, where light is available for photosynthesis. Studies on phytoplankton of Indian lentic system in relation to their environmental conditions have been made by [5-6]. Algae plays an important role in purification of water by photosynthesis. In other words, it helps in the process rejuvenation of rivers [7-9]. Phytoplanktons are often considered as powerful biological indicators of fresh water ecosystem [10].

MATERIALS AND METHODS

Rajgopalpet village present in Nangunoor mandal, Siddipet district of Telangana state in India. It is one of the biggest villages in Nangunoor mandal of Siddipet district and is situated in between siddipet to Warangal main road. Rajgopalpet is located at a Latitude of 18°09'60"38N and a Longitude of 78°93'73"93E. It has an average elevation of 675 meters (2215feet) above the sea level. Once upon a time peddacheruvu water has been used for drinking purpose but in recent days this lake water is utilizing for agriculture and fish culture. The climate of Rajgopalpet village was once fairly equitable with maximum temperature 43 °C and minimum temperature 12 °C, average annual temperature 30 °C, average summer temperature 41 °C, and average winter temperature found as 16 °C.

The water samples for physico-chemical parameter study and algal identification were collected from three different stations of peddacheruvu lake, Rajgopalpet at monthly intervals over a period of one year in a one-liter polyethene bottles and transported to the laboratory. Separate samples were collected to determine the dissolved oxygen in 250 ml BOD bottles and dissolved oxygen was fixed in the field by adding Wrinkler's reagent immediately after collecting sample from each station. The temperature and pH were measured with the help of digital thermometer and digital pH meter at collection site only. The Physico-chemical characteristics of the lake water like dissolved oxygen, Total alkalinity, Hardness, silicates, Nitrates and Phosphates were determined in every month according to standard procedure from APHA [11], Trivedi and Goel [12]. Samples were preserved in formaldehyde and reduced to 50 ml by sedimentation. This concentrated material was used for algal identification. Identification was done according to standard methods of APHA, AWWA, WEF, 2005.

RESULTS AND DISCUSSION

Temperature

It effects the biochemical reactions, population fluctuation of water body as well as physical and chemical characteristics of water. During the present investigation the surface water temperature of lake showed considerable fluctuation. The temperature varies between a December minimum of 21.3 °C to a June maximum 26.2 °C with an average of 23.83 °C.

Dissolved oxygen (D.O.)

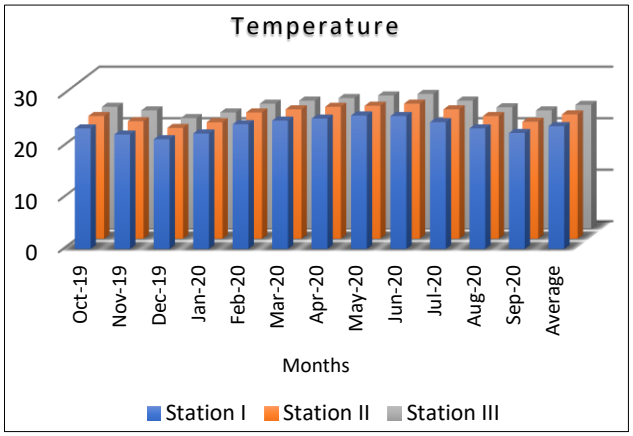
It affects the solubility and availability of many nutrients and therefore the productivity of aquatic ecosystem. Oxygen distribution is key criterion as it is the direct need for most of the organism present in the environment. The dissolved oxygen varied in the range of 7.4 to 9.6 mg/l of observations with an average of 9.7 mg/l. The fluctuation in dissolved oxygen level remained marginal during the period of present study.

During summer lowest values of dissolved oxygen may be due to high temperature and low solubility of oxygen in

water consequently affecting the BOD. Further, the dissolved oxygen content of water was low in summer because of its enhanced utilization by microorganisms in the decomposition of organic matter [13].

Table 1 Variation in temperature at monthly intervals

Temp.		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	23.4	22.2	21.3	22.4	24.2	24.9	25.3	25.9	25.8	24.6	23.4	22.5	23.83
	II	23.8	22.8	21.5	22.6	24.5	25.1	25.6	25.8	26.2	25.1	23.8	22.7	24.13
	III	23.6	22.9	21.4	22.5	24.2	24.8	25.3	25.8	26.1	24.8	23.5	22.9	23.98



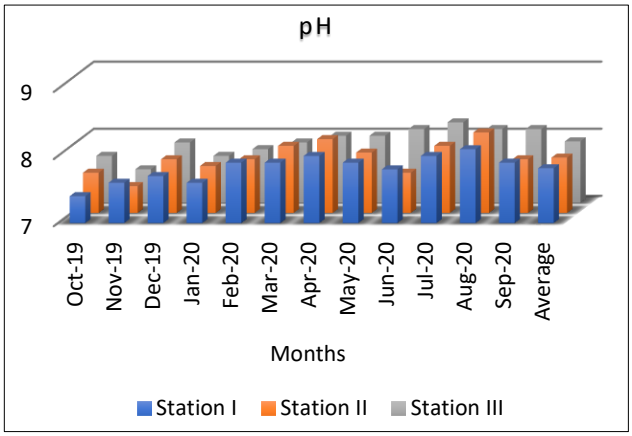
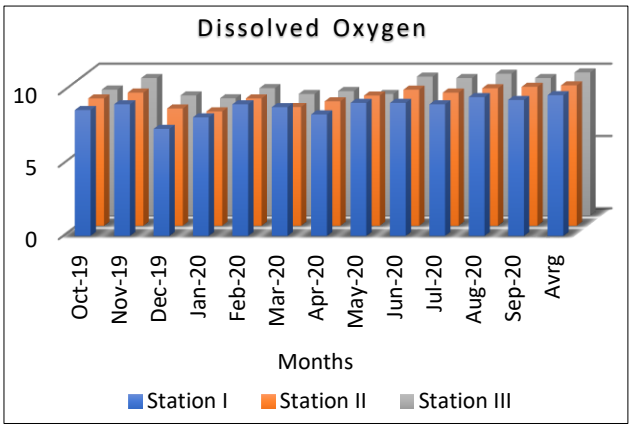


Table 2 Variation of pH at monthly intervals from October-2019 to September-2020

pH		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	7.4	7.6	7.7	7.6	7.9	7.9	8	7.9	7.8	8	8.1	7.9	7.82
	II	7.6	7.4	7.8	7.7	7.8	8	8.1	7.9	7.6	8	8.2	7.8	7.83
	III	7.7	7.5	7.9	7.7	7.8	7.9	8	8	8.1	8.2	8.1	8.1	7.92

Table 3 Variation of dissolved oxygen at monthly intervals from October-2019 to September-2020

D.O		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	8.7	9.1	7.4	8.2	9.1	8.9	8.4	9.2	9.2	9.1	9.6	9.4	9.73
	II	8.8	9.2	8.1	7.9	8.8	8.2	8.6	9	9.4	9.2	9.5	9.6	9.7
	III	8.7	9.5	8.3	8.1	8.8	8.4	8.6	8.4	9.6	9.5	9.8	9.5	9.89



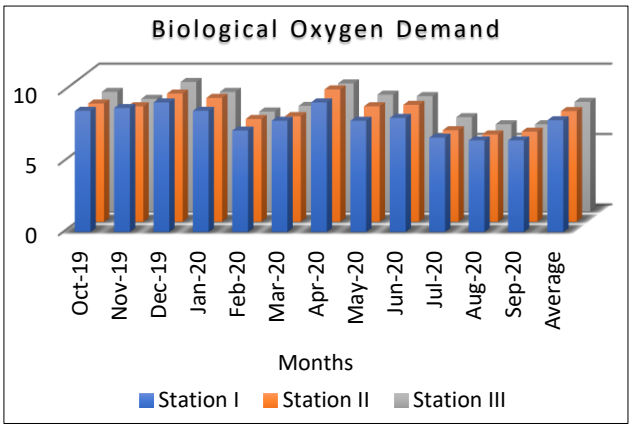


Table 4 Variation of B.O.D at monthly intervals from October-2019 to September-2020

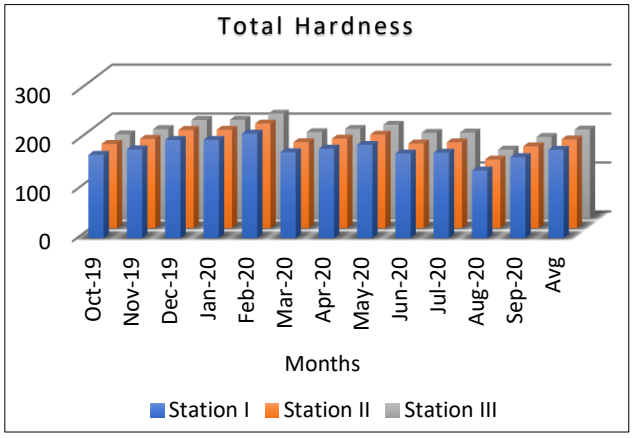
B.O.D		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	8.6	8.8	9.2	8.6	7.2	7.9	9.2	7.9	8.1	6.7	6.5	6.5	7.93
	II	8.4	8.2	9.1	8.8	7.3	7.5	9.4	8.2	8.3	6.5	6.2	6.4	7.86
	III	8.5	8	9.2	8.5	7.1	7.5	9.1	8.3	8.2	6.7	6.2	6.2	7.79

Biochemical oxygen demand (BOD)

In the present work, during the period of investigation, BOD values ranged from 6.2 mg/l to 9.4 mg/l in the Peddacheruvu lake. BOD is the major criterion used in pollution control where organic loading must be restricted to maintain desired dissolved oxygen. In unpolluted water BOD is lower while it is high in polluted water.

Table 5 Variation of total hardness at monthly intervals from October-2019 to September-2020

T.H.		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	170.2	181.3	200.6	200.8	213.6	175.6	182.8	190.4	172.8	175	138.2	165.6	180.5
	II	172.1	182.6	200.8	201.2	213.8	175.9	183.1	191.2	173.2	176	140.2	167.3	181.4
	III	171.5	182.3	201	201.4	213.9	176.1	182.6	191.2	174.6	175	140.5	166.2	181.4



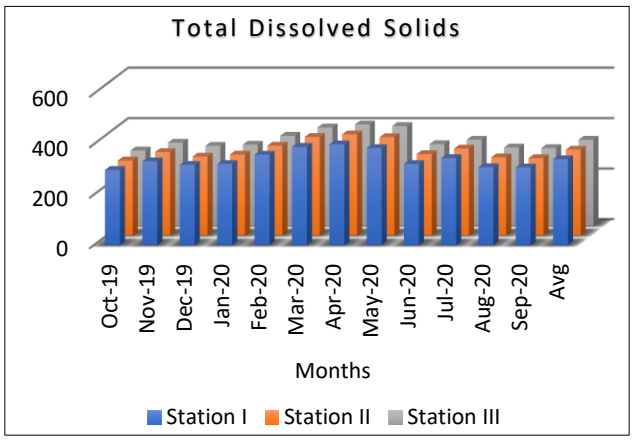


Table 6 Variation of total dissolved solids at monthly intervals from October-2019 to September-2020

T.D.S.		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	298.2	332.2	318.2	321.5	358.6	389.6	399.5	384.8	321.5	345.2	308.9	307.8	340.5
	II	297	330.5	312.6	320.5	355.8	390.5	400.6	389.4	322.6	344.2	309.6	306.2	340.0
	III	298.5	329.4	316.8	321.2	356.6	389.5	401.5	395.2	323.5	341.2	310.3	307.8	341.0

Total hardness

Total hardness varied between 138.2.0 mg/l (August) minimum and a maximum value 213.9 mg/l was during February. The total hardness values vary widely suggested that the concentration of total hardness might be increased due to input of domestic and other sewage water in the lake. According to Jhingran [14] soft water lakes are generally poorer in regard to their aquatic fauna and flora and usually contain less living matter per unit area than hard water lakes. Although the total mass of organisms is greater in hard water lakes while medium lakes hold a greater variety of living organisms.

Total dissolved solids (TDS)

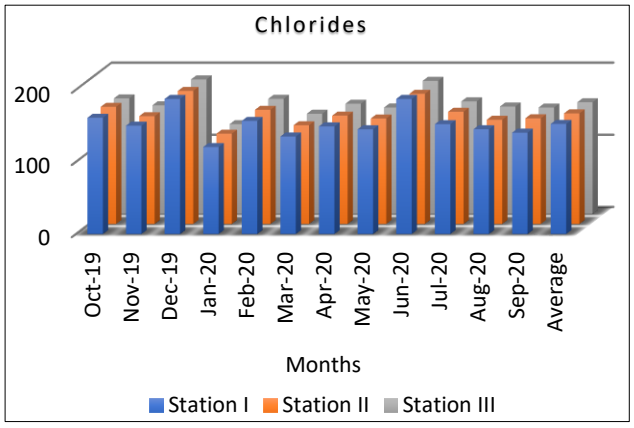
The water always contains some dissolved solids in natural condition. The solids remaining in water after filtration are called total dissolved solids. They may be organic or inorganic but precisely, the dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, sulphates, calcium, phosphate and iron [15]. The greater TDS value for Peddacheruvu lake water was estimated to be 297 mg/l in the month of October and lower was 401.5 mg/l in the month of April.

Chlorides

The estimated highest concentration of chloride was 187.3 mg/l in June. The higher concentration of chloride is considered to be an indicator of higher pollution of due to higher organic waste of animal origin [16]. Due to dilution of lake water with rain water the concentration of chlorides decreases and found 126.6 mg/l in the month of January.

Table 7 Variation of chlorides at monthly intervals

Cl^-		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	161.2	150.2	187.3	120.6	156.8	135.2	149.2	145.2	187.3	152.3	145.3	140.5	152.5
	II	162.4	149.4	184.5	125.2	158.3	136.9	150.2	146.2	180.5	155.6	144.5	146.5	153.3
	III	160.2	150.6	186.5	124.5	159.6	138.9	152.8	147.6	184.5	156.1	148.9	147.5	154.8



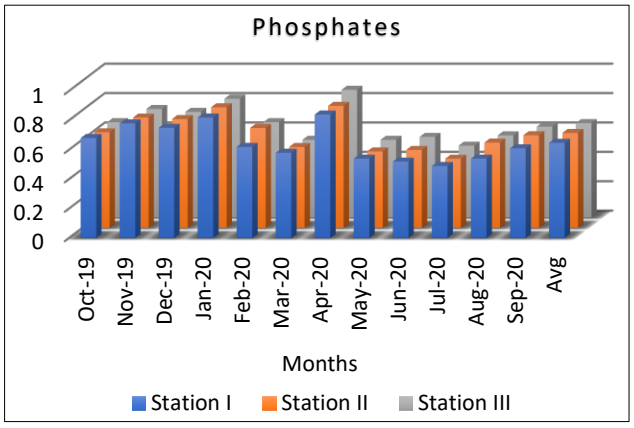
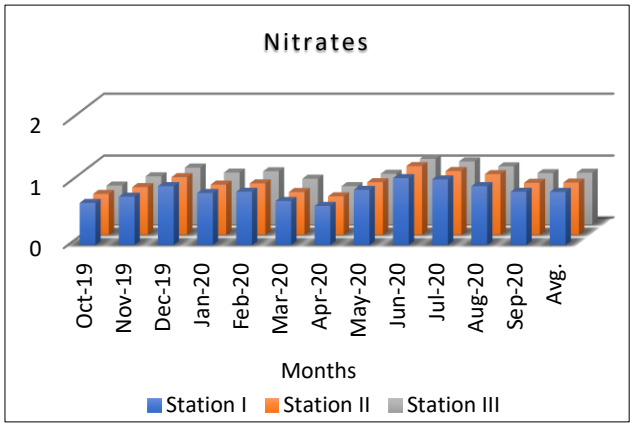


Table 8 Variation of phosphates at monthly intervals

PO_4^{3-}		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	0.68	0.78	0.75	0.82	0.62	0.58	0.84	0.54	0.52	0.49	0.54	0.61	0.65
	II	0.65	0.75	0.74	0.82	0.68	0.55	0.83	0.52	0.53	0.47	0.58	0.63	0.65
	III	0.65	0.74	0.72	0.81	0.65	0.53	0.87	0.53	0.55	0.49	0.56	0.62	0.64

Table 9 Variation of nitrates at monthly intervals

NO_3^{-1}		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	0.68	0.78	0.95	0.84	0.86	0.71	0.63	0.89	1.08	1.06	0.95	0.86	0.86
	II	0.66	0.77	0.93	0.81	0.83	0.69	0.62	0.85	1.11	1.03	0.98	0.84	0.84
	III	0.63	0.78	0.92	0.84	0.86	0.74	0.62	0.82	1.06	1.02	0.94	0.83	0.84



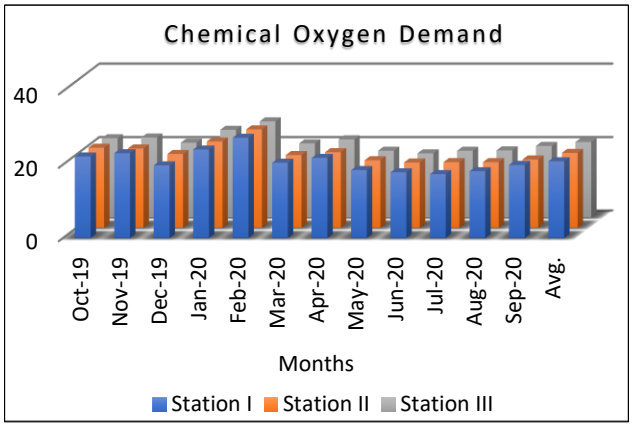


Table 10 Variation of C.O.D at monthly intervals

C.O.D		Months												
		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Average
Station	I	22.2	23.1	19.8	24.1	27.3	20.5	21.8	18.5	17.9	17.4	18.2	19.9	20.9
	II	21.8	21.6	20.1	23.5	26.8	19.8	20.6	18.4	17.8	17.9	17.9	18.6	20.4
	III	21.6	21.8	20.4	23.9	26.2	20.2	21.3	18.2	17.5	18.2	18.3	19.5	20.6

Phosphates

Phosphorus is an essential nutrient for primary producer; hence act as one of the limiting factors in the process of eutrophication and lakes can be aesthetically classified into good, fair and bad on the basis of % phosphates loading. In natural water, phosphorus is present in very small quantities. The main supply of phosphorus only in natural water is from the withering of phosphorus bearing rocks and leaching of the soils of the catchment area by rain. Generally excess of this nutrient through untreated domestic sewage and agricultural runoff lack of phosphorus content of more than 0.20 mg/l are likely to be quite productive. The phosphate-phosphorus was recorded in the range of 0.47 to 0.87 mg/l of observations.

Nitrates

It is well known fact that the role of the nitrates in biological productivity of aquatic ecosystem. In an aquatic environment, nitrogen is present in combined forms of ammonia, nitrite, nitrate, urea and dissolved organic compounds nitrate ranged between 0.62 (April) to 1.11 mg/l(June). The marked increase in the nitrates level was observed during months of June probably due to decomposition of macrophytes.

Chemical oxygen demand (COD)

The estimation of COD along with BOD is helpful in indicating toxic conditions and the presence of non-biodegradable substances in the water [17]. High number of COD indicates presence of all forms of organic matter, both biodegradable and non-biodegradable and degree of pollution of lake water. The estimated greater number of COD was 26.8 mg/l in February and lowest was 17.4 mg/l in July.

In the present investigation an attempt was made to generate base line information about some physicochemical characteristics and quality of Peddacheruvu lake water in different season. The winter, summer and monsoon seasons show seasonal fluctuations in various Physico-chemical parameters. The water of present lake is utilized for irrigation, washing of cloths, fish culture and rituals. The water parameters indicate that the lake is rich in nutrients.

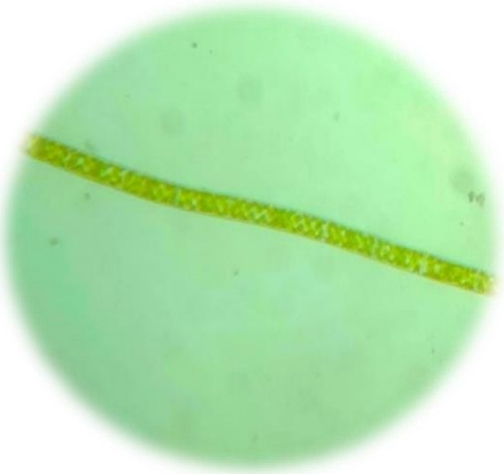
Phytoplankton plates

During the present study surface and ground water samples were collected from three different stations of Rajgopalpet Peddacheruvu lake. The following phytoplanktons have been identified in the course of the investigation period.

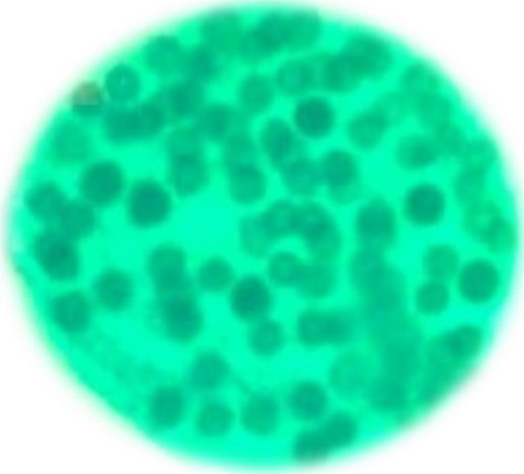
Chlorophyceae

A. *Spyrogyra alpina*: It is a free-floating green alga found everywhere in the Peddacheruvu lake. It shows anti-biotic, anti-inflammatory and cytotoxic properties.

B. *Volvox tertius*: It is a fresh water green algae generally forms oval hollow shaped colonies. It prefers to live in nutrient rich water bodies such as lakes and canals.



A



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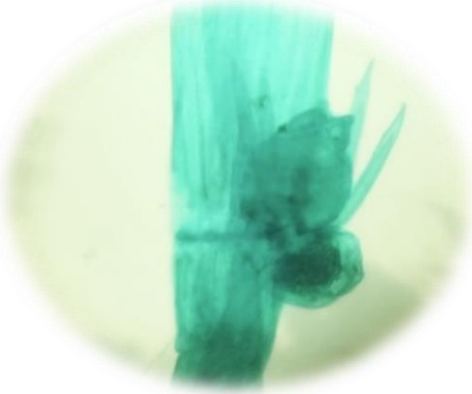

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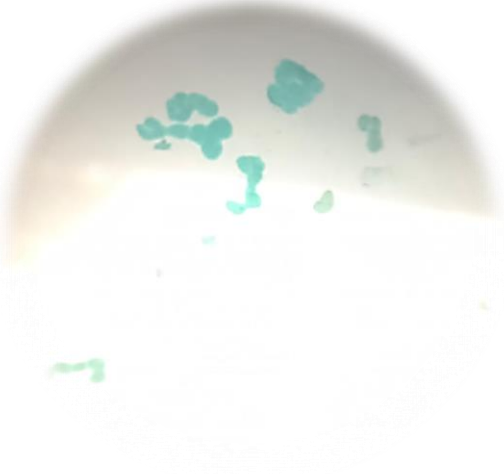

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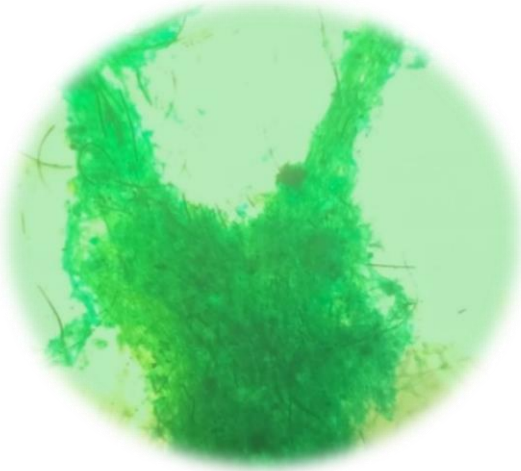

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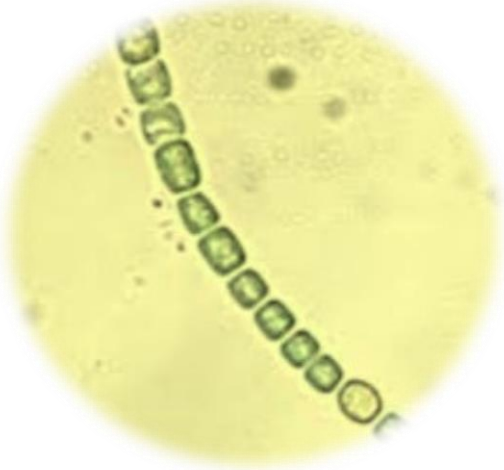

H

C. *Chara globularis*: Multicellular superficially resemble land plants. Plant body of chara is encrusted with calcium and magnesium carbonate. It provides food for various water fowl and cover for fish.

Bacillariophyceae

D. *Cyclotella bodanica*: The diatoms are widely distributed in both fresh water and marine habitats. Its cell wall is ornamented by intricate and striking patterns of silica. The growth of diatoms reflects the water pollution and they are used in tooth pastes.

Cyanophyceae

E. *Anabaena azollae*: It is a genus of filamentous cyanobacteria. Anabaena may form water blooms. They are known of nitrogen fixing abilities and they form symbiotic relationship with certain plants.

F. *Nostoc brittoni*: Nostoc may be found on soil and floating in quiet water. It is highly nutritious containing protein. It is considered to be a strong candidate for extraterrestrial agriculture.

G. Oscillatoria amoena: Filamentous, mucilaginous cyanobacteria. It is a genus of blue green algae common in fresh water environments including hot springs. It has ability to activate cells of the immune system.

CONCLUSION

The present analysis reveals that the phytoplankton in the lake assessing the quality of water. The algal data has been used as an important tool in lake study. The present investigation showed different algal members belonging to different classes namely Chlorophyceae, Cyanophyceae, Basillareophyceae and Euglenophyceae. Chlorophyceae stands first in all observations and next to cyanophyceae, Basillareophyceae was the third dominating group and last one is Euglenophyceae. The Physico-chemical parameters had indicated the wider human activity and influx of domestic waste into the lake caused to eutrophication. The values of Physico-chemical parameters assessed are found to be slightly above the permissible limit prescribed by WHO for drinking water. The Physico-chemical parameters show seasonal fluctuations. The water of present Peddacheruvu lake is useful for drinking, irrigation as well as fish culture.

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