Ecological Studies on Safilguda Lake with Reference to Water Quality

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Abstract: In this paper, the **Ecological studies on Safilguda lake were carried out. For this purpose, the physico-chemical parameters and phytoplankton were taken into consideration. The physico-chemical parameters showed some variation in the lake. The lake water is alkaline and dissolved oxygen was always recorded in low concentration. Bicarbonates, chlorides, organic matter, total hardness and total dissolved solids have been reported in high concentrations. In the lake, four groups of algae were recorded. Among these, Euglenophyceae was dominant followed by Cyanophyceae. On the basis of the physico-chemical and biological parameters, the assessment of water quality has been made.**

Index Terms: **Safilguda lake, Ecological studies, Water quality, Physico-chemical parameters and Phytoplankton**

I. Introduction

Water is the most valuable blessing to humankind and life on earth is not conceivable without water. Life on land, in the lakes, rivers and other freshwater habitats of the earth is vitally dependent on renewable fresh water, a resource that comprises only a tiny fraction of the global water pool. About 71 percent of the Earth's surface is covered with water and the distribution of water on the earth is uneven. The oceans hold about 97 percent of all Earth's water which is saline. Only 3% of Earth's water is freshwater, the amount needed for life to survive. A small portion of fresh water, less than one percent, is in lakes, rivers and streams. Lakes have environmental significance as sources of surface and ground water recharge, controls runoff, moderate the hydrological events drought and floods, host variety of flora and fauna and provide a wide array of recreational activities and aesthetic benefits for humans to enjoy.

Water is a scarce and precious resource which is not only being overexploited but also is seriously degraded due to anthropogenic activities. Water is a synonym for life without which life would not have emerged. Water, an indispensable requisite in natural state is free from contamination. Humans due to over usage, improper management and pollution have modified the quality and quantity of water resources to the greater extent. Release of waste waters from industries, household, agricultural runoff and urban waste alters the characteristics of water making it unfit and unsuitable for various purposes.

Water quality is a term used to describe the physical, chemical and biological characteristics of water, usually in respect to its suitability for a particular purpose. Potable or drinking water is defined as having acceptable quality in terms of its physical, chemical, and bacteriological parameters so that it can be safely used for drinking. Physical, chemical and biological properties which make the water quality change due to water pollution and affect the aquatic ecosystem. The aquatic organisms respond to these changes. Thus, water quality leads to the changes in distribution and composition of the species of aquatic environment. Presence or absence or dominant growth of some aquatic organisms is an indicator of water quality. Water pollution not only affects water quality but also threatens human health, economic development and social prosperity. By physico-chemical analysis, the water quality can be assessed. Chemical analysis in testing the water quality can reveal the concentration and type of pollutants present in the water. Biological analysis talks about the effects of pollutants on aquatic life.

Physico-chemical and biological factors are very important for ecological studies of water bodies. Better quality of water is described by its physical, chemical and biological characteristics [1]. Pollution alters the physical, chemical and biological parameters of water resources and deteriorates the water quality. Phytoplankton and various physico-chemical parameters help in assessing the water quality and pollution. Physico-chemical analysis is the prime consideration to assess the quality of water for its best use for drinking, irrigation and industrial purposes. The phytoplanktonic algae are the aquatic flora which grow in different aquatic ecosystems. Many taxonomic groups of algal communities are present. The study of phytoplankton gives their number, variety and distribution [2]. The variations and distribution of phytoplankton in freshwater depend on physico-chemical features. Phytoplankton are sensitive to the changes in aquatic environment and therefore act as indicators of water quality. Some phytoplankton dominate in polluted, eutrophic waters like blue-green algae and euglenoids whereas diatoms grow profusely in fresh waters. Blue greens grow abundantly and form algal blooms during summer.

II. Materials and methods

Hyderabad, the capital of Telangana which is the newly formed and youngest Indian state is one of the major urban cities in India. Aside from historical monuments, Hyderabad is popular for its lakes and was called as Limnological capital of India which provide a perfect escape from the hustle and bustle of city life.

Safilguda lake, originally named Nadimi cheruvu is a natural lake located in Safilguda, Hyderabad. The lake was the source of irrigation for the farmers and the Hyderabadi nawabs and the military authorities used to quench their

thirst. The lake was spread over 17acres. Due to gradual dwellings around the lake since 1975, the ill-effect on the lake has started. The lake is now spread over 5acres with a depth of 5metres.

Water samples were collected from the sampling stations of Safilguda lake. The entrance of the lake is the first monitoring station on the left side of the lake for immersion of Ganesh idols. Centre of the lake is taken as second sampling station. The lake's right side is the station III which is surrounded by residential areas.

From the sampling stations of Safilguda lake, water samples were collected every month during May 2017 to April 2018. The samples were tested in the laboratory for different physical and chemical parameters following APHA, 2005 [3] procedures. For Phytoplankton study, collected water samples of one litre were added with 2-3 ml of 4% formaldehyde solution and were kept in the sedimentation column undisturbed. Settling of the organisms in the samples takes about a month. For frequency measurements and identification of algal species, the samples were concentrated to 100 ml. At each station, the drop method of Pearsall et.al. (1946) [4] was followed for frequency measurement of different species of phytoplankton.

III. RESULTS AND DISCUSSION

Physico-chemical parameters: The average values of physico-chemical parameters of the three stations are incorporated in Table 1.

TABLE I.
AVERAGE VALUES OF PHYSICO-CHEMICAL PARAMETERS OF SAFILGUDA LAKE. (ALL VALUES ARE EXPRESSED IN MG/L EXCEPT PH AND TEMPERATURE)

S.No	Parameters	Station I Average	Station II Average	Station III Average
1	Temperature	21.4	21.3	21.4
2	pH	8.3	8.4	8.4
3	Carbonates	17.5	23.3	24.5
4	Bicarbonates	285.6	215.14	247.23
5	Chlorides	301.25	338.62	333.11
6	DO	3.5	3.1	3.3
7	OM	8.4	8.6	8.8
8	COD	350.8	355.6	274.5
9	Total hardness	422.2	454.6	495.7
10	Calcium	43.3	35.9	26.12
11	Magnesium	20.2	9.5	13.8
12	Phosphates	10.2	10.9	10.98
13	Sulphates	30	14.4	24.9
14	Silicates	0.91	0.94	0.91
15	Nitrites	0.003	0.0037	0.003
16	TDS	845	834	870

From the table, it is evident that the lake exhibits alkalinity with pH ranging from 8.0 to 8.8 at all the stations. 6 to 48.0 mg/L is the range for carbonates. Bicarbonates ranged from 132.0 to 295.67 mg/L. The range of Chlorides was 140.0 to 365.8 mg/ L. 1.6 to 4.2 mg/L is the range of DO. The range of Organic matter was 1.5 to 18.5 mg/L. Chemical oxygen

demand ranged from 100.0 to 560.0 mg/L. Total hardness was in the range of 210.0 to 500.0 mg /L. Ca and Mg ranged from 13.0 to 64.3 mg/L and 6.0 - 32.0 mg/L respectively. Phosphates were in the range of 8.98 - 13.89 mg /L. Nitrites were recorded in trace amounts ranging from 0.002 - 0.006 mg/L. Sulphates ranged from 11.45 to 28.89 mg/L. Silicates were in the range of 0.45 to 1.56 mg/L. Total dissolved solids ranged from 600 to 870 mg/L.

During the year, monthly analysis of water samples taken from Safilguda lake was done for physico-chemical parameters to study seasonal fluctuations, variations and interrelationships. There are certain correlations between the physico-chemical parameters.

The physico-chemical parameters exhibit certain interrelationships. The life of aquatic species is influenced by water quality characteristics. They have an impact on the variety, distribution and species makeup of the organisms. Water bodies undergo seasonal changes in their physico-chemical characteristics.

Surface water temperature regulates various physico-chemical and biological activities in the aquatic environment and has a major influence on the growth and distribution of aquatic organisms. The rate of chemical reactions in aquatic living forms can be influenced by the changes in water temperature. Hence, temperature is one of the most significant parameters for the aquatic ecosystem. In the present study, the lowest temperature was found during winter while the highest during summer.

In the present study, pH and carbonates are directly correlated. The pH and carbonates are inversely proportional to bicarbonates.

Chlorides play an important role in determining the quality of water. High concentration of chlorides indicates water pollution. The sources of chlorides in drinking water are municipal waste water discharge called sewage. High chlorides were reported in the present investigation due to sewage. Chlorides showed a positive correlation with organic matter. The release of sewage and domestic waste into the lake led to the growth of organic matter. The presence of organic matter increases the chloride content in water. Hence, chloride content in water bodies is an indicator of organic pollution.

The parameters water temperature, dissolved oxygen and organic matter are strongly related to each other and a change in one parameter has an effect on the other. Increase in water temperature and organic matter has led to decrease in dissolved oxygen. Organic matter, dissolved oxygen and chemical oxygen demand are all inversely correlated.

Water hardness and pH are strongly related. Water that is considered hard is alkaline having a pH greater than 8. Total hardness is high due to the alkaline nature of water. A decrease in magnesium levels and an increase in calcium concentrations were observed.

Phosphates in larger quantities designate the lake as polluted and eutrophic. Municipal waste water increases the phosphate levels in water. Excess phosphates lead to the profuse growth of algae and aquatic weeds. Algal blooms

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results in decreased levels of dissolved oxygen and effects the aquatic organisms.

Excess nitrates in water causes Eutrophication which changes the physical, chemical and biological characteristics of water.

TDS is an important parameter in assessing the water quality. At higher concentration, TDS influences the taste, hardness and corrosive property of water. Higher TDS effect aquatic life forms and renders the water unfit and unsafe for drinking and domestic use.

In Safilguda lake, the parameters bicarbonates, chlorides, total hardness, total dissolved solids and phosphates were high and low levels of dissolved oxygen were noted.

Phytoplankton: In the lake, four different groups of planktonic algae Euglenophyceae, Cyanophyceae, Chlorophyceae and Bacillariophyceae were encountered. Euglenophyceae was the dominant algae followed by Cyanophyceae, Chlorophyceae and Bacillariophyceae.

The percentage of Phytoplankton at all the stations is incorporated in Table 2.

The phytoplanktonic algae are the aquatic flora which grow in different aquatic ecosystems of ponds, lakes, rivers as well as oceans. Phytoplankton are seen floating, suspended or attached to other substrata. These can be single celled, grow in colonies or occur as filaments. These are small chlorophyllous plants and are of many taxonomic groups. Different phytoplanktonic algae found in various aquatic ecosystems include green algae, blue-green algae, euglenoid flagellates, desmids and diatoms. Many taxonomic groups of algal communities have been discovered so far which are present in diverse habitats. Phycological studies deal with the microscopic plant like organisms distribution, abundance and diversity. In all the habitats, phytoplankton is affected by biotic and abiotic factors. Hence, the change in the aquatic ecosystem can be predicted by phytoplanktonic algae. Planktic life in aquatic habitats indicates water quality. The environmental parameters affect the seasonal abundance and distribution of plankton types.

One of the significant groups of phytoplankton is euglenophytes which are free living, phototrophic and unicellular flagellates. Euglenoids are found in large numbers in aquatic environments that contain more organic matter. Euglenophycean members are used as markers for organic contamination. Their occurence in fresh waters indicates the possibility of eutrophication and acts as pollution indicator organisms. Euglenophyceae account for the highest percentage of algal population in the lake. It is the dominant group of phytoplankton at all the stations. Euglenoid flagellates reached high peaks during summer and the number reduced during winter. *Euglena, Phacus, Trachelomonas and Lepocinclis* are dominant in the lake. Among these, *Euglena and Phacus* showed high species diversity. High temperature, organic matter and low DO favoured good growth of euglenoids which was in conformity with Cynthia [5], Sudha Rani [6], Amin et.al.[7] Veerendra babu et.al.[8], Seeta and Manikya Reddy [9] and Padma priya et.al.[10].

Blue-green algae, also called Cyanobacteria, are commonly found in diverse habitats, mostly in all the aquatic ecosystems. These are the oldest photosynthetic organisms on the earth and occur in many diversified forms like single celled, filamentous and coccoid. These can be free living or found in symbiotic association with plants, fungi etc. Cyanophyceae is the second predominant algae. Cyanophycean members were maximum during summer and low during winter. Diversified species of *Arthrospira, Oscillatoria and Microcystis* were identified at all the stations. High temperatures, warm water and intense sunlight in summers with low dissolved oxygen and high organic matter makes blue greens to grow abundantly which is according to Manikya Reddy and Venkateshwarlu [11], Pulla Reddy [12], Sudha rani [13], Ananthaiah [14], Amin et.al. [15], Padmapriya et.al.[16] and Veerendra babu et.al.[17]. Cyanobacteria thrive well in eutrophic waters rich in organic matter having high temperatures, inadequate dissolved oxygen and poor water quality.

Chlorophyceae is the third dominant group. Green algae are the largest algal class and are closely related to higher plants due to the presence of similar photosynthetic pigments. They occur as filaments, colonies or unicellular forms and are omnipresent in all the ecosystems either fresh, marine or terrestrial habitats. These are abundant and diverse in fresh waters but sometimes form blooms under eutrophic conditions. Among Chlorophycean members, Chlorococcales dominate during the entire study period. The species of *Scenedesmus, Coelastrum, Chlorococcum, Pandorina, Eudorina* and *Pyrobotrys* were present. Many diverse species of *Scenedesmus* were identified in the lake. More organisms from chlorophycean group were encountered during summer and the number was lowest during winter. Distribution and variety of chlorophytic phytoplankton are influenced by physico-chemical factors. Growth of chlorophycean members require different physico-chemical factors which vary from other groups of phytoplankton. Cynthia [18], Sudha rani [19], Ananthaiah[20], Ruth et.al [21], Amin et.al.[22], Padmapriya et.al.[23], Veerendra babu et.al.[24], Ramadevi [25] and Harini [26] proved that high content of organic matter and low dissolved oxygen influence green algal growth. Water temperature, dissolved oxygen, organic matter, nitrites and phosphates mostly influence the chlorophycean growth, composition and abundance.

TABLE II.
PERCENTAGE OF PHYTOPLANKTON

Algal Groups	Station I	Station II	Station III
Euglenophyceae	40.55	40.73	38.56
Cyanophyceae	30.68	30.57	31.37
Chlorophyceae	17.8	18.46	18.92
Bacillariophyceae	10.95	10.23	11.13

Diatoms are the members of the class Bacillariophyceae which are widely distributed microscopic unicellular algae. These can grow in fresh and marine waters. Diatoms have a silica based cell wall and are often referred to as "jewels of the sea" due to their optical properties. These are the most beautiful microscopic algae due to their structure and sculpturing of their walls. Diatoms constitute a small portion of the phytoplanktonic algae in the present study. This group is represented in lesser numbers when compared to other groups of algae throughout the study period. Diatoms were observed in good numbers during winter and the number decreased during summer. The species of *Cyclotella, Nitzschia, Navicula, Gomphonema and Synedra* were reported in the present study. Sudha Rani [27], Amin et.al.[28], Padma priya et.al.[29], Navatha and Manikya Reddy [30], Seeta and Manikya Reddy [31] and Srinivas et.al [32] observed that diatoms are in good number in winter and low in summer season. Diatoms are crucial in biomonitoring of aquatic ecosystems since these react to environmental changes and act as bioindicators of water quality. Safilguda lake is a polluted habitat. Due to this, the development and survival of diatoms are affected.

The common and dominant algal species of Safilguda lake are represented in Table 3.

TABLE III.
COMMON AND DOMINANT ALGAL SPECIES

Group	Dominant Species
Euglenophyceae	*Euglena acus, E.polymorpha, E.tripteris, Phacus orbicularis, Ph.longicauda, Ph.acuminatus, Trachelomonas hispid and Lepocinclis ovum.*
Cyanophyceae	Arthrospira platensis, Oscillatoria animalis, Oscillatoria chalybea, Merismopedia punctata, Chroococcus minutus and Microsystis aereginosa.
Chlorophyceae	*Scenedesmus dimorphus, S.quadricauda, S.armatus, S.quadricauda var.quadrispina, . Coelastrum microporum, Chlorococcum, Pandorina morum, Eudorina and Pyrobotrys.*
Bacillariophceae	*Cyclotella menegheniana, Nitzschia palae, Navicula rhynchocephala, Gomphonema parvulum and Synedra Ulna.*

IV. CONCLUSIONS

Based on the Physico-chemical parameters, Ecological studies have been made. The physico-chemical and phytoplanktonic parameters indicate that the water in Safilguda lake is polluted. The species of *Euglena polymorpha, E. acus, E. tripteris, Phacus orbicularies, P. longicauda, Arthrospira platensis, Pandorina morum, Cyclotella menegeniana and Nitzchia palea* were present in the lake and they can be considered as good ecological indicators of water quality and pollution.

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