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Multivariate Analysis to Assess the Physico-Chemical Parameters and Phytoplankton Blooms in A Eutrophic Pond

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ABSTRACT

An examination of a seasonal earthen pond's water chemistry and the features of phytoplankton bloom production in selected pond took place between March 2022 and February 2023. The current study focused on physicochemical variables that affect phytoplankton growth in the pond, including temperature, Secchi disc transparency, pH, electrical conductivity (EC), dissolved oxygen (DO), Biochemical oxygen demand (BOD), ammonia, total phosphorus (TP), dissolved iron, and chlorophyll a. Chlorophyll a was utilised to calculate the biomass of phytoplankton. *Chlorella vulgaris, Aphanothece sp., Leptosira sp., Lepocinclis globulus*, and*Lepocinclis fusiformis* all had subsurface phytoplankton blooms in the pond. In March 2023, *Lepocinclis globulus* and *Euglena proxima* visible scums were also noted. There was a principal component analysis.

Keywords: *Phytoplankton, Physico-chemical parameters, blooms.*

I.INTRODUCTION

According to De Meester et al. (2005)"water bodies between area, which may be either permanent or seasonal, including ponds, are good model systems for ecological investigations." (Biggs, Williams, Whitfield, Nicolet, & Weatherby, 2005). Both man-made and natural water bodies are included. There are millions of artificial ponds built by people to suit different water demands in addition to natural ponds generated by geological and biological processes (Biggs, Corfield, Walker, Whitfield, & Williams, 1994). Many ponds dry out in the summer since they are seasonal, which is a perfectly normal occurrence. The seasonal pond-specific species are doing well used to such dry periods (Biggs et al., 1994). Pond management frequently corresponds to regional land-use patterns (Sokol et al., 2015). For the purpose of creating a generic model for pond community structure and development phases, the variability of ponds, especially at the regional level, poses a significant difficulty (Jeffries, 2008). Moreover, ponds provide a sustainable way to implement more effective and long-lasting conservation measures with less effort, despite the fact that they are usually ignored in freshwater science. According to Vijayarani et al. (2016), ponds are directly related to human civilisation. They have a significant impact on Telangana traditions, water storage, use, and management techniques. A few decades ago, the habit of building ponds as a source of irrigation water flourished across Telangana villages due to the vast agricultural there. They also kept small clay ponds on their property for bathing, washing, irrigation, and even drinking water. Traditional yearly cleaning techniques safeguarded and maintained these ponds.

utilization of these domestic and agricultural ponds with the arrival of bore wells, and the adoption of new water delivery methods leads to their neglect and/or degeneration. They became a breeding ground for harmful algal blooms due to a lack of adequate management and use (Dhanya, Sebastian, & Joseph, 2012).

Being substantial primary producers, phytoplankton constitute an essential link in the food chain of a pond environment. Their diversity, abundance, and species composition are influenced by a variety of physicochemical factors and biological interactions. They multiply to generate algal blooms as environmental circumstances improve (Ekhalak, Mohini, & Ranjana, 2013; Wetzel, (2001). Eutrophic lakes and ponds have a high concentration of nutrients, turbidity, and algal blooms on the water's surface (Suresh, Aravinda, &Thirumala, 2011). Despite the fact that eutrophication is a natural process in shallow ponds, the effects of water chemistry on phytoplankton dynamics and bloom formation remain a complicated mechanism requiring interactions. (Bialonski et al., 2016;Wang et al., 2017).

Knowing the water chemistry that leads to eutrophication and species succession in ponds may be used to better understand the ecology of vast ecosystems and to implement effective management techniques.

To this objective, a domestic mud pond within of a sizable area of an abandoned agricultural field was chosen for the current study. It was found to contain a yellow-green algal growth, its surface with slime following the northeast monsoon. It was therefore proposed that bloom production in the pond is caused by inorganic nutrients draining out of the neighbouring vacant agricultural land region. The ecology of the pond's phytoplankton will thus be revealed by a chemical study of the water. The goal of the current research is to better understand the water chemistry factors that influence phytoplankton dominance and the development of algal blooms.

II.MATERIAL AND METHODS

Study Site:

The pond used for the current study is in the Perkapally village pond near to Saidapoor, Karimnagar District Telangana, India. An earthen pond that dries out in the summer is the research pond. Domestically, it is utilised for irrigation, and due to the vegetation in the area, it has a lot of shade. It has a canal that overflows into an adjacent deserted paddy field. During the monsoon, the pond has a 1 km surface area and a depth of 657 metres with 1sluice.

Physico-chemical analysis:

Over the period of one-year morning samples of pond water were taken every two weeks. sampling was done while the ponds were full monsoon. Water temperature, pH, and Secchi depth (SD) were all measured on-site. Water samples were collected for dissolved oxygen (DO) measurements in 300 ml BOD bottles, fixed with alkali-iodide azide, and then analysed using the azide modification technique (APHA, 2005). By measuring the difference between the DO content in the water sample at the time of sampling and after the sample had been incubated at 20°C for five days, the biochemical oxygen demand (BOD) was calculated.

APHA recommends diluting samples with low DO values with dilution water. Using a conductivity metre, electrical conductivity (EC) was measured. Subsurface.In one-liter polythene bottles, water samples were collected, and the remaining parameters were determined in the lab. The ascorbic acid technique was used to test total phosphorus (TP), then persulfate digestion, hydrazine reduction for measuring nitrate-nitrogen (NO3-N), colorimetry for measuring nitrite-nitrogen (NO2-N), and phenate for measuring ammonia-nitrogen (NH4-N). After being collected in containers that had been acid-washed and filtered using a 0.45-m membrane filter, water samples for the analysis of dissolved iron were then analysed spectrophotometrically using the phenanthroline technique (APHA).

Water samples were collected in containers that had been acid-washed, filtered through a 0.45-m membrane filter, and then the filtrate was analysed spectrophotometrically for the presence of dissolved iron.

the phenanthroline technique (APHA). Using a spectrophotometer, chlorophyll a (Chl a) was extracted in 90% acetone and quantified at different wavelengths of 630, 647, 664, and 750 nm. The Jeffrey and Humphrey (1975) equation was used to calculate the chloride concentration. In a one-litre polythene bottle, phytoplankton subsurface water samples were collected. The sample was centrifuged at 3,000 rpm for 15 minutes using 100 microliters of sample. The pellate at the base was next dissolved in 2 ml of distilled water, which was used to view the sample under a light microscope. Ten subsamples put on slides were used for one hundred microscope field observations, with the frequency of taxonomic observations documented in accordance with Rao (1975) to determine the dominating or bloom-forming phytoplankton species.

Table No-1Trophic state categories proposed for tropical and subtropical reservoirs (Cunha et al. 2013)

Trophic state Category	Chl*a* (µg/L)	Total Phospharus (µg/L)	Trophic Status Index
Ultraoligotrophic	≤2.0	≤15.9	≤51.1
Oligotrophic	2.1–3.90	16.0–23.8	51.2–53.1
Mesotrophic	4.0–10.0	23.9–36.7	53.2–55.7
Eutrophic	10.1–20.2	36.8–63.7	55.8–58.1
Supereutrophic	20.3–27.1	63.8–77.6	58.2–59.0
Hypereutrophic	≥27.2	≥77.7	≥59.1

Index of Trophic States:

Using the TSI formulae for subtropical reservoirs developed by Cunha et al., the pond's trophic status index was determined,based on the Chl-a and TP concentrations, is shown in Table 1.

III. RESULTS AND DISCUSSION:

Physico-chemical Parameters:

Temp-The pond's water has a temperature range of 24.8 to 27.8°C. It peaked from November through the beginning of December before beginning to fall in late December or early January. It then progressively increased from reached 27.8°C in February to March before dropping down after that.

Transparency-Secchi disc transparency ranged from 29 to 65 cm. In March, the pond's transparency value was at its lowest. Following this, the pond dried out, and during the end of April and the beginning of May, respectively, improved Secchi depth values of 29 and 32 cm were recorded.

pH -The pond's water had a pH between 5.53 and 6.87. From November to January, the water's pH was below 6, then it rose beyond 6 after that. At the conclusion of the May sample, the pH was at its highest level.

EC-Pond source of electrical conductivity (EC) varied from 89 to 240 mho/cm. The EC value was 110 mho/cm in November. It gradually increased until the end of January, when it reached a value of 159 mho/cm, before declining in February and then increasing after that.

DO-The pond water's dissolved oxygen (DO) content varied from 1.61 to 7.26 mg/L. At the start of the sample, the DO effort was 4.70 mg/L in November, and it increased gradually until the first part of February, when it reached 6.18 mg/L. However, it abruptly decreased to 1.61 mg/L in the second half of February. During a dry spell, the greatest DO value was recorded in May.

BOD-The biochemical oxygen demand (BOD) fluctuated in parallel with the DO concentrations, reaching its greatest levels during the second half of February and April. These values ranged from 5.64 to 10.52 mg/L.

Ammonia-The pond water's ammonia-nitrogen content varied from 13.71 to 177.58 g/L. It had a varying pattern, beginning with a value of 44.63 g/L in November and peaking in January, the second part of January will be valuable. The second part of February saw the lowest ammonia levels ever seen.

TP-Between 96.60 and 555.4 g/L, the total phosphorus (TP) concentration fluctuated throughout the course of the research, reaching its highest level in April.The level of dissolved iron likewise showed a varying pattern, rising in the months of December, January, and March, and varied between 199.5 and 588.8 g/L.

Chlorophyll -The pond water's chlorophyll a concentration varied from 21.35 to 245.5 g/L, with a high of 207.6 g/L in November. It subsequently showed a few up and down fluctuations before reaching its peak in the first half, that March. After the dry summer season, it then showed a tendency towards shrinking.

Trophic State Index (TSItsr):

The pond showed TSItsr levels between 60 and 65. According to Cunhas suggested trophic state categories, the pond had a hypereutrophic condition from November to May.The months of January and April saw the greatest trophic levels.

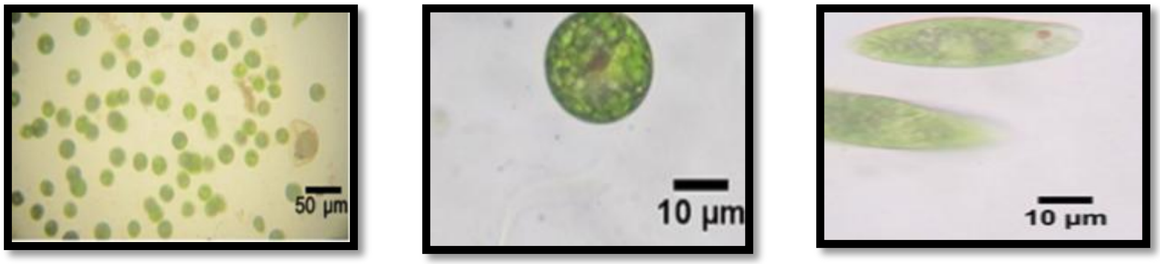
Blooms of Phytoplankton:

Chlorophyll A was utilised as a quantitative indicator of phytoplankton abundance in the pond water samples. a bloom of phytoplankton (Zohary, Fishbein, Kaplan, &Pollingher, 1998) defined formation as the time when the chlorophyll a concentration surpassed 50 g/L.

Hence, except for May, practically all of the sample months showed phytoplankton blooms in the pond based on the chlorophyll a concentration in the pond. In the pond in November, there were no dominating bloom-forming phytoplankton species. *Chlorella vulgaris* produced a chlorophycean bloom in December, which was followed by blooms from *Leptosira sp.* and *Aphanothece sp.* in the first and second halves of January, respectively. During February to April the dominant green and blue-green algae in the pond changed to *Euglenozoa*, with *Lepocinclis* globulus and *Lepocinclis fusiformis* serving as the bloom-forming species.

Development of pond surface scum:

The pond's water was crystal pure from November to December Invading the pond in December the floating weed Lemna minor quickly covered the whole water's surface. a thin yellow-green film In February, it was possible to see coloured scum progressively covering the pond. The pond dried up in the second part of March before being revived by summer rains in the second half of April. *Lepocinclis globulus* and *Euglena proxima* were among the two Euglenozoan species that made up the yellow-green scum that was found in the pond. *Lepocinclis globulus*, (fig 1,2) which made up more than 90% of the scum, was the dominant species during the bloom.



[a] [b] [c]

Fig No-1: Microscope images of (a) *Euglenozoa bloom*; (b) Lepocinclis globulus*;and* (c) *Euglena proxima*

Fig No-2; Development of surface scum in study pond -thin green scum over water surface

IV.CONCLUSION:

The level of organic contamination in the research pond, which caused Euglenozoa to flourish, was disclosed by the current investigation. the organic decay of leaf litter, which releases nitrogen as ammonia. *Lepocinclis globulus* and *Euglena proxima* were shown to be more dominant when dissolved iron was present. Algal bloom production in the pond was determined to be caused by natural eutrophication and organic decomposition. In order to manage and conserve these significant local freshwater supplies, the current study emphasises the necessity of yearly cleaning and sediment removal from such pond.

Compliance with ethical standards:

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Disclosure of conflict of interest

The authors (Dr Raju Potharaju, Prof M. Aruna) declare no conflict of interest

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