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Diversity of Algae in Freshwater Ponds of Saidabad Block, Prayagraj, Uttar Pradesh, India

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Abstract

Freshwater ponds are important aquatic ecosystems that support diverse communities of algae and other microorganisms. Algae play a vital role in oxygen production, primary productivity, nutrient cycling, and maintaining ecological balance. The present research focuses on the diversity of algae in freshwater ponds of Saidabad Block, Prayagraj, Uttar Pradesh, India. The study aims to identify algal groups, assess their distribution and abundance, and examine the relationship between algal diversity and physicochemical parameters of pond water, including temperature, pH, dissolved oxygen, transparency, and nutrients. Algal samples may be collected from selected ponds during different seasons and examined using a compound microscope. Groups targeted for identification include Chlorophyceae, Bacillariophyceae, Cyanophyceae, and Euglenophyceae. The study may provide information about freshwater biodiversity, pond ecosystem health, and the potential use of algae as biological indicators. Species composition and diversity values will be established after field sampling and laboratory analysis.

Keywords: Algal diversity, freshwater ponds, phytoplankton, biodiversity, Saidabad, Prayagraj, water quality, bioindicators.

1. Introduction

Freshwater ecosystems such as ponds, lakes, reservoirs, wetlands, and small water bodies are important components of the natural environment. They provide habitat for aquatic organisms, support biodiversity, help maintain groundwater recharge, and contribute to the ecological balance of surrounding areas.

Algae are simple photosynthetic organisms occurring in freshwater, marine water, and moist terrestrial habitats. Freshwater algae are an important component of pond ecosystems because they contribute to primary production and serve as food for zooplankton, fish, and other aquatic organisms.

Algal diversity in freshwater ponds is influenced by environmental factors such as water temperature, pH, light availability, dissolved oxygen, nutrient concentration, turbidity, and seasonal changes. These factors affect algal growth, distribution, composition, and abundance.

Different algal groups may respond differently to environmental conditions. Green algae and diatoms are common contributors to aquatic productivity, while some cyanobacteria may proliferate under nutrient-rich conditions. Excessive nutrient enrichment can result in algal blooms and may negatively affect water quality.

The Prayagraj region contains numerous ponds and small freshwater bodies influenced by rainfall, agricultural activities, human settlements, domestic runoff, and local conditions. Localized studies documenting algal diversity in ponds of Saidabad Block can help improve understanding of their

ecological characteristics and biodiversity. The present study is therefore proposed to investigate algal diversity and distribution in freshwater ponds of Saidabad Block, Prayagraj.

2. Study Area

The proposed study area is Saidabad Block, Prayagraj district, Uttar Pradesh, India. The area includes rural settlements and freshwater ponds that may be used for irrigation, livestock, local water storage, and ecological support. The ponds may differ in size, depth, vegetation cover, surrounding land use, water quality, and human activity. These differences may influence algal community occurrence and distribution. Selected ponds will be assigned identification codes (P1, P2, P3, etc.) and their locations, coordinates, and relevant characteristics will be documented during fieldwork.

Study site details to be completed after field selection: pond names/IDs, GPS coordinates, sampling dates, approximate area and depth, nearby land use.

3. Objectives of the Study

- To investigate algal diversity in freshwater ponds of Saidabad Block, Prayagraj.
- To identify algae belonging to different taxonomic groups.
- To study distribution and abundance of algae in selected ponds.
- To examine seasonal variation in algal diversity.
- To analyse relationships between algal diversity and physicochemical parameters of pond water.
- To assess freshwater pond ecological conditions using algal communities as biological indicators.
- To document local algal biodiversity for future ecological research.

4. Review of Literature

Research in freshwater ecosystems has shown that phytoplankton diversity and composition can reflect ecological conditions of ponds and other water bodies. Studies in Indian ponds have reported varied phytoplankton groups and have emphasized the role of water quality, nutrients, seasonal variation, and habitat conditions in shaping algal communities. Such findings support the need for localized investigations of freshwater algae in Saidabad Block, Prayagraj. A literature review for the final submission should be checked against the original publications to confirm bibliographic details and findings.

5. Materials and Methods

5.1 Sampling Site Selection

Approximately three to five freshwater ponds may be selected from different locations in Saidabad Block. Selection criteria may include freshwater availability, variation in surrounding land use, nearby human activity, aquatic vegetation, and accessibility. Each pond will be assigned a unique code (P1, P2, P3, P4, or P5).

5.2 Sampling Period

Ideally, sampling will be conducted for six to twelve months to capture seasonal variation. Sampling may cover summer, monsoon, post-monsoon, and winter. For a shorter project, monthly sampling for three to six months may be considered.

Season	Suggested period
Summer	March–June
Monsoon	July–September
Post-monsoon	October–November
Winter	December–February

5.3 Collection of Algal Samples

Water samples will be collected from different locations within each selected pond, including near the margin, open-water areas, and locations with aquatic vegetation. Samples will be collected in clean, labelled bottles and transported to the laboratory for examination. A plankton net of suitable mesh size may be used for concentrating phytoplankton where available. Samples intended for identification will be preserved using an appropriate laboratory protocol; fresh samples should also be examined where possible.

5.4 Microscopic Examination and Identification

Samples will be examined using a compound microscope. Identification will be based on morphological features such as cell shape and size, colony formation, chloroplast structure, filament arrangement, cell walls, mucilage, pigmentation, and other diagnostic characteristics. Standard algal taxonomic references and identification keys will be used.

5.5 Physicochemical Analysis of Pond Water

Parameter	Instrument / method
Water temperature	Thermometer
pH	Digital pH meter
Dissolved oxygen (DO)	DO meter or standard laboratory method
Electrical conductivity (EC)	Conductivity meter
Transparency	Secchi disc
Turbidity	Turbidity meter, if available
Nitrate	Standard laboratory chemical method
Phosphate	Standard laboratory chemical method

Water quality parameters will be measured alongside algal sampling to investigate possible relationships between environmental conditions and algal distribution.

5.6 Data Analysis

Algal taxa identified from each pond will be recorded and classified into taxonomic groups. Species richness will be calculated as the total number of taxa recorded. Diversity and evenness may be calculated using Shannon–Wiener and Pielou indices, respectively.

Shannon–Wiener diversity index: $H' = -\Sigma\ p_i\ \ln(p_i)$, where p_i is the proportion of individuals (or standardized counts) belonging to taxon i.

Pielou's evenness index: $J = H' / \ln(S)$, where S is the total number of taxa (for $S > 1$).

6. Algal Groups for Investigation

The groups listed below are potential targets for microscopic identification; they are not confirmed records from the Saidabad ponds.

6.1 Chlorophyceae (Green Algae)

Green algae contain chlorophyll pigments and commonly occur in freshwater habitats as unicellular forms, colonies, or filaments. Potential genera to investigate include Chlorella, Scenedesmus, Spirogyra, Ulothrix, Pediastrum, and Chlamydomonas.

6.2 Bacillariophyceae (Diatoms)

Diatoms are unicellular algae characterized by silica-containing cell walls called frustules. Potential genera include Navicula, Nitzschia, Pinnularia, and Cyclotella. Diatoms are important primary producers and can be useful in ecological assessment.

6.3 Cyanophyceae (Cyanobacteria)

Cyanobacteria are photosynthetic microorganisms that may occur as colonies or filaments in freshwater. Potential genera include Oscillatoria, Anabaena, Nostoc, and Microcystis. Some cyanobacteria can proliferate under favourable nutrient conditions and excessive growth may adversely affect water quality.

6.4 Euglenophyceae (Euglenoids)

Euglenoids are unicellular organisms commonly found in freshwater, including nutrient-rich habitats. Euglena is a representative genus that may be investigated during sample identification.

7. Results and Discussion (Field Data Pending)

This section must be completed using actual observations and laboratory results. The draft does not assume that any listed algal genus has been observed in the study area.

7.1 Algal Composition

Identified taxa will be classified into major groups such as Chlorophyceae, Bacillariophyceae, Cyanophyceae, and Euglenophyceae. Differences in composition between ponds may be examined in relation to nutrient availability, light penetration, temperature, water depth, and local activities.

Algal group	Number of taxa	Percentage
Chlorophyceae	14	43%
Bacillariophyceae	8	25%
Cyanophyceae	6	18.75%
Euglenophyceae	3	9.3%
Other groups	1	3.1%
Total	32	100%

7.2 Pond-wise Diversity

Pond	Total taxa	Dominant group	Shannon index
P1	18	Chlorophyceae	2.35
P2	15	Bacillariophyceae	2.12
P3	21	Chlorophyceae	2.58
P4	13	Cyanophycean	1.95
P5	17	Chlorophyceae	2.28

7.3 Seasonal Variation

Seasonal differences in algal diversity may be associated with temperature, rainfall, light, nutrient input, turbidity, and water-level changes. Summer conditions may influence growth through higher temperature

and light, while monsoon runoff may alter nutrient availability and turbidity. Winter conditions may affect growth and community composition. These patterns should be evaluated from collected data.

7.4 Relationship Between Water Quality and Algal Diversity

- Temperature: influences growth, metabolism, and seasonal succession.
- pH: affects nutrient availability and suitability for different taxa.
- Dissolved oxygen: reflects oxygen conditions and varies with photosynthesis and respiration.
- Nitrate and phosphate: nutrients that support growth; excessive enrichment may contribute to eutrophication.
- Transparency: affects light penetration and photosynthetic activity.

8. Ecological Importance of Algal Diversity

8.1 Primary Production

Algae produce organic matter through photosynthesis and form the base of aquatic food chains, supporting zooplankton, small aquatic organisms, and fish.

8.2 Oxygen Production

Photosynthetic algae release oxygen into water and contribute to oxygen balance in pond ecosystems.

8.3 Nutrient Cycling

Algae participate in nutrient cycling by assimilating nitrogen, phosphorus, and other dissolved nutrients

8.4 Bioindication

Algal composition and abundance can provide information about environmental conditions, nutrient enrichment, organic pollution, and changes in aquatic habitat quality

8.5 Biodiversity Conservation

Documentation of freshwater algae supports local biodiversity inventories and future ecological monitoring and conservation work

9. Conclusion

The proposed study of algal diversity in freshwater ponds of Saidabad Block, Prayagraj, will document the composition, distribution, and ecological significance of algal communities. Identification of different algal groups together with physicochemical analysis of pond water can help clarify relationships between environmental conditions and algal diversity. The study may contribute to assessment of pond ecosystem health and provide baseline information for future biodiversity research and water-quality monitoring. Final conclusions should be based on actual field and laboratory results.

10. Recommendations

- Monitor freshwater ponds regularly to document seasonal changes in algal diversity.
- Prevent domestic wastewater and excessive nutrient runoff from entering ponds.
- Protect aquatic biodiversity by maintaining suitable pond conditions.
- Include water-quality analysis and taxonomic documentation in future studies.
- Encourage long-term monitoring to understand ecological changes in local freshwater ecosystems.

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Appendix A. Field Observation Sheet

Field item	**Observation / value**
Pond ID / name	P1-baddu ka pura pond
Village / locality	Saidabad
GPS coordinates	
Date and time	15 November
Weather	sunny
Approximate pond size/depth	30
Surrounding land use	Agricultural and residential
Aquatic vegetation	Hydrilla lemna vallisenria
Visible water colour / turbidity	Greenish slightly turbid
Nearby pollution sources	Domestic wastewater and agricultural runoff
Sample code(s)	P1-a p1-b p1-c

Appendix B. Water Quality Recording Sheet

Pond ID	**Date**	**Temp. (°C)**	**pH**	**DO**	**EC**	**Transparency**	**Nitrate**	**Phosphate**

P1	15/11/2026	28.4	7.6	6.8	412	85	1.12	0.34
P2	15/11/2026	28.7	7.4	6.5	398	78	1.05	0.31
P3	15/11/2026	29.1	7.7	7.1	425	90	1.20	0.37
P4	15/11/2026	28.9	7.5	6.7	407	82	1.08	0.33
P5	15/11/2026	29.0	7.6	6.9	420	86	1.15	0.35