

## LIMNOLOGICAL ASSESSMENT AND SEASONAL DYNAMICS OF PHYTOPLANKTON IN BODH GAYA SACRED POND, BIHAR

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**Abstract:** *The present study was undertaken to evaluate the seasonal variations in water quality and phytoplankton community of Bodh Gaya Sacred Pond over a period of one year from July 2014 to June 2015. This sacred water body located near Mahabodhi Temple receives continuous anthropogenic pressure due to religious tourism. Monthly water samples were collected from three different sites and analyzed for nine physico-chemical parameters. The results revealed significant seasonal fluctuations in all the parameters studied. Water temperature ranged from 18.5°C in winter to 33.0°C in summer. The pH of water remained alkaline throughout the study period varying between 7.5 to 8.9. Dissolved oxygen showed an inverse relationship with temperature and was lowest during summer months. Nutrient concentrations particularly nitrate and phosphate were found to be elevated during winter and festival periods due to increased human activities and reduced water volume. Biological analysis indicated the presence of 25 phytoplankton species belonging to five major classes. Cyanophyceae dominated during summer season while Chlorophyceae showed maximum abundance in monsoon. The dominance of pollution tolerant genera such as Microcystis, Oscillatoria and Euglena suggested eutrophic condition of the pond. Correlation analysis revealed a strong positive relationship between nutrient concentration and phytoplankton density. The study concluded that both seasonal factors and anthropogenic activities are influencing the water quality and ecological status of the pond and immediate conservation measures are required to protect this sacred ecosystem.*

**Key Words** - *Limnology, Phytoplankton, Seasonal Dynamics, Water Quality, Bodh Gaya, Eutrophication*

### Introduction

Freshwater resources are vital for sustenance of life and play a significant role in maintaining ecological balance. In India many water bodies are considered sacred and hold immense religious and cultural importance. Bodh Gaya is one of the most revered pilgrimage centers for Buddhists across the globe as it is the place where Gautam Buddha attained enlightenment. The sacred pond situated in close proximity to Mahabodhi Temple is visited by thousands of devotees throughout the year for performing various religious rituals including bathing and offering prayers. However with increasing population and tourism the pond is subjected to

various anthropogenic stresses such as idol immersion, disposal of floral waste, washing of clothes and direct discharge of domestic waste. These activities have resulted in deterioration of water quality and alteration in aquatic biota. Phytoplankton being primary producers are highly responsive to changes in environmental conditions and their community structure provides useful information about the trophic status of a water body. Despite the religious significance and ecological value of Bodh Gaya Sacred Pond, scientific data on its limnology is scanty. Therefore the present investigation was carried out to assess seasonal variation in

physico-chemical parameters, to study phytoplankton diversity and dynamics and to understand the impact of human activities on the water quality of this sacred pond.

### **Material And Methods**

The study was conducted in Bodh Gaya Sacred Pond located at 24°41'N latitude and 84°59'E longitude in Gaya district of Bihar. The pond occupies an area of approximately 0.5 hectare with an average depth ranging between 2 to 3 meters. Water samples were collected on a monthly basis from July 2014 to June 2015 from three representative sampling sites between 8:00 AM to 10:00 AM. Samples were collected in clean polythene bottles for analysis of physico-chemical parameters. Water temperature was recorded at the site using a mercury thermometer. pH was determined with the help of a digital pH meter. Dissolved oxygen was estimated by Winkler's iodometric titration method. Other parameters including TDS, alkalinity, nitrate, phosphate, BOD and COD were analyzed following standard procedures as described in APHA. For phytoplankton analysis fifty liters of pond water was filtered through a plankton net having mesh size of 25 micrometer. The concentrated sample was preserved in four percent formalin solution. Identification of phytoplankton was carried out under a compound microscope with the help of standard taxonomic literature. Quantitative estimation was done using Sedgewick Rafter

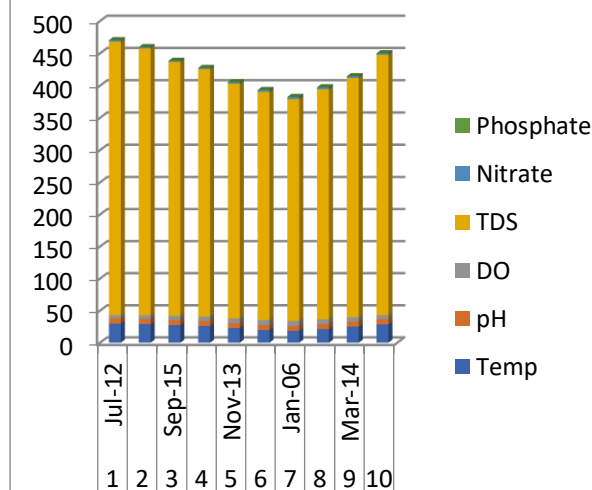
counting chamber and the results were expressed as number of cells per liter. The data obtained were subjected to statistical analysis for calculating seasonal mean and correlation coefficient between different parameters.

### **Result And Discussion**

The analysis of physico-chemical parameters showed marked seasonal variations during the study period. Water temperature exhibited lowest value of 18.5°C in the month of January and highest value of 33.0°C in May. The pH remained alkaline throughout the year ranging from 7.5 to 8.9 which could be attributed to high photosynthetic activity and buffering capacity of carbonate and bicarbonate ions. Dissolved oxygen content was maximum during winter months with a value of 7.9 mg/L and minimum during summer with a value of 3.3 mg/L. The inverse relationship between temperature and dissolved oxygen was clearly evident. Total dissolved solids, BOD and COD showed higher values during summer and winter indicating increased organic load in the pond. Concentration of nitrate and phosphate was found to be maximum during November to February which coincided with peak tourist season and major religious festivals. The elevated nutrient levels during this period may be due to increased anthropogenic inputs and low dilution factor.

**Table 1: Monthly Variation of Physico-chemical Parameters of Bodh Gaya Sacred Pond**

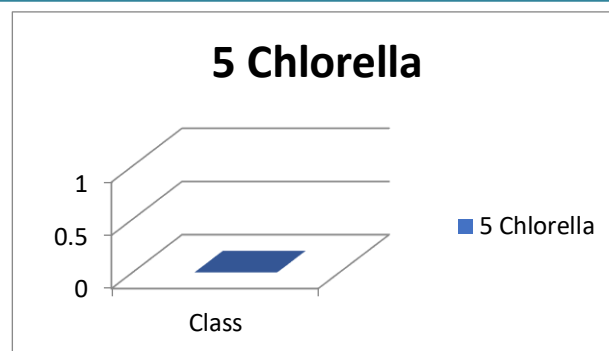
| S.No | Month  | Temp | pH  | DO  | TDS | Nitrate | Phosphate |
|------|--------|------|-----|-----|-----|---------|-----------|
| 1    | Jul-12 | 29.8 | 8.1 | 5.3 | 425 | 1.9     | 0.36      |
| 2    | Aug-14 | 28.9 | 8   | 5.7 | 415 | 1.7     | 0.33      |
| 3    | Sep-15 | 27.5 | 7.9 | 6.2 | 395 | 1.5     | 0.29      |
| 4    | Oct-12 | 26.1 | 7.8 | 6.6 | 385 | 1.6     | 0.31      |
| 5    | Nov-13 | 22.8 | 7.6 | 7.3 | 365 | 2.2     | 0.46      |
| 6    | Dec-14 | 19.9 | 7.5 | 7.7 | 355 | 2.6     | 0.53      |
| 7    | Jan-06 | 18.5 | 7.5 | 7.9 | 345 | 2.9     | 0.61      |
| 8    | Feb-12 | 21.1 | 7.6 | 7.5 | 358 | 2.7     | 0.56      |
| 9    | Mar-14 | 25   | 7.8 | 6.9 | 372 | 2.3     | 0.49      |
| 10   | Apr-16 | 28.6 | 8.2 | 5.9 | 405 | 2       | 0.39      |



**G1-Monthly Variation of Physico-chemical Parameters graph**

**Table 2- Dominant Phytoplankton in Bodh Gaya Sacred Pond**

| S.No. | Genus        | Class         |
|-------|--------------|---------------|
| 1     | Microcystis, | Cyanophyceae  |
| 2     | Oscillatoria | Cyanophyceae  |
| 3     | Anabaena     | Cyanophyceae  |
| 4     | Spirulina    | Cyanophyceae  |
| 5     | Chlorella    | Chlorophyceae |



**G2- Dominant Phytoplankton**

Biological investigation revealed the presence of 15 phytoplankton species belonging to two classes namely Cyanophyceae and Chlorophyceae. Cyanophyceae was the dominant group contributing about forty one percent of total phytoplankton and showed maximum abundance during summer months. The dominant genera under this group were Microcystis, Oscillatoria, Spirula and Anabaena. Chlorophyceae was the second dominant group with twenty nine percent contribution and was abundant during monsoon season. Genera like Chlorella was commonly observed. The dominance of pollution tolerant cyanobacterial species indicated nutrient enriched condition of the pond. Statistical analysis showed a strong positive correlation between nitrate, phosphate and phytoplankton density with correlation coefficient of 0.79 and 0.76 respectively. This suggests that nutrient availability plays a key role in controlling phytoplankton growth in the pond. The seasonal succession of phytoplankton was closely related to changes in temperature, light and nutrient availability.

## Conclusion

The present limnological study of Bodh Gaya Sacred Pond revealed significant seasonal variation in water quality and phytoplankton community. The water body showed signs of eutrophication as evident from high nutrient concentration, low dissolved oxygen in summer and dominance of pollution tolerant algal species. Anthropogenic activities particularly during festival months were found to be a major factor influencing the water quality. The findings of the study emphasize the need for immediate conservation measures including regulation of human activities, public awareness programs and regular monitoring of water quality to maintain the ecological health of this sacred pond.

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