

## ORIGINAL ARTICLE

# Seasonal Variation in Physico-chemical Properties and Primary Productivity of a Pond

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### ABSTRACT

*Present study has been conducted to study the seasonal variation in physico-chemical properties and primary productivity of a pond. This pond receives domestic sewage and effluents from local industries. Water quality has been determined in term of selected parameters such as Water temperature, pH, Total dissolved Solids, Dissolved oxygen (D.O.), Phosphate, Chloride and Alkalinity. Primary productivity was determined by using standard 'Light and Dark bottle' method of Garden and Gran (1927). Physico-chemical parameters and primary productivity values were found high indicating its eutrophic nature.*

**Keywords:** Seasonal variation, Physico-chemical characteristics, GPP, NPP, CR.

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### INTRODUCTION

Fresh water bodies are an important source of water available for human consumption and other useful activities. These water bodies often get polluted due to sewage and effluents coming from urban and industrial establishments. These conditions cause nutrient enrichment which results in eutrophication of water bodies. The water quality of these eutrophic bodies gets degraded and water becomes unfit for human consumption.

Study of water quality parameters (physico-chemical parameters) and primary productivity provides a clue about the overall health of these water bodies. Primary productivity is the rate at which the sun's radiant energy is stored by photosynthetic activities of producers in the form of organic substances [1]. Primary production studies are very important to understand the effect of pollution on system's efficiency. Estimation of primary productivity is essential to understand food chain and food web, water quality and pollution study.

Several workers have studied the physio-chemical properties and primary productivity of fresh water bodies [2-7]. Present study has been undertaken to study the physico-chemical characteristics and primary productivity of a pond in Aligarh city. This pond receives water from domestic discharges and rain water which accumulates during rainy season. City sewage and effluents from some small industries also accumulate in this water body.

### MATERIAL AND METHODS

The pond under study, Kalidah is a small (1.5-2.0 hectare) perennial water body located in Aligarh city. The study was carried out during Nov. 2005 to Oct. 2006. Water samples were collected from a selected station every month and brought to the laboratory for the estimation of some physico-chemical parameters such as Water temperature, pH, Total dissolved solids (TDS), Dissolved oxygen (D.O.), Phosphate, Chloride and alkalinity. Temperature and pH were recorded on site. The initial dissolved oxygen and the dissolved oxygen in light and dark bottles were determined by using modified Winkler's method [8]. The observed Gross primary productivity (GPP), Net primary productivity (NPP) and Community Respiration (CR) in mg/l/hr were converted into gC/m<sup>3</sup>/h by multiplying these values with a factor of 0.375 as suggested by Benton, A.H. et al [9].

### RESULTS AND DISCUSSION

Seasonal variation in physico-chemical parameters is given in Table-1.

The present study of seasonal variation in physico-chemical parameters reveals the following results. Water temperature showed minimum in winter season ( $17.7 \pm 0.27$ ) and maximum in summers ( $31.0 \pm$

1.24). pH values observed lower in winter ( $7.9 \pm .13$ ) and higher in rainy season ( $9.06 \pm 0.03$ ). This variation in pH might be due to household detergents coming into pond water from nearby houses and chemical rich effluents from local industries and also due to cattle bathing.

The dissolved oxygen (DO) observed lower in winter ( $7.27 \pm 0.24$ ) and higher in summer ( $8.63 \pm 0.98$ ). High D.O. content might be due to increased photosynthetic activity of autotrophs while low content might be due to increase respiration of organisms, low photosynthetic rate and increased organic matter decomposition. Total dissolved solids (TDS) were recorded higher in rainy season ( $463.3 \pm 179.28$ ) and lower in winter ( $248.7 \pm 30.2$ ). These dissolved solids are mainly organic in nature and can pose serious problems of pollution.

Alkalinity showed minimum in rainy ( $235 \pm 8.8$ ) and maximum in winter ( $546.7 \pm 25.96$ ). Phosphate values observed higher in summer months ( $1.626 \pm 0.08$ ) and lower in rainy season ( $0.317 \pm 0.08$ ). Chloride content observed higher in summer season ( $62.67 \pm 4.66$ ) and lower in winter season ( $33.67 \pm 0.72$ ). The higher concentration of chloride is considered to be an indicator of higher pollution due to higher sewage content and also due to increased temperature and evaporation of water.

**Table 1: Seasonal variation in the physico-chemical parameters in pond.**

| Parameters                  | Winter<br>Mean $\pm$ SE | Summer<br>Mean $\pm$ SE | Rainy<br>Mean $\pm$ SE |
|-----------------------------|-------------------------|-------------------------|------------------------|
| pH                          | 7.9 $\pm$ 0.13          | 8.4 $\pm$ 0.09          | 9.06 $\pm$ 0.03        |
| Water Temp. ( $^{\circ}$ C) | 17.7 $\pm$ 0.27         | 31.0 $\pm$ 1.24         | 30.0 $\pm$ 0.59        |
| D.O.*                       | 7.27 $\pm$ 0.24         | 8.63 $\pm$ 0.98         | 8.37 $\pm$ 0.17        |
| TDS*                        | 248.7 $\pm$ 30.2        | 399.3 $\pm$ 93.68       | 463.3 $\pm$ 179.28     |
| Alkalinity*                 | 546.7 $\pm$ 25.96       | 399.3 $\pm$ 132.1       | 235 $\pm$ 8.8          |
| Phosphate                   | 0.317 $\pm$ 0.08        | 1.626 $\pm$ 0.08        | 0.812 $\pm$ 0.22       |
| Chloride*                   | 33.67 $\pm$ 0.72        | 62.67 $\pm$ 4.66        | 38.67 $\pm$ 8.24       |

\* mg/l.

Seasonal variation in primary productivity is presented as Gross primary productivity (GPP), Net primary productivity (NPP) and Community Respiration (CR) in Table 2.

**Table 2: Seasonal variation in the Primary productivity (GPP, NPP and CR) of pond.**

| Seasons parameters                      | Winter<br>Mean $\pm$ SE | Summer<br>Mean $\pm$ SE | Rainy<br>Mean $\pm$ SE |
|---|-------------------------|-------------------------|------------------------|
| GPP ( $\text{gC}/\text{m}^3/\text{h}$ ) | 0.178 $\pm$ 0.02        | 0.279 $\pm$ 0.02        | 0.259 $\pm$ 0.01       |
| NPP ( $\text{gC}/\text{m}^3/\text{h}$ ) | 0.098 $\pm$ 0.02        | 0.149 $\pm$ 0.02        | 0.136 $\pm$ 0.02       |
| CR ( $\text{gC}/\text{m}^3/\text{h}$ )  | 0.08 $\pm$ 0.01         | 0.13 $\pm$ 0.01         | 0.123 $\pm$ 0.01       |

**Gross primary productivity ( $\text{gC}/\text{m}^3/\text{h}$ ):** Seasonal variation in GPP of pond observed higher in summer season ( $0.279 \pm 0.02$ ) and lower in winter season ( $0.178 \pm 0.02$ ).

**Net primary productivity ( $\text{gC}/\text{m}^3/\text{h}$ ):** Seasonal variation in NPP of pond observed higher in summer season ( $0.149 \pm 0.02$ ) and lower in winter season ( $0.098 \pm 0.02$ ).

**Community Respiration ( $\text{gC}/\text{m}^3/\text{h}$ ):** Seasonal variation in CR of pond observed higher in summer season ( $0.13 \pm 0.01$ ) and lower in winter season ( $0.08 \pm 0.01$ ).

Gross primary productivity is the total rate of photosynthesis including the organic matter utilizes in respiration during the period of measurement. Net primary productivity is the rate of storage of organic matter in plant tissues in the excess of the respiratory use by plants during the measurement period. Seasonal record of gross and net primary productivity was minimum in winter season. The highest rate of productivity during the summer season may be due to bright sunlight with higher temperature, high phytoplankton density and algal blooms which leads to eutrophic conditions in pond. The low values in winter season could be due to low light intensity and low temperature causing decrease in photosynthetic rate and reduction in phytoplankton population. High productivity indicates the pollution and eutrophication of water bodies.

Community respiration means deducting the net primary productivity from gross primary productivity and converted into carbon dioxide release. CR values were higher in summer season. This may be due to the effect of sewage water and effluents from local industries coming into pond that enhance their biological activities of microbes especially in summer due to decomposition of organic matter. Radwan, A.M. [11] reported maximum primary productivity in summer season and lower in winter and rainy season from Burulus Lake of Egypt.

Present study indicates highly polluted state of this water body. Due to accumulation of sewage and effluents, water quality has become very poor and not fit for human consumption.

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