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Hydrological Status and Primary Productivity in Rasalpura Pond in Saran District of Bihar

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ABSTRACT

The primary productivity of the Rasalpura pond was estimated from March 2019 to February 2021 through relationship between abiotic parameters and phytoplankton density during the study period. The seasonal variation of primary productivity revealed that maximum and minimum values of Gross primary productivity and community respiration were associated with monsoon and summer seasons respectively. The minimum values of Net primary productivity were recorded during monsoon season and maximum during winter during study period.

Keywords: Gross primary Productivity, Net primary productivity, Community respiration, Physicochemical, Seasonal fluctuations.

INTRODUCTION

The increasing human population and the organic matter as needful to trophic balance in an aquatic ecosystem has basis to evaluation of the primary productivity in this ecosystem to estimate ecosystem potential to provide food to the existing higher trophic level. The inland aquatic system yet covers only 1% of the earth but has great productive capability and further the disturbances in the production rate of freshwater are the ecologically valuable due to their marked spatial and temporal variation. There is scarce of literature on the in India, however, contribution are available from the tropical regions is from Ahmed et *al* (2005), Verma and Srivastva (2016), Deka (2017), Yusuf et *al.,* (2019) and Shwetan Shumla et *al* (2019).

The Ponds are historically and ecologically important ecosystem representing around 30 percent of the global surface area of standing water. These inland water resources serve as cheap and convenient source of water for drinking, domestic, irrigation and industries. The services provided by the pond are ground water recharge, food alleviation, high local and regional aquatic biodiversity, culture, aesthetic and recreation.

The present study was aimed to assess phytoplankton productivity in a perennial pond, Rasalpura in Saran district of Bihar and pond status evaluation in terms of ecosystem services for local population.

METHODS AND MATERIALS

The Rasalpura pond is located in Saran district as somewhat rectangular in outline with water throughout the year and maximum depth of the pond at full water level is about 4.2 m. The primary productivity is determined through initial monthly sampling of water from each side and estimated by measuring the changes in the dissolved oxygen concentration in light and dark bottles after following methodology of Gaarder and Gran (1927) and Vollewinder (1974).

RESULTS AND OBSERVATIONS

The productivity of Rasalpura pond calculated in terms of gross primary productivity (GPP), net community respiration (CRR) and Net primary productivity (NPP). The results revealed the mean values of gross primary productivity during the study period as given in Table 1.

Table 1: Seasonal variation in Gross Primary Productivity (g cm^{-3} day^{-1}).

Season	Range		Mean±SD
	Minimum	Maximum	
Summer	1.72	1.24	2.44±1.25
Monsoon	0.96	4.51	2.04±3.12
Winter	0.48	8.45	2.84±1.86

The gross primary productivity sharply decreased from the month of December to February with minor variation i.e. 0.48±0.6 to 0.9±1.05 g.cm^{-3} day^{-1} and then again increased from March to May i.e. 1.72±1.1 to 3.24±1.5 g.cm^{-3} day^{-1}.

Season wise analysis showed that maximum value of gross primary in rainy season i.e. 3.04 ± 2.12 g.cm^{-3}day^{-1}and lower in summer i.e. 2.44 ± 1.25 g.cm^{-3}day-1. It has been found that gross primary productivity showed significant positive correlation with community respiration (Figure 1).

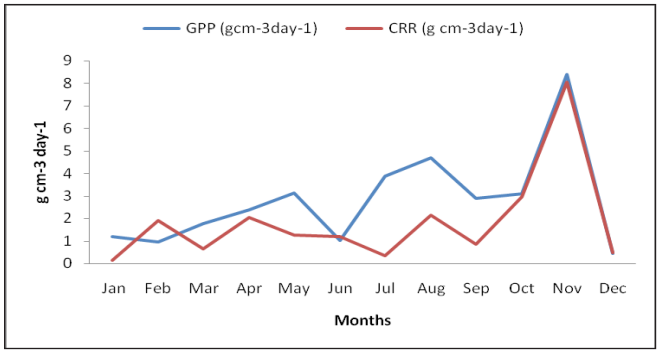

Figure 1: Variation of Gross Primary Productivity (GPP) with Community Respiration (CRR).

The value of net primary productivity showed irregular pattern throughout the year. The value of net primary productivity was higher in July i.e. 3.722±3.90 g.cm^{-3} day^{-1} and lowest in the month of June i.e. 0.43±0.21 g.cm^{-3} day^{-1} (Table 2).

Table 2: Seasonal variation in Net Primary Productivity (g cm^{-3} day^{-1}).

Season	Range		Mean±SD
	Minimum	Maximum	
Summer	0.76	1.87	1.28±0.88
Monsoon	0.43	3.72	2.45±1.85
Winter	0.46	2.20	1.18±1.36

It was observed that the value of net primary productivity gradually decreased from August to December and then increased till the May. Season wise analysis showed that during the winter season the average value and highest during the monsoon. The net primary productivity showed the significant positive relationship with chloride (Figure 2).

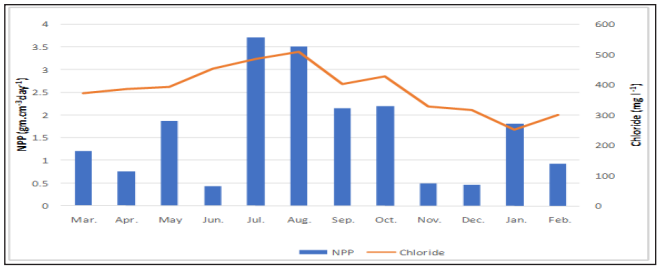

Figure 2: Variation of NPP with Chloride

During the course of present investigation, community respiration values on an average were found to vary from 0.1±0.2 g.cm^{-3} day^{-1} to 7.9±2.62 g.cm^{-3} day^{-1} (Table 3).

Table 3: Seasonal variation in Community Respiration (g cm^{-3} day^{-1}).

Season	Range		Mean±SD
	Minimum	Maximum	
Summer	0.60	1.90	1.27±0.59
Monsoon	0.19	2.11	1.04±1.63
Winter	0.10	7.90	2.72±1.74

The value of community respiration show decline in December i.e. 0.61±0.76 g.cm-3 day-1 to March i.e. 0.6±0.17 g.cm^{-3} day^{-1} and then in the later month with minor variation. Community respiration average value showed marked seasonal variation being minimum during the monsoon season and maximum during the winter (1.04± 0.63 to 2.72± 1.7 g.cm^{-3} day^{-1}).

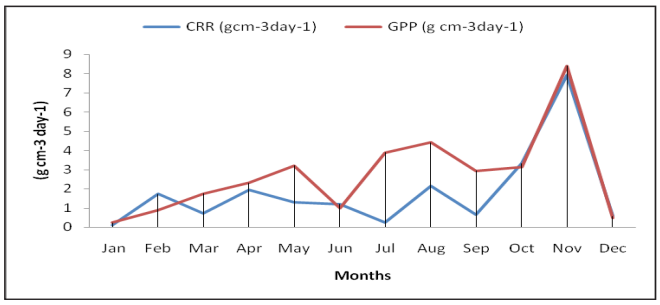

Figure 3: Variation in Community Respiration with Gross Primary Productivity (g cm^{-3}day^{-1})

The community respiration was found to record a positive significant correlation with dissolved oxygen (Figure 4)

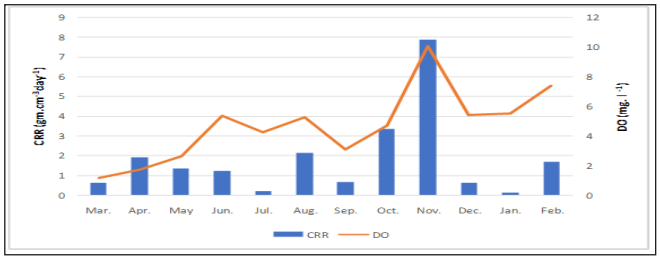

Figure 4: Variation in Community Respiration with Dissolved Oxygen level.

DISCUSSIONS

The primary productivity of an ecological system, community or any part thereof, is defined as the rate at which radiant energy is stored by activities of the producer organisms in the form of organic substances which can be used as food materials (Verma and Srivastava, 2016). The primary productivity is rate of energy flow in trophic levels and thus indicating potential of aquatic ecosystems. It is defined as the rate at which radiant energy is stored by producer organisms which can be used as food materials (Odum 1971). Sharma and Sharma (1992) state that phytoplankton encountered in the water body as well as they may be used as indicators of the water quality. The measurement of primary productivity provides a photosynthetic integration of physical, chemical and biological conditions, and if conducted over time, is an excellent measure of change in the trophic state of an aquatic system (Goldman, 1988). Primary production is an important biological phenomenon in the aquatic environment in which phytoplankton act as a primary producer, their physiological activities greatly controlled by physico-chemical characters of the water body (Kumar and Siddiqui 1997).

There are three types of productivity determinations, gross primary productivity (GPP), net primary productivity (NPP) and Community respiration rate (CR). The higher value of gross primary productivity in early monsoon and winter was the indicator of phytoplankton diversity and higher photosynthesis rate. The lowest GPP were recorded during monsoon season may be due to water dynamics and turbidity affecting light absorption by plankton population. Sharma and Yadav (2006) in Kayad lake also reported the similar trend during monsoon. The pond recorded average GPP monthly productivity within the range of 0.48±0.6 $g.cm^{-3}$ day^{-1} to 3.89±3.8 $g.cm^{-3}$ day^{-1}.

The value of Net primary productivity was affected by rainfall and net primary productivity values lower than the gross primary productivity in the present study. This is due to the fact that phytoplankton cell loose excess assimilated carbon during different metabolic activity. In the present study CRR and GPP are positively correlated with each other and similar observations made by Sreenivasan (1976) and Verma and Shrivastava (2016) in another polluted pond.

The average and regular pond productivity during study period might be due to desirable pH, temperature and phytoplankton. Primary productivity of the ponds mainly depends on the intensity and quality of light, carbon supply, availability of nutrients and biomass (Khan and Siddiqui, 1971; Sharma and Sahai, 1988). The estimation of primary productivity of aquatic ecosystem is of great importance for aquaculture management and helps to understand the food chain and food web relationship that prevails in the ecosystem. The highest rate of productivity during monsoon may be due to high temperature and high phytoplankton density. The winter lowering could be attributed to the reduced photoperiod coupled with low light intensity, temperature and scarce phytoplankton.

CONCLUSION

The high value of primary productivity indicates that the pond primary rich in nutrients with enough lighted zone and energy content. From the present study, it can be concluded that the productivity of Rasalpura pond is higher which is clearly indicating that the pond headed toward pollution. In Rasalpura pond inflow and outflow of water, nutrient loading and entry of harmful materials of different ways, have a direct and immediate effect on the metabolic rates, so it can be concluded that primary productivity can be taken as an important factor for pollution studies.

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