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Studies on the primary productivity of Rani Pokhar Vaishali, Bihar

Shailendra Kumar[a]* & Vijay Kumar[b]

[a]University Department of Zoology, B.R.A. Bihar University, Muzaffarpur, Bihar, India

[b]Department of Zoology, R.N. College, Hajipur, Vaishali, Bihar, India

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Abstract- Water is one of the most vital components of the environment, serving as a fundamental medium for sustaining aquatic life. Among freshwater ecosystems, ponds and lakes represent highly productive systems that play a significant role in ecological balance and offer valuable ecosystem services such as irrigation, drinking water supply, and habitat for aquatic organisms. The present study focuses on assessing the primary productivity of Rani Pokhar, a freshwater pond located near Belkunda Chowk in Vaishali district, Bihar. The study was conducted over a six-month period from July to December 2023 to understand the seasonal dynamics of gross primary productivity (GPP), net primary productivity (NPP), and community respiratory rate (RR). Using the classical light and dark bottle method, monthly water samples were collected and analyzed for carbon fixation as an indicator of phytoplanktonic activity and overall ecological health. The results revealed distinct monthly variations in productivity, with GPP ranging from 1.72 to 2.10 mgC/L/hr, NPP from 0.90 to 1.50 mgC/L/hr, and RR from 0.60 to 0.84 mgC/L/hr, indicating that the highest productivity occurred during the post-monsoon months, particularly in September and November. These variations are closely linked to environmental parameters such as nutrient availability, temperature, and light penetration. The findings suggest that Rani Pokhar exhibits a moderate to high level of biological productivity, making it ecologically significant for supporting aquatic life and potentially vulnerable to pollution and eutrophication. This study provides baseline data that can be instrumental for future conservation efforts, water quality monitoring, and sustainable management of the pond ecosystem.

Keywords: Rani Pokhar, Gross Primary Productivity, Net Primary Productivity, phytoplanktonic activity

INTRODUCTION

Water is one of the most important natural resources required essentially for the life and health of living organisms. Such water gets contaminated and abused as a convenient dumping ground for wastes and effluents of all kinds, including agricultural, industrial and domestic wastes. The unique peculiarity of aquatic ecosystem, whether it is lentic or lotic, is its inhabitation by planktonic organisms. Generally, planktons are considered as an index of fertility of the water column.[1] Planktonic organisms have short life cycle with a high metabolic activity, which facilitates them to respond to any pollution stress quickly and significantly, compared to benthic or nektonic organisms.[2] Hence, study of planktonic community is of crucial importance in understanding pelagic productivity and pollution impacts.

Studies on plankton population were done by Pillai *et al.* (1973)[3] in Vembanad lake, Nair & Abdul Aziz (1981)[4] in Ashtamudi estuary, Shobha & Miranda (1981)[5] in Kudinumkulum lake and George Thomas & Tresa Femandez (1989)[6] in Kumaraskum back waters.

*Corresponding author :
Phone : 8210313379
E-mail : shailendrabio11@gmail.com

Productivity of lakes depends on the presence of plankton biomass. Enrichment of nutrients and dissolved matter in the water bodies affect diversity of plankton and also physico-chemical properties of water. Diversity in the distribution, abundance and variations in the biotic factors provide information of energy turnover in aquatic ecosystems. A host of workers have studied the influence of nutrients and physico-chemical factors on algal density.[7]

In any aquatic body primary productivity gives an information relating to the amount of energy available to support bioactivity of the system.[8] Estimation of primary productivity of the aquatic systems, those are adversely affected by anthropogenic activities, serves as an important tool in studying the effect of those activities on the system. Several studies are available relating to the primary productivity of different ponds, lakes and reservoirs in different parts of India.[9]

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.[10,11] Phytoplankton also serves as food for aquatic animals especially for fishes and also, they play an important role ecological balance and quality of the water.[12] Sharma & Sharma (1992)[13] noted that phytoplankton encountered in the water body as well as they may be used as indicators of the water quality.

The present study has been undertaken to study the primary productivity of the freshwater Rani Pokhar, from the point of view of future pollution abatement programmes. There are three types of productivity determinations, gross primary productivity, net primary productivity and community respiratory rate. Rate of photosynthesis by the natural population was frequently lower at the surface than at three metre depth, especially during the period of bright sunshine although phytoplankton population remains uniformly distributed.[14]

MATERIALS & METHODS

The Rani Pokhar is a freshwater pond situated in Belkunda chowk near Hajipur. The total depth of the pond is 14.5feet and an area of about 5.81 sq. km. The total water holding capacity of the pond is 32.21 million cu.ft. Nearly 705 acres of village gets irrigation facilities from the pond. For the present study sampling points were fixed in the pond to study the ecology of the pond water, and samples were collected for a period of six months from July 2023 to Dec. 2023. The pond receives water from the catchment areas of during rainy seasons. The water samples were collected from 12 Noon to 2 P.M. during the first week of every month. The samples were collected in sterilized polythene containers completely to exclude any air space, sealed tightly and transported to the laboratory within 24 hours. Primary productivity has been estimated by light and dark bottle method.

RESULTS & DISCUSSION

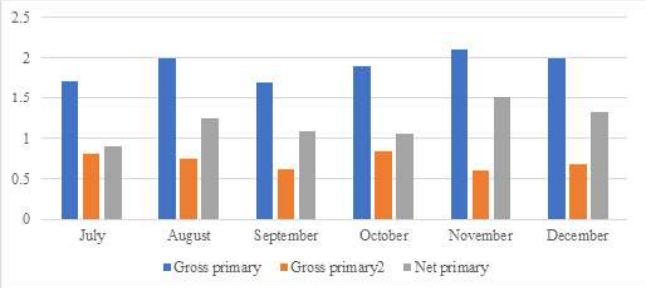
The values of primary productivity are presented in Table 1. The values of gross primary productivity, respiratory rate and net primary productivity fluctuated between 1.72-2.1, 0.6-0.84 and 0.9-1.33 mgC/L/hr respectively. Maximum values were recorded in the month of September, and minimum in July.

The fluctuation of productivity values in Rani Pokhar water in different months is well marked. It has been reported that high and low productivity values of water bodies might be due to high and low nutrients status of the water.[15]

Variation of productivity values, directly or indirectly, are influenced by environmental factors.

Table 1: Variations in the primary productivity in Rani Pokhar (2023). Units: mgC/L/hr

Months	Gross Primary Productivity	Gross primary	Net Primary Productivity
July	1.72	0.82	0.90
August	2.00	0.75	1.25
September	1.70	0.62	1.08
October	1.90	0.84	1.06
November	2.10	0.60	1.50
December	2.00	0.67	1.33
Mean	1.90	0.72	1.19
SD ±	0.16	0.10	0.20



A significant direct relationship of temperature with productivity is established by several authors.[9,16-18]

Basheer *et al.* (1996)[19] while studying primary productivity in Kalidah pond, receiving sewage effluents from Aligharh city, did find a direct relationship between

air temperature and productivity. The minimum and maximum occurrence of productivity values in different times has been reported by several researchers. Generally, the rate of photosynthesis increases with the rising temperature up to maximum and then diminishes rapidly with further rise of temperature. The pH, phosphate and nitrogen are another important factor, controlling productivity of aquatic ecosystems.[20] Thus, the present study gives a clear idea on the primary productivity of Rani Pokhar.

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