



RESEARCH ARTICLE

BIO-ENERGETICS AND PLANKTONIC COMMUNITY INDICES AS INDICATORS OF CARBON OPTIMIZATION IN URBAN FISH PONDS

Dr. Priyama Kumari

University Department of Zoology, T.M. Bhagalpur University, Bhagalpur, Bihar, India

ARTICLE INFO

Article History:

Received 15th December, 2025
Received in revised form
25th January, 2026
Accepted 18th February, 2026
Published online 30th March, 2026

Keywords:

Bio-energetics, Planktonic Index, Carbon Optimization, Shannon-Weiner Index, Bhagalpur, Trophic Efficiency.

*Corresponding author:

Dr. Priyama Kumari

Copyright©2026, Priyama Kumari. 2026. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Dr. Priyama Kumari. 2026. "Bio-energetics and Planktonic Community Indices as Indicators of Carbon Optimization in Urban Fish Ponds". *International Journal of Current Research*, 18, (03), 36701-36702.

ABSTRACT

The efficiency of carbon optimization in aquatic ecosystems is directly reflected in the diversity and density of planktonic communities. This study evaluates the bio-energetics of two urban ponds in Bhagalpur (Bhairwa) by analyzing the correlation between carbon fixation rates and plankton abundance. A total of 30,930 units/liter of phytoplankton and 9,120 units/liter of zooplankton were recorded. The Shannon-Weiner Index (H') and Species Richness were used to quantify the ecological health. Results demonstrate a high carbon-to-biomass conversion efficiency, with Chlorophyceae and Rotifera as the dominant groups. This study provides a quantitative framework for utilizing planktonic indices to optimize carbon sequestration in urban aquaculture.

INTRODUCTION

In freshwater ecosystems, the conversion of inorganic carbon into biological biomass is mediated by phytoplankton—the primary producers. The efficiency of this "carbon optimization" determines the energy available for higher trophic levels, such as zooplankton and fish (Odum, 1971). High primary productivity (GPP) does not always translate to high fish yield if the energy is lost through excessive respiration or if the plankton community is dominated by inedible species (Wetzel, 2001). Recent research in the Indo-Gangetic plains suggests that urban ponds often face "nutrient-shocks," which alter the planktonic community structure (Saha *et al.*, 2023). To optimize these ponds for aquaculture, it is essential to correlate physicochemical drivers with biological indices (Kumar *et al.*, 2021). This article presents clear, standardized data on the planktonic density and diversity of Bhagalpur's ponds to evaluate their bio-energetic potential.

MATERIALS AND METHODS

Plankton Sampling and Identification

- **Collection:** 50 liters of pond water were filtered through a bolting silk plankton net (No. 30, mesh size 77/cm²).

- **Preservation:** Samples were preserved in 5% formalin and analyzed using a Sedgwick-Rafter Counting Cell.
- **Identification:** Standard keys by Edmondson (1959) and Needham & Needham (1962) were used for taxonomic identification.

Productivity Correlation: Simultaneously, Gross Primary Productivity (GPP) was measured using the Light and Dark bottle method to calculate the Carbon-Biomass Conversion Ratio.

Statistical Indices

- Shannon-Weiner Index (H'): $H' = -\sum (P_i \ln P_i)$
- Species Richness (D): $(S-1) / \ln N$

RESULTS AND DISCUSSION

The study revealed a high degree of biological complexity, which facilitates efficient carbon cycling.

Discussion of Carbon Optimization: The strong positive correlation between GPP and Chlorophyceae ($r = +0.892$) indicates that green algae are the primary engines of carbon fixation in these ponds. The high species richness in summer ($H' = 2.45$) suggests a stable ecosystem capable of absorbing high nutrient loads without collapsing.

The negative correlation with Phosphates indicates that plankton communities are rapidly "consuming" available nutrients to build biomass, which is the ideal state for carbon optimization.

Table 1. Density and composition of phytoplankton groups (Annual Total)

Phytoplankton Group	Total Count (unit/lt)
Chlorophyceae	11,546
Myxophyceae	11,225
Bacillariophyceae	5,431
Euglenophyceae	2,728
Total	30,930

Table 2. Seasonal Bio-energetic indices (Bhairwa Pond)
This table demonstrates the co-rrrelation between carbon fixation (GPP) and Biological density

Season	GPP (gc/ms/day)	Phytoplankton
Summer	3.42	8,773
Monsoon	2.10	5,615
Winter	1.85	8,704

Table 3. Correlation Metrix between carbon Fixation and Biological groups

Parameter Relationship	Carbon Correlation
GPP Vs Chlorophyceae	+ 0.892
GPP Vs Rotifera	+ 0.814
Phosphate Vs Plankton Density	-0.943
Temp. Vs. Diversity	+ 0.765

•Recommended ranges based on Bhatnagar *et al.* (2004)

CONCLUSION

The bio-energetic profile of Bhagalpur's urban ponds indicates a highly efficient system where carbon is rapidly converted into edible planktonic biomass. To further optimize this process, management should focus on maintaining the dominance of Chlorophyceae over Myxophyceae to ensure that the fixed carbon is high-quality for fish consumption.

REFERENCES

- APHA 2018. Standard Methods for the Examination of Water and Wastewater. 23rd Edition.
- Das, S., *et al.* 2024. Thermal stress and metabolic efficiency in tropical ponds. *Journal of Thermal Biology*, 112.
- Edmondson, W.T. 1959. *Freshwater Biology*. John Wiley & Sons, New York.
- Kumari, P. 2023. Study of Primary Productivity of Fish Ponds of Bhagalpur, Bihar. Ph.D. Thesis, T.M.B.U.
- Saha, A., *et al.* 2023. Nutrient dynamics in urban lentic systems. *Water Resources Management*, 37.
- Verma, S. K., *et al.* 2020. Phytoplankton diversity in freshwater ponds. *Limnology and Oceanography*, 15.
