

Ecohydrological Assessment of Water Bodies: Monitoring Eutrophic Water Bodies and Algal Toxin

Bishal Paul

Department of Environmental Science, Tezpur University, Napaam, Tezpur, Assam, India

Nayanmoni Gogoi *

Assistant Professor, Department of Environmental Science, Tezpur University, Napaam, Tezpur, Assam, India

Abstract

Eutrophication of lentic ecosystems is an increasing ecological and public health concern in the floodplains of Northeast India. In the Sonitpur district of Assam, nutrient enrichment of freshwater lakes and wetlands promotes the proliferation of Harmful Algal Blooms (HABs), particularly cyanobacteria producing Microcystin-LR (MC-LR), a potent hepatotoxin harmful to humans and aquatic fauna. This study adopted an ecohydrological approach to evaluate the interaction between hydrological dynamics and eutrophication in 25 lentic water bodies across agricultural, roadside, residential, and township localities during 2021–2023. Water quality assessment included Secchi Disc Depth (SDD), Total Phosphorus (TP), algal density, Chlorophyll-a and b, Carlson's Trophic State Index (TSI), and MC-LR quantification using ELISA. Statistical analyses involved ANOVA, Pearson's correlation, and Principal Component Analysis (PCA). Results showed significant seasonal and spatial variations. Water clarity was higher in winter, while monsoon runoff increased sediment load and nutrient enrichment. TP frequently exceeded the critical limit of 1.0 mg L^{-1} , with significant seasonal variation ($F = 10.38$, $p < 0.05$). Chlorophyll-a and algal density peaked during monsoon months, indicating enhanced algal productivity. Township lakes recorded the highest trophic stress (TSI: 59–62), whereas roadside water bodies remained moderately eutrophic. MC-LR concentrations ranged from 0.414 to 19.42 ppb, with 21 of 25 sites exceeding the WHO safety limit of 1.0 ppb. A strong positive correlation was observed between TSI and MC-LR ($r = 0.905$, $p = 0.01$). PCA identified eutrophication-related variables (TP, TKN, Chl-a, algal density, COD, and TOC) as major drivers of cyanotoxicity. The study demonstrates that monsoonal hydrology accelerates nutrient loading and HAB formation in Sonitpur wetlands, highlighting the urgent need for watershed management, runoff control, and ecological restoration strategies.

Keywords

Ecohydrology, Carlson Trophic State Index, Microcystin-LR, Harmful Algal Blooms, PCA, Biomonitoring.