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Phosphate dynamics in a sub-tropical lake ecosystem

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Lake Ecosystem is a key component of biosphere that supports aquatic life and provide sink to the untreated effluent (domestic, industrial, and agricultural). Due to rapid industrialisation and changing climate, 30-40% of the lakes in the world are now eutrophic. The basic cause of eutrophication is the addition of nutrients (nitrogen and phosphate) into the lake system. Phosphate has been observed to be the limiting nutrient in 80% of the lakes and reservoirs in the world. Unlike other elements, phosphate does not escape from the system but changes from one form to the other depending upon the prevailing physico-chemical conditions. Chemical parameters like pH and redox potential are the major governing factors for phosphate fluxes. Sediments in the benthic zone serves as a sink as well as the source of phosphate for the photic zone. In the present study, a relationship between the physico-chemical properties of water and the fractions of phosphate in the sediments were studied. The study was conducted during three different seasons i.e. post-monsoon, winter, and summer to observe the seasonal variation. The pH, DO, ORP, and available phosphate in the water varied from 8.5, 14.7 mg/l, 39 mV, and 5.8 mg/l, 8.4, 3.5 mg/l, -64 mV, and 8.7 mg/l, and 7.8, 7.3 mg/l, 119 mV, and 10.5 mg/l during post-monsoon, winter, and summer, respectively. Phosphate in sediments was fractionated using SMT protocol. It was categorised under inorganic and organic phosphate classes, and the inorganic phosphate was further categorised as Non apatite inorganic phosphate (NAIP: Fe/Al bound) and Apatite inorganic phosphate (AIP: Ca bound). The inorganic phosphate in the sediments was observed to be more than organic phosphate during post monsoon and summer, and at the same time the available phosphate in the overlying water was found low in concentration. The growth of phytoplankton is constrained by decreasing bio available phosphate in water. Concentration of NAIP was observed to vary with redox potential and concentration of AIP with pH. The study justified the hypothesis of direct relationship of sediment chemistry with bio availability of phosphate in water. Winter was found to be the extreme weather for phosphate fluxes. The findings point towards need of proper management such as chemical precipitation, sediment dredging etc. during this extreme weather conditions.