# Water Quality Restoration from Nutrients Enrichment: A Review of 30 Years' Efforts for a Hyper-eutrophic Lake in China

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Excessive nutrient discharges have resulted in pervasive water pollution and aquatic eutrophication. China has made massive efforts to improve water quality since 1990s. However, how long-term policy interventions govern external and internal fluxes as well as nitrogen (N) and phosphorus (P) concentrations is not well known. Here we examine the historical monthly N concentration trend and its key drivers in eutrophic Lake Dianchi (southwest China) over the past 30 years, based on observations of water quality and external N and P fluxes, local surveys of mitigation measures, and process-based model simulations of internal N fluxes. Our data indicate that N concentrations peaked at 3.0 mg $L^{-1}$ in 2007-2010 but afterwards declined down to 1.2 mg $L^{-1}$ in 2018. Compared with 2002, The decline in lake N concentrations was attributed to reduced riverine N inflow, denitrification and benthic N flux. Adoptions of wastewater treatment, pollution interception, and transboundary water transfer dominated the changes in external and internal fluxes of N and P, and thereby the decline lake water quality concentrations. We also proposed perspective for cleaner lakes, including well-defined water quality targets at long- and short-term scales, model-based optimal decision making, sufficient and persistent financial supports, priority on industrial structure adjustment for low-nutrient sectors and reduction of domestic and industrial wastewater, improving water and nutrient recycling and nature-based solutions under climate change.

**Keywords**

Lake eutrophication, Nutrient enrichment, Modeling, Internal flux