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A silver lining to a century of unthrottled nutrient release to a shrinking terminal lake?

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Effective water management becomes crucial amidst global water resource depletion, particularly where existing policies put large water masses at risk of pollution, posing threats to environmental and public health. The Salton Sea, California's largest lake, illustrates the consequences of policy delays. Over a century, unchecked agricultural runoff—permitted by regulatory agencies—has inundated the lake with excessive nitrogen and phosphorus, resulting in hypereutrophication and mass fish die-offs due to anoxia and euxinia. Moreover, mounting evidence indicates that microbial toxins from the lake, transported by aerosols, impact lung health in nearby communities.

Contrary to the prevailing narrative attributing the Salton Sea's decline solely to reduced water volumes from drought, irrigation demands, and urban water consumption—underscored by salinity levels around 70, more than double that of the Pacific Ocean—the overlooked issue lies in point-source pollution and the absence of a suitably designed management system for a terminal lake of its magnitude. Time-monitored studies from 2020 to 2022 consistently reveal suboxic water column conditions year-round and summer anoxia (dissolved oxygen below 5 and 0 mg/L, respectively). The year-round persistence of low sulfidic conditions contrasts with past seasonal extremes. Geochemical analyses depict significant alterations in the top 20 cm of sediment due to human activity, with extreme enrichments in organic matter (TOC up to 7 wt. %), sulfides (pyrite up to 0.9 wt. %, sulfide in pore waters up to 4 mM), and notable nitrogen isotope ratios ($\delta^{15}N$ ~13 ‰) indicating extensive denitrification.

Many proposed mitigation strategies neglect the nutrient loads from nearby agriculture, often overshadowed by salinity concerns. A comprehensive approach requires collaborative efforts among academic, industrial, and governing bodies to manage the approximately 6 km^3 of water. Proposed solutions include nature-based strategies like wetlands and improved inflow systems to purify the lake's water, considering changing redox structures due to shallowing. Direct nutrient removal through intermittent nitrification and denitrification to reduce N nutrient inventories and harnessing algal blooms for biofuel production may also be considered. These system-based 'natural' remedies highlight the importance of reimagining wastewater as a valuable resource, promoting sustainable water management within an adaptive engineering framework that yields benefits and opportunities outweighing costs.