The Impact of Human Activities on a Lake Ecosystem on the Chiapas Coast, Mexico: A Physicochemical and Biological Approach

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Abstract:

Water bodies in Mexico face increasing environmental pressure due to the discharge of insufficiently treated wastewater and the runoff of agrochemicals, particularly fertilizers, from intensive agricultural activities. This situation is especially critical in coastal and estuarine systems, where contaminants tend to accumulate before reaching the marine environment, resulting in significant ecological and socioeconomic impacts. The Mar Muerto Lagoon, located on the Pacific coast of Chiapas, Mexico, exemplifies this problem. This coastal lagoon plays a vital role in supporting artisanal fisheries, which constitute a primary source of livelihood for local communities. However, in recent years, a marked decline in fishery productivity has been observed, raising concerns about the lagoon's ecological health. To evaluate water quality and its spatiotemporal dynamics, 35 physicochemical and biological parameters were systematically analyzed. The results allowed for the identification of three distinct environmental zones—estuarine, transitional, and marine—along with notable seasonal variations between the wet and dry periods. These variations revealed patterns of phytoplankton succession associated with hydrological fluctuations. Furthermore, elevated concentrations of heavy metals, particularly those associated with the improper disposal of electronic waste, were detected, posing a significant risk to aquatic life and potentially affecting the food web. The findings underscore the urgent need for integrated management strategies to protect this vulnerable ecosystem.