PHYTOREMEDIATION OF SEBOU ESTUARY WATER USING PISTIA STRATIOTES: NITRATE REMOVAL EFFICIENCY AND WATER QUALITY IMPLICATIONS FOR A STRESSED AFRICAN RIVER SYSTEM

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The Sebou River, one of Morocco's most ecologically and economically vital watercourses, is subject to intensifying anthropogenic pressures, including agricultural runoff, urban wastewater discharges, and industrial effluents. At its estuarine zone, a critical transitional interface between freshwater and marine ecosystems, nitrate (NO_3^-) accumulation poses significant risks of eutrophication, hypoxia, and biodiversity loss. From a public health perspective, elevated nitrate exposure is associated with methemoglobinemia in vulnerable populations, endocrine disruption, and increased gastrointestinal cancer risk. In the context of African river governance, finding low-cost, nature-based solutions to improve effluent quality before discharge into sensitive receiving systems is a priority for both ecological resilience and socio-environmental equity.

This study aims to quantify the nitrate concentrations in water sampled from the Sebou Estuary, evaluate the nitrate removal efficiency of *Pistia stratiotes* L. (Araceae) over a 14-day phytoremediation experiment, and discuss the implications for aquatic ecosystem health and water quality management in a stressed African river context.

Water samples were collected from the Sebou Estuary and subjected to a 14-day controlled complementary phytoremediation treatment using *P. stratiotes* under semi-natural conditions. Nitrate concentrations were determined at Days 0, 3, 7, 10, and 14 using the sulfosalicylic acid spectrometric method in strict accordance with NM ISO 7890-3:2021. Calibration was performed over a 0–5 mg/L NO_3^- range ($R^2 = 0.998$) using the equation: C = (DO + 0.032) / 0.148. Removal efficiency (RE %) was calculated relative to the Day 0 initial concentration.

Nitrate concentrations in Sebou Estuary water decreased progressively throughout the treatment period, from **2.24 mg/L at Day 0 to 0.34 mg/L at Day 14**, corresponding to an overall removal efficiency of **84.8 %**. The most dynamic removal phase occurred within the first seven days (73.2 %), consistent with active vegetative growth and peak rhizospheric uptake activity of *P. stratiotes*. A slight slowdown in removal rate between Days 7 and 14 reflects progressive nutrient saturation of plant biomass.

The 84.8 % removal efficiency achieved by *P. stratiotes* aligns with values reported in peer-reviewed literature for this species (70–95%), with rhizosphere-mediated microbial denitrification and direct plant assimilation identified as primary removal pathways. Applied to the Sebou Estuary context, this nature-based approach could meaningfully reduce the nitrate load entering sensitive estuarine and coastal ecosystems, contributing to eutrophication control, biodiversity protection, and the safeguarding of downstream water uses, including fishing communities and irrigation agriculture, dimensions central to the socio-ecological resilience framework of ICAR 2026.

Pistia stratiotes proves to be a highly effective, low-cost, and ecologically sound solution for tertiary nitrate removal from estuarine water in African river systems. These findings support the integration of floating macrophyte-based phytoremediation into multi-scale water quality governance strategies for the Sebou Basin, with potential transferability to other stressed African river corridors.

Keywords: *Phytoremediation, Pistia stratiotes, Nitrate removal, Sebou Estuary, Water quality, ecosystem health.*