

Peer Review

Review of: "Phosphorus Recovery Potential from Decentralised Wastewater Treatment Systems in India: A Constrained Mass-Balance Study of Auroville"

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This manuscript evaluates the phosphorus recovery potential of a community-scale decentralized wastewater treatment system (DEWATS) in Auroville, India, using a steady-state constrained mass-balance framework. By integrating influent–effluent monitoring data with literature-derived partitioning coefficients, the author reconstructs internal phosphorus pathways and models three magnesium-based struvite recovery scenarios: pre-primary dosing, pre-secondary (vortex) dosing, and sludge-line processing. The study finds that while pre-primary dosing maximizes theoretical phosphorus recovery ($\sim 2.6 \text{ kg P d}^{-1}$), pre-secondary dosing provides the most balanced outcome, improving effluent quality ($\text{TP} \approx 2.7 \text{ mg L}^{-1}$) with lower operational complexity. The manuscript also proposes a “tropical advantage,” suggesting elevated ambient temperatures ($\sim 27^\circ\text{C}$) enhance phosphorus bioavailability and recovery efficiency.

The study addresses an important gap in decentralized sanitation research and offers a practical modelling framework for data-limited systems. The constrained mass-balance approach is particularly valuable for small-scale infrastructure lacking internal monitoring. The scenario comparison is logically structured and policy-relevant.

However, several technical aspects require strengthening.

First, the internal nutrient partitioning relies heavily on literature-derived coefficients without probabilistic uncertainty propagation. The current approach uses OAT ($\pm 15\%$). For nonlinear precipitation systems and partition-based inference, this is insufficient, in my opinion. Monte Carlo analysis would

improve robustness. Second, struvite precipitation efficiencies are assumed rather than supported by chemical equilibrium modelling (e.g., speciation or saturation index analysis), and competing ions are not considered. Third, the techno-economic assessment lacks an explicit capital annualization methodology and sensitivity to magnesium price variability. Finally, the “tropical advantage” claim would benefit from a quantitative kinetic comparison using temperature-corrected hydrolysis rates.

Overall, the manuscript presents promising and policy-relevant findings but requires methodological refinement before publication in a high-impact water journal.

Declarations

Potential competing interests: No potential competing interests to declare.