RETASTE Conference Abstracts
RETASTE-AWR-1348-In-person Poster
Rethymno, September 16-18, 2026
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DOI:10.5281/zenodo.23678069

Microbiological and Chemical Risk Assessment of Treated Domestic Wastewater Reuse for Irrigation in Hotel Facilities: A Case Study

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Abstract

Water scarcity and increasing tourism-related water demand in Mediterranean regions have intensified the need for sustainable water management strategies, particularly in hotel facilities with high seasonal consumption patterns. Treated domestic wastewater reuse for landscape irrigation represents a promising alternative water resource; however, its safe implementation requires comprehensive assessment of microbiological and chemical risks associated with reclaimed water quality and long-term environmental exposure. This study presents a case study-based risk assessment of treated domestic wastewater reuse for irrigation in hotel facilities, focusing on the evaluation of microbiological and chemical parameters in relation to regulatory requirements and public health protection. The investigation was conducted using operational data from hotel wastewater treatment systems located in Crete, Greece, where reclaimed effluent is utilized for irrigation of green areas and ornamental landscapes. The assessment included monitoring of key microbiological indicators, such as Escherichia coli and Total Coliforms, together with physicochemical and chemical quality parameters including biochemical oxygen demand (B.O.D.5), total suspended solids (T.S.S.), nitrogen, phosphorus, salinity, and residual chlorine. The study also evaluated the potential risks associated with nutrient accumulation, soil degradation, and human exposure pathways during irrigation practices. Results indicate that properly operated decentralized wastewater treatment systems can consistently achieve effluent quality suitable for restricted or controlled irrigation reuse applications. Microbiological monitoring demonstrated substantial pathogen reduction efficiency, while chemical analyses showed compliance with most national and international reuse standards. Nevertheless, the findings also highlight the importance of continuous monitoring, operational control, and site-specific risk management measures, particularly during periods of fluctuating hydraulic loading associated with tourism seasonality. The study further discusses the role of decentralized wastewater reuse systems in supporting circular water management and reducing freshwater consumption in the hospitality sector. The implementation of reuse practices in hotel facilities may contribute significantly to water conservation targets, especially in water-stressed island environments where tourism activities place additional pressure on local water resources. The proposed framework combines technical monitoring with environmental and public health risk assessment principles, providing a practical approach for evaluating wastewater reuse applications in tourism infrastructure. The findings can support policymakers, hotel operators, and water management authorities in developing safe and sustainable reuse strategies aligned with circular economy and climate resilience objectives.

Keywords: Wastewater reuse, Risk assessment, Irrigation, Hotel facilities, Water quality

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