

**Mitigating Environmental Impact: A Novel Grey Water Treatment Approach for Small Hotels in Anuradhapura, Sri Lanka**

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**Abstract**

Anuradhapura, a historic city in Sri Lanka with over 50 small-scale hotels, faces pressing environmental challenges due to the release of untreated gray water into municipal canals, which ultimately flow into Malwathu Oya. This study introduces a cost-effective greywater treatment system tailored for these establishments, with the goal of improving water quality and enabling reuse for non-potable applications such as toilet flushing. The research methodology included the analysis of key water quality parameters at the discharge points of 15 selected hotels, with samples collected over a three-month period. The assessed parameters included pH, Total Dissolved Solids (TDS), Chemical Oxygen Demand (COD), Biological Oxygen Demand over five days (BOD<sub>5</sub>), Total Suspended Solids (TSS), dissolved phosphorus, ammonia nitrogen (as N), and oil and grease levels. A three-stage treatment system was designed, incorporating a debris screener, an oil trap, and a sand-gravel filtration unit. The filtration system was composed of sequential layers, including gravel, coarse sand, fine sand, activated charcoal, and metal. Post-treatment results revealed significant improvements in water quality, with reductions averaging 85% in COD, 78% in BOD<sub>5</sub>, 92% in TSS, and 76% in oil and grease. These improvements ensured compliance with wastewater discharge standards established by the Central Environmental Authority. The efficacy of the system was validated through statistical analysis using paired t-tests, which indicated significant differences ( $p < 0.05$ ) between pre- and post-treatment water quality. The treated greywater met regulatory standards for safe discharge and reuse, offering a practical solution to water management challenges. By implementing this system, small-scale hotels in Anuradhapura can mitigate environmental pollution, conserve water resources, and reduce operational costs. This study highlights the potential for broader adoption of the treatment system, contributing to sustainable tourism practices and enhanced environmental stewardship in the region.

**Keywords:** *Gray water treatment, Sustainable tourism, Environmental pollution, Water quality improvement.*