



Eco-Cycle Dynamics: Methodological Insights into Waste Management within Municipalities of South Africa

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Abstract

Waste management within South African municipalities is a critical environmental challenge, necessitating innovative approaches to promote sustainable development and resource efficiency. The study employs a mixed-methods approach, integrating quantitative surveys with qualitative interviews among municipal officials and community representatives. A Bayesian hierarchical model is utilised to analyse the impact of waste management policies on recycling rates ($\pi = 0.6 \pm 0.05$). Recycling rates in surveyed municipalities varied significantly, ranging from 20% to 45%, with a notable trend towards higher rates in urban areas where educational outreach programmes were implemented. The findings underscore the importance of tailored policy interventions and community engagement for enhancing waste management efficiency within municipal frameworks. Municipalities should prioritise education and outreach efforts to maximise recycling participation, while policymakers must consider local context-specific solutions in designing circular economy strategies. The empirical specification follows $Y = \beta_{0+\beta}^{-1} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, Geographic Information Systems, GIS, Sustainability Metrics, Life Cycle Assessment, Participatory Modelling, Circular Economy Principles*

ABSTRACT-ONLY PUBLICATION

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