# Integrated Solid Waste Management in Amphibious Communities: Risk Integration, Circular Economy and Artificial Intelligence

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## Abstract

This doctoral research proposes a strategic tool to guide decisions in the integrated management of solid waste, specifically in amphibian communities in La Mojana, Colombia. The objective is to develop an operational solution that allows prioritizing sustainable and adaptive interventions, integrating circular economy principles, environmental and social risk analysis, and artificial intelligence techniques. The proposal addresses a gap in the scientific literature and territorial practice, where conventional approaches have demonstrated limitations in addressing the complexity of vulnerable territories excluded from traditional planning systems.

The tool is based on a decision tree optimized using the Random Forest algorithm, which allows for the generation of contextualized and predictive recommendations. A mixed explanatory-sequential methodological approach is adopted, combining a qualitative phase (systematic review, interviews, focus groups, and field observation) with a quantitative phase focused on prioritizing variables, calculating risk (R=A×V/CA), scenario simulation, and model training. The process includes participatory validation with community stakeholders, which strengthens its applicability, legitimacy, and local ownership.

The expected result is a replicable, scientifically grounded tool adaptable to similar contexts, contributing to both environmental planning and evidence-based public policymaking. This thesis aligns with the Sustainable Development Goals (SDGs), promotes climate resilience, and provides a theoretical and methodological innovation by articulating traditionally fragmented approaches into an integrated, practical, and territorially focused model.