Report

Comparative Waste Characterisation across countries

Abstract

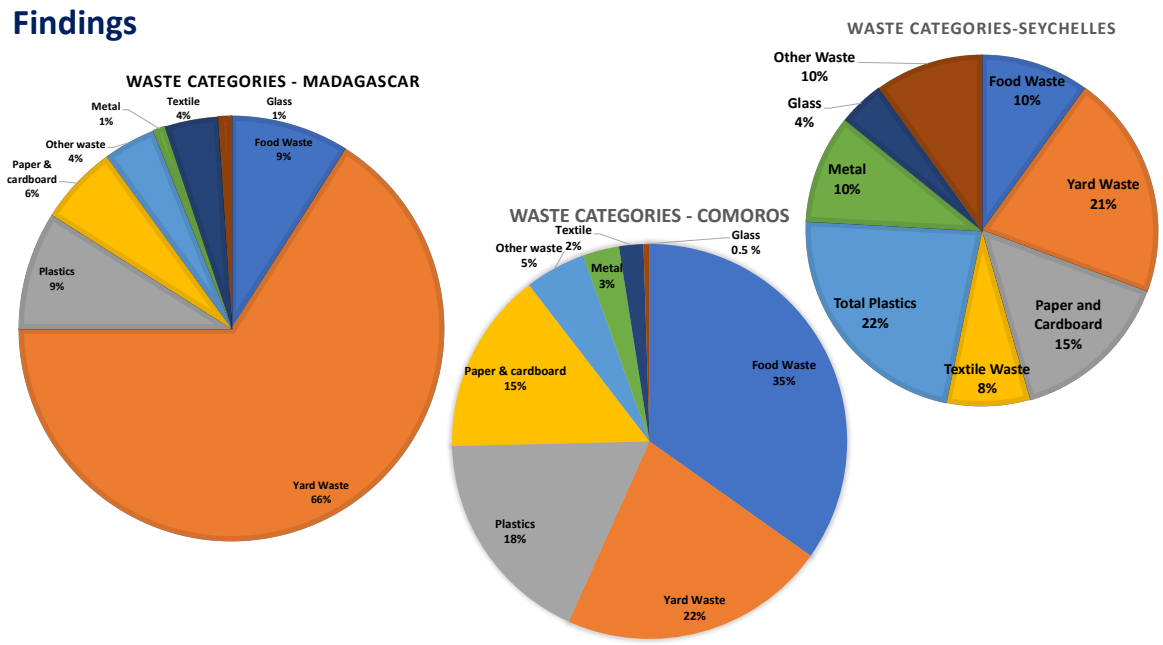
This report presents a comparative analysis of municipal solid waste characterisation studies conducted under the TWENex project in three Indian Ocean island nations: Madagascar, Comoros, and Seychelles. The findings serve as a foundational input for assessing the feasibility of waste-to-energy technologies, particularly anaerobic digestion. Waste composition data reveal significant variation across the three countries. Madagascar's waste stream is dominated by yard waste (66%), indicating high potential for composting and decentralised biogas systems. Comoros shows a more balanced composition with 57% organic waste (food and yard), making it suitable for scalable biodigester implementation alongside moderate recycling infrastructure. Seychelles exhibits the most diversified stream, with notable proportions of plastics (22%), organics (31%), and inorganics, suggesting the need for integrated waste management approaches combining digestion, recycling and advanced separation technologies.

Introduction

The management of municipal solid waste poses increasing challenges for small island states in the Southwest Indian Ocean. With limited land for disposal, growing urban populations, and mounting pressure on public infrastructure, these countries are seeking more sustainable and efficient ways to handle waste. At the same time, their dependence on imported fossil fuels has raised interest in solutions that can produce energy from local resources. The TWENex project: Transformation of the Waste Sector towards a Waste-Energy Nexus in the Southwest Indian Ocean Region was introduced to support this shift. Its objective is to strengthen local research and institutional capacity while promoting practical approaches to recover energy from waste in Comoros, Madagascar, Mauritius, and Seychelles. A necessary step in developing any waste-to-energy system is to first understand the composition of the waste being generated. The quantity and type of organic waste, the presence of materials that can be recovered or reused, and the level of contamination all influence which technologies can be applied and how they should be designed. Waste characterisation helps ensure that project planning is grounded in the actual conditions of

each country, avoiding mismatches between system capacity and available feedstock. This report presents the results of waste characterisation studies conducted in Comoros, Madagascar, and Seychelles. It provides a comparative overview of the types of waste generated in each country and explores what these findings mean for the potential use of technologies such as anaerobic digestion. The information will directly support the technical direction of the TWENex project and contribute to the broader effort to link waste management with renewable energy generation in a way that reflects local needs and resources.

2. Waste composition by country



Madagascar

The waste profile of Madagascar is heavily concentrated in organic matter, particularly yard waste, which accounts for approximately 66% of the total waste stream. Food waste contributes an additional 9%, while other categories such as plastics (9%), paper and cardboard (6%), and textiles (4%) are present in smaller amounts. Inert materials like glass and metals are minimal, each at around 1%. This distribution reflects a largely plant-based, biodegradable stream with low levels of packaging waste or industrial residues. The high share of yard waste suggests a strong potential

for decentralised organic waste treatment, including composting and small-scale anaerobic digestion. The relatively low presence of contaminants such as plastics and metals is favourable for biological treatment processes, as it reduces the need for intensive pre-treatment or source separation. These characteristics position Madagascar as well-suited for pilot initiatives focused on organic waste valorisation, particularly in peri-urban or institutional settings where organic material is readily available.

Comoros

Comoros presents a more evenly distributed waste composition. Food waste makes up the largest share at 35%, followed by yard waste at 22%, plastics at 18%, and paper and cardboard at 15%. Other components such as metals (3%), textiles (2%), glass (0.5%), and other waste (5%) are also present. This mix indicates a typical urban municipal waste stream that includes both biodegradable material and a sizeable proportion of packaging and recyclables. The combined organic fraction (57%) offers a strong case for biogas production through anaerobic digestion, though the notable presence of plastics and other dry waste suggests that successful implementation would require basic source separation or pre-sorting at collection points. The presence of paper and cardboard further supports the co-digestion of organic materials. Overall, the balance of waste types in Comoros offers flexibility in technology selection, provided institutional support is in place for separation, training, and maintenance.

Seychelles

The waste stream in Seychelles is the most diverse among the three countries studied. Plastics account for the largest share at 22%, followed by yard waste (21%) and food waste (10%). Paper and cardboard represent 15%, textile waste 8%, metals 10%, and glass 4%, with a further 10% classified as other waste. This complex composition reflects a highly mixed municipal waste stream, influenced by both residential and commercial activities. While the organic fraction (31%) remains suitable for biological treatment, the high presence of dry recyclables and non-biodegradables complicates the design of any single treatment pathway. Implementing anaerobic digestion or other waste-to-energy systems in Seychelles would require an integrated approach, combining mechanical separation, material recovery facilities, and advanced sorting to ensure

feedstock quality. In this context, waste valorisation efforts in Seychelles should be coupled with parallel strategies for recycling, policy incentives for separation at source, and capacity building to manage more technically demanding infrastructure.

3. Implications for TWENex implementation

The findings of the waste characterisation studies have direct implications for the implementation of TWENex activities in each country. Component 1, which focuses on the development of a biodigester and capacity building, must account for the quantity and type of organic waste available. For Madagascar, the high percentage of yard waste makes it a strong candidate for decentralised systems focused on composting or biogas production. The implementation team may consider aligning training modules with local waste profiles, focusing on source separation and low-contaminant feedstock handling.

In Comoros, the relatively balanced waste profile offers the flexibility to explore various energy recovery models. However, the presence of plastics and other dry waste highlights the need for basic sorting and community-level awareness programmes. The feasibility studies under Component 2 should reflect this dual requirement of digestion potential and the need for pre-treatment infrastructure. Additionally, capacity-building components must address institutional coordination and the operational requirements of mixed-waste facilities.

Seychelles, due to its diversified waste stream, requires a more sophisticated approach. The implementation of Component 3, which deals with energy recovery from sewage sludge, could benefit from a combined strategy that integrates solid waste treatment with existing wastewater systems. Moreover, Component 1 activities should consider the incorporation of advanced separation and recovery technologies, while policy efforts should focus on incentivising waste segregation at source and investment in material recovery facilities.

4. Strategic recommendations

1. Country-specific strategies are necessary to account for variations in waste composition. Madagascar can prioritise yard waste management through decentralised composting and biodigestion; Comoros can invest in basic source separation and modular biodigesters;

Seychelles must pursue integrated solutions combining digestion with recycling infrastructure.

2. Training should be adapted to local waste characteristics and institutional realities. Operators, technicians, and community facilitators need specific skills relevant to their national context, such as safe handling of food waste, maintenance of small-scale digesters, or operation of advanced separation units.
3. Across all three countries, successful implementation of waste-to-energy systems will require some form of waste separation, whether at the source or at centralised facilities. Investments in awareness campaigns, collection systems, and basic mechanical sorting will improve feedstock quality.
4. Regulatory frameworks should support the use of bio-waste for energy, including incentives for separate collection, procurement policies for compost or biogas, and guidelines for the integration of organic and wastewater streams.
5. TWENex provides a unique opportunity for cross-country collaboration. Lessons learned in one national context—such as low-contaminant feedstock handling in Madagascar or multi-stream integration in Seychelles—can inform others. Regular technical exchanges and regional platforms should be established.

5. Conclusion

The waste characterisation results from Madagascar, Comoros, and Seychelles offer valuable knwoledge into the practical realities of designing waste-to-energy systems in small island settings. Each country presents unique opportunities: Madagascar with its high organic load and low contamination; Comoros with its balanced and adaptable waste stream; and Seychelles with a mixed but recoverable resource base. These findings reinforce the importance of grounding technical and policy decisions in empirical data and local conditions. Moving forward, the TWENex project should continue to support country-specific approaches while fostering regional cooperation and knowledge exchange to build a more resource-efficient and energy-responsive future for the Southwest Indian Ocean region.