



‘ReCycling’ in a Mozambican city

Frederica Mendonça

- Recycling in sub-Saharan Africa is constrained by a coordination failure: households have little incentive to separate waste when collection is unreliable; potential collectors do not operate where recyclables are scarce.
- Only a small fraction of urban waste is recycled, and rising waste volumes are increasing environmental and public health pressures on municipalities with limited resources.
- A low-cost intervention in Quelimane mobilised informal bicycle-taxi drivers as waste collectors. A household information campaign encouraged residents to separate waste and contact their regular cyclists for pickup, while a new buy-back centre compensated cyclists per kilogram of recyclables delivered.
- A second arm added a simple public-visibility nudge to strengthen pro-social motivations and neighbourhood spillovers.
- Early results show strong behavioural change among both households and collectors. Within 21 weeks, cyclists delivered over 3.5 tonnes of recyclables, with 84% making at least one delivery. Households increased waste separation, reduced waste burning, and demonstrated higher knowledge of recyclable items. Cyclists gained a new, more stable income stream, with some earning up to ten times a standard passenger fare per delivery.

Modest, locally grounded interventions can shift cities out of low-recycling equilibria. Low-cost behavioural cues and partnerships with existing local systems offer a scalable, politically feasible pathway for improving municipal waste management in low-capacity urban settings.

Introduction

Cities around the world are expanding rapidly, and urban areas now house 45% of the global population (United Nations & Social Affairs, 2025). Quelimane, Mozambique's sixth-largest city, is growing at approximately 4% per year (UN-Habitat, 2022). Although urbanisation offers important economic opportunities, it also places increasing pressure on essential public services (Bryan et al., 2020). These pressures are particularly acute in vulnerable neighbourhoods where infrastructure has not kept pace with population growth. Solid waste management is one of the most significant challenges created by this rapid expansion.

Waste generation in sub-Saharan Africa is expected to grow by nearly 40% between 2020 and 2050 (UNEP, 2024). Waste accumulation contributes to soil and water contamination and leads to open burning, which significantly increases greenhouse gas emissions. In Quelimane, the problem is intensified by high exposure to flooding, since accumulated waste frequently blocks drainage canals during storms and heavy rains (World Bank, 2019). This combination of environmental risks underscores the need for urgent, cost-effective solutions.

The municipal waste agency, EMUSA, has been responsible for collection since 2005. However, chronic underfunding, limited infrastructure, and the city's expanding spatial footprint constrain the agency's ability to provide regular services. As a result, only about 45% of the city's waste is collected (Villa et al., 2022). This is particularly striking since slightly over 30% of waste in sub-Saharan Africa is recyclable, while less than 5% is treated. Household incentives for separating recyclables are very limited in this context, since no reliable mechanism exists for collecting them. Although a few private operators recover recyclables in Quelimane, they focus mainly on commercial establishments, leaving household-level materials largely uncollected. At the same time, households express dissatisfaction with current waste services, and only 16% report that waste is collected on time. A credible and reliable collection mechanism could therefore be sufficient to induce more households to separate waste.

Understanding why such a mechanism is not yet available is essential. Physical access to households and common bins is often costly because of the city's narrow streets, which are difficult for large vehicles to navigate. In addition, EMUSA faces severe budget constraints that limit the hiring and deployment of additional waste collectors. These challenges motivate exploring alternative delivery models that rely on existing local capacity.

One such opportunity arises from the extensive network of bicycle taxi drivers in Quelimane. Cyclists account for roughly 35% of all daily trips (Mendiate et al., 2022). They are well suited to Quelimane's flat terrain, are environmentally friendly, and can reach areas that are inaccessible to larger vehicles. Despite these advantages, they earn very low and unstable incomes. A typical passenger trip costs the equivalent of GBP 0.23, and the average daily income among cyclists is roughly GBP 1.29, which is below the international poverty line of GBP 1.63 (USD 2.15). Demand for rides is highly concentrated during peak hours, leaving long periods when cyclists are under-utilised. At the same time, cyclists maintain frequent and regular contact with households. Many have at least one household with whom they interact daily, creating a decentralised, low-cost channel for waste collection.

These observations suggest that repurposing part of the cyclist workforce as waste collectors could generate efficiency gains, as illustrated in Banares-Sanchez & Wiskamp (2025). Cyclists are numerous, have deep knowledge of neighbourhoods, and maintain consistent relationships with households. Their network provides an existing foundation through which information, collection requests, and recyclable materials could be transferred at low cost.

This project investigates whether offering households a credible collection mechanism, implemented through this under-utilised yet well-connected labour force, can trigger household-level waste separation and contribute to a cleaner and more sustainable urban environment.

The project

The project piloted a low-cost recycling initiative in Quelimane in partnership with the municipal government, under the programme “*ReCiclar com Quelimane*” (ReCycling with Quelimane). The intervention ran from July to November 2025 and combined two components: a household information campaign on recycling and free collection of recyclable waste conducted by bicycle-taxi drivers.

Bicycle-taxi drivers, known locally as cyclists, were engaged as community-based waste collectors alongside their regular work. Cyclists received training and information on recycling through targeted videos and were paid for each kilogram of recyclable material they delivered to a municipal storage centre. This approach provided a simple, credible collection mechanism for households while generating an additional income stream for low-wage workers.

Information campaign

The information campaign consisted of three rounds of structured household visits. During each visit, participants watched short videos that explained the environmental and health benefits of recycling, encouraged separation of

plastic, metal, and glass waste, and clarified how to request collection using their regular cyclist. The videos were tailored to each group: households were encouraged to separate waste and reuse existing bags for storage, while cyclists were encouraged to collect waste from their clients and reinforce the programme's messages.

Each round focused on a different theme. The first introduced recycling and highlighted its benefits for neighbourhood cleanliness. The second addressed the problems associated with waste accumulation and explained how to separate metal and glass. The third summarised all materials accepted for recycling and encouraged households to share the information with nearby neighbours. Cyclists were reminded to transport recyclables to the municipal storage point, where materials were weighed and compensated.

Social-visibility nudge

To assess whether visibility can strengthen recycling behaviour, a second treatment arm introduced a simple behavioural device: a “thermometer” poster displayed on household doors. Each time a cyclist collected recyclables, one bar on the poster was coloured in. This made participation visible to neighbours and reinforced pro-social norms.

Households with completed thermometers were eligible to be featured on a public display in the city centre. During the first measurement wave, households that had already completed a full thermometer received a small reward (a sticker) and a new card to maintain motivation. Field staff documented progress by photographing posters and recording the number of bars filled, creating a consistent record of household engagement throughout the programme.

Main findings

Within five months, cyclists recovered over 3,700 kilograms of recyclable waste, 72% of it plastic.

On average, the buy-back centre received around 735 kg of recyclables per month during the intervention, with volumes remaining broadly stable aside from minor fluctuations. Deliveries were slightly higher in the visibility-nudge group, although differences varied across months. Most of the material collected was plastic, consistent with regional waste-composition estimates: plastic accounted for roughly half of all recyclables delivered, followed by metal and then glass. Each delivery averaged 3.7 kg, generating an average payment of MZN 34, roughly equivalent to the earnings from three standard passenger trips for a cyclist.

Figure 1. Total kilograms delivered by month by treatment group

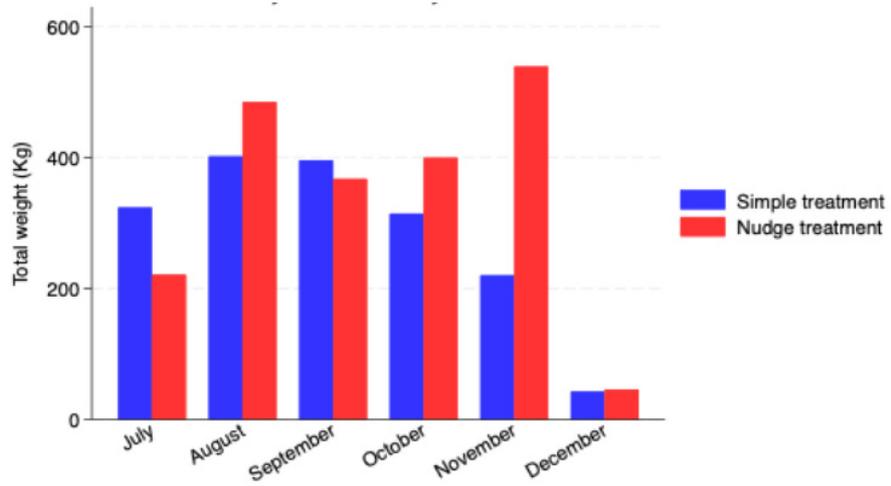


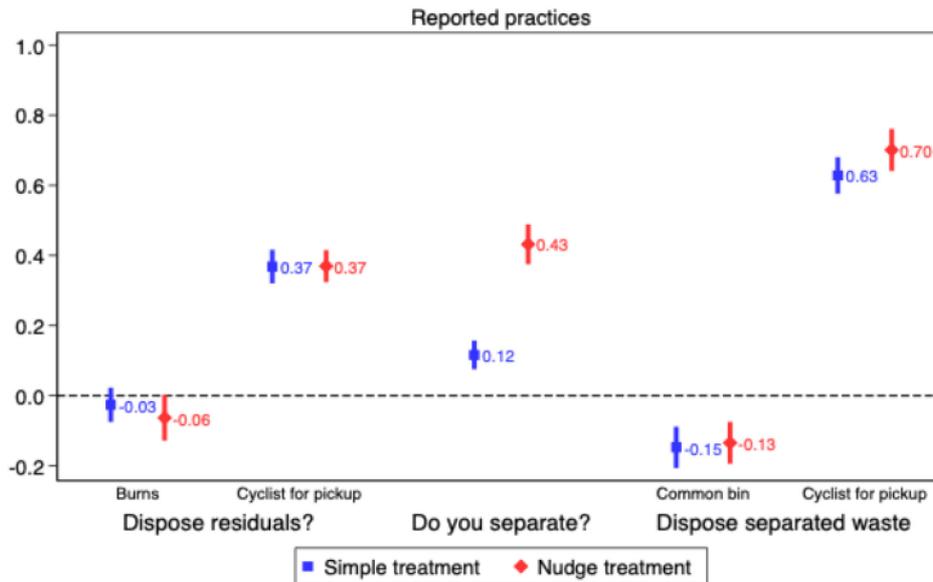
Figure 2. Deliveries by recyclable waste type by month

Figure 3. Amount paid to cyclists per delivery

Data for December are still incomplete, which lowers the apparent trend for the final month. This is expected to change. The third round of the information campaign emphasised sharing programme details with neighbours, and additional engagement at this stage is expected to increase the volume of materials delivered as households respond to the renewed encouragement.

Households report less burning, increased separation and contacting the cyclist for pickup.

Figure 4. Self-reported household practices



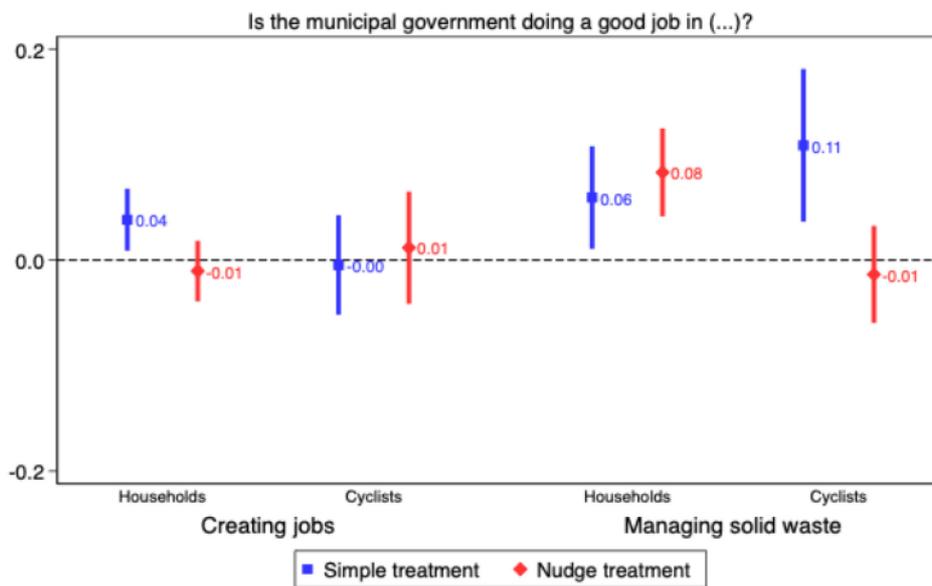
The intervention produced notable improvements in household waste-management practices, beginning with a reduction in environmentally harmful disposal methods. Households reported a modest but statistically meaningful (in the nudge treatment) decline in burning waste. Although this effect does not appear consistently across both treatment arms, it provides early evidence that offering a practical and trusted alternative to unmanaged disposal can reduce burning in participating neighbourhoods.

More than one-third of treated households contacted their regular cyclist to request collection, demonstrating that once a credible collection mechanism was introduced, households were willing to adopt it quickly.

Waste separation increased significantly across both interventions. Among households that separated recyclables, both programmes shifted behaviour away from discarding these materials in common bins. Participants were far more likely to request collection from cyclists, indicating that pairing guidance with a convenient, door-to-door collection channel can reshape routine disposal habits.

Increased satisfaction with government policy regarding job creation and solid waste management increases.

Figure 5. Satisfaction with municipal government



Households in the simple treatment group expressed slightly higher approval of the municipality's broader job-creation efforts, suggesting that visible improvements in local services can enhance confidence in government even beyond the specific programme.

The clearest effects emerge for solid-waste management. Approval among households rose by 6 percentage points in the basic treatment and by 8 percentage points when the visibility nudge was added. These shifts indicate that even modest improvements in day-to-day waste collection can meaningfully change how residents assess municipal service delivery.

Cyclists, who experienced the programme both as workers and as city residents, reported similar changes. Their approval of municipal waste services increased by 11 percentage points, driven primarily by those in the simple treatment group. This pattern suggests that expanding opportunities for informal workers, while simultaneously improving neighbourhood cleanliness, can strengthen perceptions of municipal effectiveness among multiple groups.

Policy takeaways

- Partnering with informal labour networks can expand waste-collection capacity at very low cost.

Cyclists already maintain dense, reliable links with households and were able to provide consistent collection when supported with basic training and a guaranteed outlet for recyclables. Policymakers looking for practical ways to

extend service coverage can consider models that build on these existing networks rather than creating entirely new structures.

- Providing a credible and convenient collection mechanism seems to be sufficient to change household behaviour.

The intervention showed that households respond quickly once they can rely on a system that works. Even if recycling itself is not their primary concern, residents value cleaner neighbourhoods and are willing to participate when doing so is straightforward. This suggests that the main constraint may not be motivation but the lack of a trustworthy and functional service.

- Low-cost, functional systems can activate latent demand for cleaner urban environments.

By combining a reliable collection mechanism with readily available informal labour, the project demonstrated that significant improvements in recycling behaviour can be achieved without major investment. Ensuring service reliability appears central to generating household compliance.

- Future work will investigate why viable collection systems have not already emerged.

A key priority is understanding the underlying market failure: what prevents households, informal workers, and the municipality from coordinating on a functioning recycling system? The next phase will examine what households value in waste services and why they choose to comply when a new mechanism becomes available. These insights will help clarify how to design systems that are both affordable and responsive to residents' needs.

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