



PLASTIC WASTE AND THE CIRCULAR ECONOMY: COMMUNITY-BASED EVIDENCE FROM MANNAR, SRI LANKA

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The intense use of plastics and linear waste systems has increased the accumulation of plastic in the environment. Such accumulation is a leading global issue, which suggests a shift to a circular economy focusing on recycling and waste reduction. This study examines the circular economy strategies for plastic waste management, recycling, upcycling, biodegradable alternatives, and eco-designs. The study was conducted as a case study from Mannar District in Sri Lanka on the collection and disposal of plastics among 147 respondents across six coastal fishery communities. The waste disposal sites were mapped to provide spatial patterns across the selected communities. The results showed that high levels of plastic waste originating from fisheries, households, and marine debris were due to poor disposal practices, limited infrastructure, and low public awareness. Among the identified disposal methods, illegal dumping (24.1%) and burning (17.9%) were the most prevalent. Additionally, 444 ± 17 kg Polyethene Terephthalate (PET) bottles were recovered from 24 fishery sites per month. The survey in Mannar District revealed widespread informal disposal practices and a considerable accumulation of marine plastics. However, this study highlighted strong community willingness to participate in structured waste management solutions. These findings reveal the importance of expanding similar assessments across Sri Lanka to develop effective strategies. Such efforts are essential for advancing a balanced and sustainable national plastic waste management framework grounded in circular economy principles.

Keywords: circular economy, plastic waste management, recycling, coastal communities, Mannar district, PET recovery

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INTRODUCTION

Plastic pollution has become one of the most pressing environmental challenges of the 21st century. Global plastic production has surpassed 400 million tons annually, with a significant portion ending up in landfills, oceans, and natural ecosystems (Rhodes, 2019). Single-use plastics account for nearly 90% of these products, often used briefly but persisting in the environment for centuries (Majo, 2021; Vanapalli et al., 2021). The prevailing linear economy, characterised by the "take-make-dispose" model, has proven unsustainable, contributing to widespread waste, resource inefficiency, and ecological degradation (Sharma et al., 2021).

In contrast, circular economy models offer a sustainable alternative by promoting resource recovery, recycling, eco-design, and biodegradable substitutes. These approaches aim to keep materials in use for as long as possible, minimising environmental impact and reducing dependency on virgin resources. Importantly, circular solutions can also benefit low-income and coastal communities, where waste management infrastructure is often lacking, and livelihoods are closely tied to natural ecosystems (Bucknall, 2020).

Sri Lanka, as an island nation, faces growing threats from plastic pollution, particularly in its coastal and marine environments. In the Mannar District, a region with vibrant fisheries and fragile ecosystems, plastic waste is increasingly visible and harmful. Informal disposal practices such as open dumping and burning are widespread due to limited formal waste management systems, low awareness, and geographic isolation. The objective of this study is to assess the current plastic waste disposal practices and PET bottle collection potential in Mannar District to identify the major challenges and opportunities for developing effective, sustainable, and community-based waste management strategies.

METHODOLOGY

The study was carried out in six coastal fishery communities within the Mannar District, chosen for their active engagement in fisheries and documented challenges with plastic pollution. A structured questionnaire was used to gather information regarding plastic collection. The survey was conducted with 147 respondents, including households, fishery workers, and local stakeholders. The survey collected quantitative data on plastic collection volumes, with a particular focus on Polyethylene Terephthalate (PET) bottles, as well as disposal methods such as illegal dumping,

open burning, and recycling.

Mapping was done using ArcMap to visualise waste disposal sites, informal disposal practices.

RESULTS AND DISCUSSION

The analysis of plastic waste disposal methods across 147 geo-referenced locations in six coastal communities of Mannar District reveals a highly fragmented and informal waste management landscape (Fig. 1). The most prevalent method was illegal dumping, which was reported at 24% of the locations. This highlights a gap in waste collection services and regulatory monitoring, particularly in marginalized coastal zones where access to formal disposal systems is limited.



Figure 1: Map showing the PET bottle collection sites and the number of bottles collected in each location.

Burning was the second most common practice, observed at 18% of the locations. This method poses severe environmental and public health risks, such as air pollution and the release of toxic compounds (Table 1). The combination of burning and illegal dumping (12%) and burning combined with sending waste to the local authority (11%) suggests that many residents' resort to multiple disposal methods, likely as a response to irregular or insufficient waste services (Asmal et al., 2023).



Formal collection by local authorities (LA) was reported in 21% of cases, indicating the existence of public waste management infrastructure to a certain degree. The presence of mixed methods, such as sending to LA + selling (6%) and burning + sending to LA (11%), implies inconsistent service delivery or partial engagement with formal systems.

Less common methods, such as selling recyclable materials (5%), burying (1%), and other (1%), show that while some residents are attempting more sustainable practices, these efforts are minimal and uncoordinated. The low uptake of selling and recycling highlights both the absence of a structured recycling market and a potential lack of community-level knowledge or access to such systems.

Similarly, a study of five fishery harbours in the Western Province reported that plastic waste constituted 85% of debris items by count and approximately 60% by weight, citing poor on-site management as the primary concern (Wijesekara & Premakumara, 2022).

The overall pattern reflects a heavy dependence on informal practices due to infrastructural and institutional limitations. However, the use of multiple disposal methods at many locations also indicates a degree of adaptability and potential readiness for more structured interventions. These findings show the need for improved infrastructure, education, and formal integration of community efforts into a circular economy framework for plastic waste management.

Table 1: Plastic waste disposal methods, frequency (by GPS coordinates) and PET bottle collection

Disposal Method	Number of Locations	PET bottle collection kg	Percentage % weight
Illegal dumping	35	536 ± 12	12%
Burning	26	476 ± 23	11%
Sending to Local Authority (LA)	31	602 ± 28	14%
Burning + Illegal dumping	18	328 ± 22	7%



Burning + Sending to LA	16	382 ± 39	9%
Illegal dumping + Sending to LA	1	110	3%
Burying	1	10	0.2%
Burying + Sending to LA	1	10	0,2%
Selling	7	1737 ± 520	40%
Sending to LA + Selling	8	183 ± 41	4%
Other	1	12	0.3%

Table 2: Monthly PET Bottle Collection Potential by Location Type in Mannar District

Location Type	Monthly PET Collection (kg)
Army Camp	4
Bus Depot	180 ± 85
Fishery Locations	444 ± 17
Hospitals	223 ± 30



Hotel	373 ± 31
Illegal Dump Yards	56 ± 2
Legal Dump Yards	250 ± 25
Office Complex	152 ± 44
Other	1,680 ± 494
Polluted Coastal Point	185 ± 14
Polluted River Point	143 ± 7
Railway Station	107 ± 33
Religious Point	130 ± 21
Restaurant Only	105 ± 28
Service Station	302 ± 24
Supermarket	5
Tourist Points	47 ± 4

The analysis of monthly PET bottle collection potential across various location types in the Mannar District reveals distinct spatial and functional patterns that offer key opportunities for targeted recycling interventions.

The highest PET collection potential (38%) was recorded under the broad category “Other” (1,680 kg/month). While this category lacks specific classification, its substantial volume indicates the presence of high-consumption areas potentially



including informal markets, large events, or unregistered waste sources. This finding suggests a need for further categorisation and monitoring to effectively capture and manage this significant waste stream.

Among clearly defined categories, fishery locations (444 kg/month), hotels (373 kg/month), service stations (302 kg/month), and legal dump yards (250 kg/month) demonstrated the highest PET recovery potential (Table 2). These sites are consistent with areas of intensive consumption and operational waste, making them ideal candidates for the establishment of formal collection points and recycling infrastructure. In particular, fishery locations represent a critical node in both the generation of and exposure to plastic pollution, emphasising the need for source-level recovery mechanisms such as deposit-return schemes or community-run collection systems.

Institutional settings like hospitals (223 kg/month), bus depots (180 kg/month), and office complexes (152 kg/month) also showed considerable collection volumes, suggesting opportunities for structured waste segregation programs and public-private partnerships. Religious sites (130 kg/month) and restaurants (105 kg/month) add to the profile of medium-yield sources, where awareness campaigns and easily accessible bins could help improve recovery rates.

Environmental leakage points, such as polluted coastal (185 kg/month) and river points (143 kg/month), indicate significant secondary accumulation of PET bottles, reflecting the failure of upstream waste collection. These sites should be prioritized for cleanup and preventive strategies, including community education, improved coastal waste monitoring, and physical barriers to prevent debris flow.

On the lower end, supermarkets (5 kg/month) and army camps (4 kg/month) reported minimal PET waste. These low figures may be due to either genuinely low consumption or underreporting. Overall, the results highlight the need for location-specific interventions, prioritizing high-yield and high-risk areas. Integrating these findings into a circular economy framework through localized collection systems, recycling incentives, and stakeholder engagement can significantly enhance PET bottle recovery while reducing environmental impact.

CONCLUSIONS / RECOMMENDATIONS

This study reveals serious plastic waste challenges in Mannar District, driven by poor infrastructure and informal disposal practices. However, it also highlights strong community interest and considerable PET bottle recovery, particularly at fishery and commercial sites. Targeted, location-specific interventions and improved collection systems can greatly enhance recycling outcomes.



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