

Performance analysis of municipal solid waste litter management scheme using on-site technical indicators in developing economies

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Abstract

The municipal solid waste (MSW) generation rate has increased exponentially in past few decades. This has also increased the frequency of littering and open dumping of MSW across different public places. It is estimated that only 82% of MSW is collected efficiently and remaining 18% (0.027 million TPD) is littered across the streets, market places, open areas, railway tracks etc. (CPCB, 2013). The MSW litter (MSWL) consists of food waste, dust, debris, plastic products, paper, cardboard, aluminum cans, glass bottles, construction and demolition waste etc. (Kumar et al., 2020), such waste is mostly left unattended and undisturbed, which causes nuisance in the surrounding environment. Manual collection of these MSWL requires more manpower and working hours, which ultimately causes increase in budget for MSW management (Kumar et al., 2020). Therefore, it is essential to access indicators influencing MSWL collection scheme in developing countries (Gholami et al., 2020). The present study highlights some key factors responsible for failure of existing collection scheme in MSWL management, especially in developing country like India. The findings of the study can be a resource for technocrats, innovators and policy makers to understand the present status of MSWL collection scheme.

A preliminary survey was carried out with 30 waste practitioners and managers in urban areas. The aim was to understand and identify the existing status of MSWL management in developing countries. The study areas were classified as a) residential areas: apartments, bungalows and colonies; b) commercial areas: institutions, public infrastructures etc. MSWL samples were collected from classified areas using visual sampling method. Physical quantification and characterization of MSWL samples were performed as per IS 10158:1982 standards. The technical indicators (TI) were selected based on study reported in literature since 2006-2022. The TI for MSWL collection was classified as a) street cleaning and maintenance b) Collection and disposal. Table 1 represents five major TI and their reference/standard values construed from preliminary study. Based on the TI rating scheme, the existing MSWL collection scheme was rate as was rated as good (<10), mediocre (11-20), Bad (21-30).

Table 1. Proposed technical indicators along with reference values.

Symbol	Indicator	Unit	Reference value for TI performance		
			Good	Mediocre	Bad
TI ₁	Street cleaning (water jet)	km/lab/day	1.5-2	1-1.5	<1
TI ₂	Street sweeping	km/lab/day	1.3-1.5	0.8-1.2	<0.8
TI ₃	Collection coverage	%	>90	70-90	<70
TI ₄	Collection equipment	%	80-100	50-80	<50
TI ₅	Collection efficiency	t/h	>0.5	0.2-0.5	<0.2

The existing status of MSWL collection for residential and commercial areas was evaluated using five technical indicators. Fig. 1 represents aggregate TI rating for residential and commercial areas. It was found that commercial areas have better street cleaning and sweeping performance compared to residential areas. However, the collection coverage was maximum for residential areas, as the labors deployed were higher. Generally, the physical method was adopted for MSWL collection, which results in higher time consumption. It is recommended to use advance automated technologies for street sweeping, washing and litter collection. While, the physical quantification of MSWL had higher readily available recyclable materials such as PET bottles, plastics bags, paper products, tiers, products made from plastic and glass. Detailed physical quantification for MSWL has been represented in Fig. 2. At the same time, the higher organic fraction from residential MSWL can be utilized for household composting and bio-methanation process.

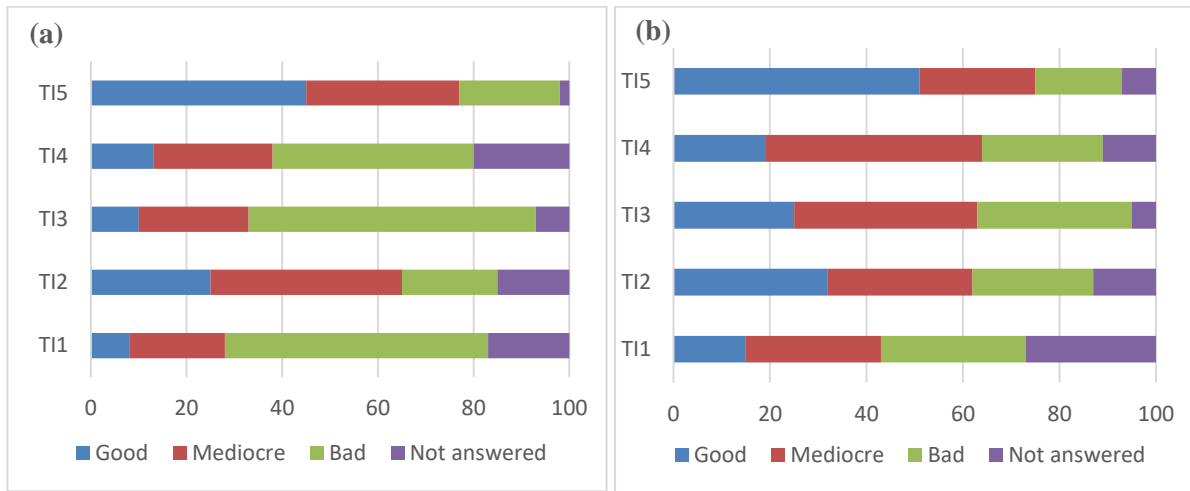


Fig. 1. Aggregate TI rating for (a) residential (b) commercial areas.

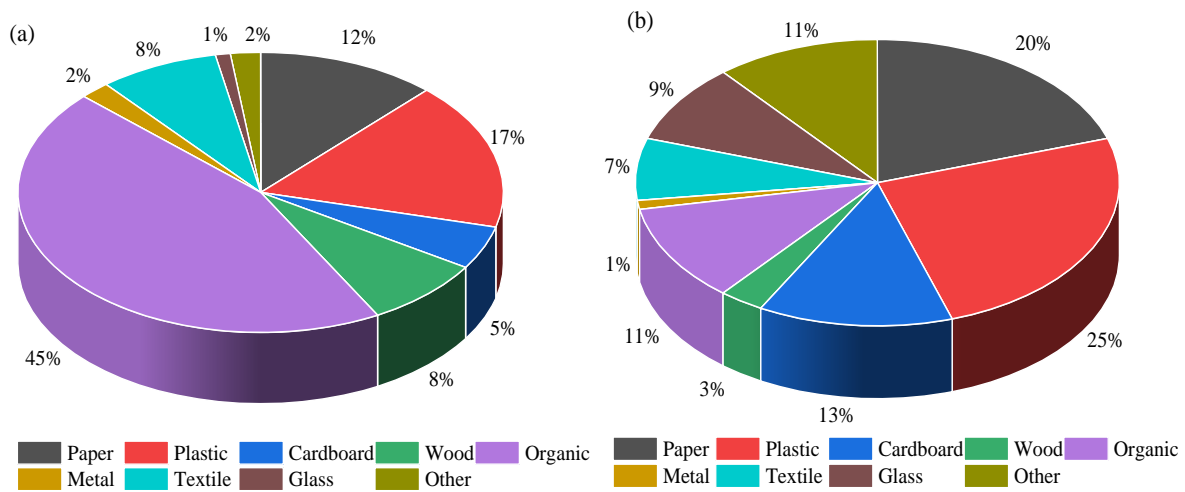


Fig. 2. Physical composition of MSWL (a) residential and (b) commercial areas.

Keywords: Littering; Municipal solid waste; Recycling; Street sweeping, Technical indicator.

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