POLICY, PRACTICE AND PLASTIC

COST OF MANAGING PLASTIC WASTE IN INDIAN CITIES

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INTRODUCTION

With 1.44 billion people generating over 158,000 TPD of waste, India's infrastructure is buckling under growing volumes—a situation worsened by urbanization, single-use plastics, and uneven waste services.

While the Plastic Waste Management and Solid Waste Management Rules (2016), established a legal framework for Extended Producer Responsibility (EPR), enforcement has been uneven. Amendments have expanded obligations but still fall short on cost recovery and accountability.

By comparing city-level plastic waste management costs with current EPR credit rates, this study offers actionable insights to recalibrate financial flows and strengthen EPR for circularity and municipal cost recovery.

1.1 GLOBAL WASTE SCENARIO

Municipal solid waste (MSW) generation has surged to an unprecedented 2.3 billion tonnes annually as of 2024, and is projected to climb by 56 per cent—reaching a staggering 3.8 billion tonnes by 2050 if current waste management practices remain unchanged.[1] This surge in waste generation is primarily driven by rapid urbanization, industrialization, and changing consumption patterns, with stark disparities observed in waste generation and management across different regions.

While developing and underdeveloped countries contribute significantly to the global waste volume due to their large populations, their per capita waste generation remains comparatively lower than that of high-income nations. For instance, Central and South Asia, including India, generate only 0.5 kg/person/day, whereas North America and Western Europe generate 2.2 kg/person/day and 1.6 kg/person/day, respectively.[1] This disparity highlights the stark inequalities in consumption patterns, where excessive packaging, single-use plastics, and convenience-based lifestyles drive disproportionate waste generation in high-income regions.

Despite producing lower per capita waste, developing and underdeveloped regions bear a disproportionate burden of mismanaged waste due to inadequate collection, processing, and disposal infrastructure. In low-income countries, only 40 per cent of the MSW is collected, compared to over 90 per cent in high-income countries.[1] Consequently, approximately 2.7 billion people, located primarily in the Global South, lack access to structured waste collection services. This figure is expected to rise to three billion by 2050. This inadequate waste collection infrastructure will result in the doubling of uncontrolled waste disposal from 806 million tonnes in 2020 to 1.6 billion tonnes by 2050, exacerbating environmental degradation, greenhouse gas emissions, and public health risks.[1]

1.2 INDIA'S WASTE MANAGEMENT SCENARIO

With a population of approximately 1.44 billion, India accounts for

18 per cent of the global population. Its massive population also translates to one of the highest volumes of MSW generated by a country globally.[2] The country's demographic size, combined with rapid urbanization and economic growth, presents a significant challenge for waste management systems. Over the decades, India's economy has transitioned from a predominantly agrarian base where agriculture contributed 51.45 per cent to the GDP in 1951, to one driven by industrialization and the expansion of the service sector, with agriculture's contribution declining to around 17-18 per cent by 2024.[3] This economic transformation has fuelled rapid urbanization, with approximately 35 per cent of the population (530 million people) now residing in over 8,000 towns and cities.[4] This demographic shift has resulted in rising consumption patterns and increased waste generation, placing enormous pressure on India's waste management infrastructure.

India generates approximately 1,58,619 tonnes per day (TPD) of MSW, making it one of the largest waste producers globally.[5] However, the country's average per capita waste generation remains relatively low at 0.12 kg/day, varying significantly across regions due to urbanization levels, income brackets, and consumption behaviours.[6] Large metropolitan cities such as Delhi, Mumbai, and Bengaluru generate several thousand tonnes of waste daily, whereas smaller towns and rural areas contribute considerably lower volumes.

Over the past decades, waste management practices in India have improved significantly, particularly through initiatives like the Swachh Bharat Mission (SBM). As a result, 95.4 per cent of urban wards now have door-to-door waste collection systems, and 78 per cent of collected waste undergoes some form of treatment.[5] However, the remaining 22 per cent—equivalent to over 41,000 TPD of untreated waste—is still disposed of in open dumpsites, leading to groundwater contamination, air pollution, and greenhouse gas emissions.[5] The financial strain of managing this growing waste stream remains a major challenge for municipalities that struggle with inadequate infrastructure, operational inefficiencies, and funding constraints.

Table 1: Waste generation and processing data for Indian states and Union Territories

#	State/UT	Total ULB	Total no. wards	Wards with 100 per cent door- to-door collection	Wards with 100 per cent source segregation	Generation (TPD)	Processed (TPD)	Processing %
1	ANDAMAN AND NICOBAR ISLANDS	1	24	24	24	65	60	92%
2	ANDHRA PRADESH	123	3,872	3,831	3,765	6,210.13	5,550.74	89%
3	ARUNACHAL PRADESH	48	529	526	507	131.08	50.07	38%
4	ASSAM	96	1,063	1,028	652	1,281.32	841.4	66%
5	BIHAR	262	5,690	5,492	4,102	6,423.92	2,062.58	32%
6	CHANDIGARH	1	35	35	35	489.18	489.18	100%
7	CHHATTISGARH	183	3,255	3,255	3,255	2,615.14	2,612.97	100%
8	DAMAN DIU AND DADRA NAGAR HAVELI	3	43	43	43	107.24	107.24	100%
9	DELHI	3	271	271	167	11,129.41	8,821.24	79%
10	GOA	14	225	225	225	126.85	123.33	97%
11	GUJARAT	169	1,385	1,375	1,364	11,278.24	11,250.90	100%
12	HARYANA	89	1,702	1,690	1,460	4,346.77	3,813.74	88%
13	HIMACHAL PRADESH	68	599	590	578	362.56	347.25	96%
14	JAMMU AND KASHMIR	80	1,099	1,094	1,038	1,373.63	1,214.55	88%
15	JHARKHAND	50	1,061	927	857	2,197.22	1,214.04	55%
16	KARNATAKA	319	7,381	7,163	6,371	10,006.27	8,734.57	87%
17	KERALA	94	3,655	3,552	3,545	1,458.77	1,441.33	99%
18	LADAKH	2	26	26	26	1.23	1.23	100%
19	MADHYA PRADESH	418	7,696	7,602	7,575	6,692.60	6,612.27	99%
20	MAHARASHTRA	431	6,819	6,693	6,650	25,105.41	23,502.90	94%
21	MANIPUR	27	305	303	296	298.11	173.94	58%
22	MEGHALAYA	10	123	89	65	159.71	88.81	56%
23	MIZORAM	28	209	209	152	204.68	51.61	25%
24	NAGALAND	39	420	204	119	21.14	1.71	8%
25	ODISHA	115	2,038	2,038	2,031	1,753.43	1,709.93	98%
26	PUDUCHERRY	5	116	116	116	174.09	174.09	100%
27	PUNJAB	169	3,199	3,194	3,169	3,913.52	3,721.35	95%
28	RAJASTHAN	311	9,985	8,376	4,251	7,695.29	4,274.74	56%
29	SIKKIM	7	51	51	51	59.1	48.48	82%
30	TAMIL NADU	651	12,806	12,640	12,560	15,240.58	9,950.98	65%
31	TELANGANA	134	2,944	2,941	2,911	11,016.44	10,765.55	98%
32	TRIPURA	20	334	334	334	335.23	327.52	98%
33	UTTAR PRADESH	777	14,197	13,955	13,771	20,454.27	20,050.72	98%
34	UTTARAKHAND	115	1,339	1,329	1,294	1,857.29	1,709.31	92%
35	WEST BENGAL	131	3,008	2,878	2,545	6,804.74	700.99	10%
	Total	4993	97504	94099	85904	161389.59	132601.26	

Source: Swachh Bharat Mission-Urban 2026 (website)

Among the various waste streams, plastic waste has emerged as one of the most difficult to manage due to its non-biodegradable nature and widespread usage. The increase in single-use plastics, multilayered packaging, and the lack of effective recycling mechanisms have contributed to an escalating plastic waste crisis. While traditional MSW management efforts in India have prioritized organic waste processing and dumpsite remediation, the management of plastic waste has remained fragmented due to its complex material composition and lower biodegradability. Unlike organic waste, which can be composted or converted into biogas, plastics require specialized collection, sorting, and recycling/processing systems to ensure effective material recovery and environmental sustainability. This necessitates a dedicated framework for managing plastic waste, including policy-driven interventions such as the Plastic Waste Management Rules and the Extended Producer Responsibility (EPR) framework.

1.3 PLASTIC WASTE MANAGEMENT IN INDIA

The management of plastic waste in India has become a pressing environmental and economic challenge due to its widespread use, diverse composition, and low recycling rates. The rapid increase in single-use plastics, multilayered packaging, and non-recyclable materials has placed an immense burden on existing waste management systems. Despite various initiatives, a significant portion of plastic waste continues to be mismanaged, leading to severe environmental consequences such as marine pollution, air pollution from open burning, and microplastic accumulation.

India generated approximately 4.12 million tonnes per annum (TPA) of plastic waste in 2020–21, a figure expected to rise in tandem with economic growth and shifting consumption patterns.[7] Urban centres, particularly metropolitan cities, account for a substantial share of this waste due to higher consumer activity and industrial production. However, the lack of a streamlined plastic waste collection system, coupled with inefficient segregation at the source, has resulted in uncollected and unmanaged plastic waste contributing significantly to environmental degradation.

Although 60 per cent of plastic waste is reportedly recycled - a widely cited figure that traces back to older CPCB estimates and has been questioned by some researchers as outdated. The effectiveness of its management varies significantly across regions.[8] A large portion of the collected plastic waste is handled by the informal sector, which plays a crucial role in sorting and recycling but operates without formal recognition, financial security, or policy support.[9] The low-value nature of flexible plastics and multilayered packaging further complicates the recycling process, as these materials are often rejected by recyclers and end up in landfills or incineration facilities. This highlights the need for enhanced policy mechanisms that incentivize circularity and sustainable plastic waste management.

Recognizing these challenges, India has implemented a series of regulatory interventions to strengthen plastic waste management. The Plastic Waste Management (PWM) Rules, 2016, and its subsequent amendments, have introduced various measures, including bans on specific plastic products, mandatory source segregation, and increased producer responsibility through the EPR framework. EPR, in particular, represents a transformative shift by making producers, importers, and brand owners (PIBOs) accountable for the end-of-life management of plastic packaging waste.

However, the implementation of EPR has faced challenges, particularly in aligning financial incentives with the actual costs of management of plastic packaging waste. The disparity between EPR credit rates and the real expenditures incurred by municipalities and waste processors remains a key concern. Furthermore, the Plastic Waste Management (Amendment) Rules, 2024, introduced stricter compliance measures and revised criteria for plastic carry bags and multilayered packaging. Separately, the government has also moved to extend an EPR-style framework to other packaging materials — paper, glass, and metal — along with sanitary products, through a distinct notification under the Environment (Protection) Act, 1986.

Table 2: Plastic waste generation in Indian states and Union Territories

State	Plastic waste generation (TPA)
Andaman and Nicobar	492.34
Andhra Pradesh	39,626.45
Arunachal Pradesh	3,755.9
Assam	58,765
Bihar	74,263.68
Chandigarh	13,107.15
Chhattisgarh	47,450
Daman Diu and Dadra Nagar Haveli	4,726
Delhi	3,45,000
Goa	29,441
Gujarat	3,37,693.96
Haryana	1,85,168
Himachal Pradesh	6,206.78
J&K	51710.6
Jharkhand	20,263.44
Karnataka	3,68,080
Kerala	1,20,063.87
Lakshadweep	523.54
Madhya Pradesh	1,38,483.58
Maharashtra	3,11,254
Manipur	10,303
Meghalaya	3,343.4*
Mizoram	1,514.51
Nagaland	4,785.94
Odisha	51,269.9
Puducherry	12,754
Punjab	108,332.06
Rajasthan	66,324.57
Sikkim	82.75
Tamil Nadu	430,107
Telangana	472,675
Tripura	61.65
Uttar Pradesh	375,950
Uttarakhand	18,647.75

Source: Annual Report 2020–21 on Implementation of Plastic Waste Management Rules, 2016

* https://nmcg.nic.in/writereaddata/fileupload/ngtmpr/8_Meghalaya%20MPR%20Jan%202021.pdf?utm

As India transitions towards a circular economy, it is imperative to analyze the effectiveness of these regulatory frameworks, assess their financial implications, and determine their impact on waste management infrastructure.

1.4 POLICY LANDSCAPE AND EVOLUTION OF WASTE MANAGEMENT REGULATIONS IN INDIA

1.4.1 SOLID WASTE MANAGEMENT RULES, 2016

The Solid Waste Management Rules, 2016 (SWM Rules) were introduced by the Ministry of Environment, Forest, and Climate Change (MoEFCC) to replace the Municipal Solid Waste (Management and Handling) Rules, 2000. These rules establish a comprehensive regulatory framework governing the collection, segregation, transportation, processing, and disposal of MSW across urban and rural areas. Covering all waste generators, including households, institutions, commercial entities, and local bodies, the SWM Rules emphasize a multi-stakeholder approach to waste management. Given India's escalating waste crisis, these regulations aim to enhance waste handling practices, integrate informal waste pickers, and promote decentralized processing technologies. Moreover, the rules set the foundation for EPR, an evolving policy mechanism critical to India's waste management financing and cost recovery strategies.

Key provisions and responsibilities

The SWM Rules, 2016, expand the scope of waste governance by extending obligations beyond urban local bodies (ULBs) to state authorities, manufacturers, and bulk waste generators. The key provisions include:

- **Source segregation and collection:** Waste generators must segregate waste at the source into biodegradable, non-biodegradable, and hazardous waste categories and hand it over to authorized collectors. ULBs must ensure 100 per cent door-to-door collection and facilitate decentralized waste processing through home composting, biomethanation, and local treatment facilities.

- **Decentralized waste processing:** The rules emphasize localized waste treatment solutions, including biomethanation, composting, and refuse-derived fuel (RDF) production to reduce transportation costs and minimize landfill dependency. High calorific non-recyclable waste must be directed to cement kilns or waste-to-energy (WtE) plants.

- **Waste collection from bulk generators:** Institutions generating over 100 kg of waste per day must process their biodegradable waste on-site or enter agreements with authorized waste handlers.

- **Sanitary landfills and waste disposal:** The rules limit landfill use to non-recyclable and non-biodegradable waste, mandating scientific landfill management with gas venting, leachate treatment, and periodic monitoring. Bioremediation and biomining of old dumpsites are encouraged to reclaim land and mitigate environmental pollution.

- **Integration of informal waste collectors:** The rules emphasize formalization of the informal waste sector, requiring local bodies to recognize waste pickers, issue identity cards, and integrate them into waste collection and recycling systems.

- **State and central responsibilities:**
  - » State Governments must formulate a solid waste management strategy and ensure land allocation for waste processing facilities.
  - » The Central Pollution Control Board (CPCB) oversees compliance with environmental standards and evaluates new waste processing technologies.

1.4.2 PLASTIC WASTE MANAGEMENT RULES, 2016

The Plastic Waste Management Rules, 2016 (PWM Rules), notified by the MoEFCC, form the cornerstone of India's regulatory framework for managing plastic waste. Replacing the earlier Plastic Waste (Management and Handling) Rules, 2011, the 2016 rules mark a significant shift towards a more comprehensive and decentralized approach to plastic waste management. With the growing concern over plastic pollution and its environmental impacts, the PWM Rules introduced the principle of EPR, a transformative policy tool aimed at making producers, importers, and brand owners (PIBOs) accountable for the post-consumer management of plastic packaging waste. The framework aligns with the polluter-pays principle, emphasizing the responsibility of plastic producers across the product life cycle from production to final disposal.

Key provisions and responsibilities

The Plastic Waste Management Rules, 2016 (PWM Rules), apply to a wide range of stakeholders, including waste generators, local bodies, gram panchayats, manufacturers, importers, producers, and brand owners. The key provisions include:

- **Source segregation and collection:** Waste generators must segregate plastic waste at the source and hand it over to authorized waste collection agencies or recyclers. Institutional generators, such as hotels, malls, and educational institutions, are required to establish systems for segregated waste collection and channelization to authorized recyclers.

- **Ban on certain plastic items:** The rules prohibit the manufacture and use of plastic sachets for storing tobacco, gutkha, and pan masala. Additionally, the rules stipulate that all bags made from virgin or recycled plastic must have a minimum thickness of 50 microns (further increased to 120 microns in 2022 amendment), aimed at reducing the prevalence of thin, non-recyclable plastic bags.

- **Role of local bodies and Gram Panchayats:**
  - » Urban local bodies are responsible for setting up plastic waste collection, segregation, storage, and processing systems.

   » Gram panchayats must manage plastic waste in rural areas, ensuring proper collection and disposal infrastructure.

- **Integration of informal waste pickers:** Local bodies are mandated to engage informal waste pickers and recyclers to improve plastic waste collection efficiency and support the livelihoods of the informal sector.

- **Reuse and recycling standards:** Plastic waste that can be recycled must be channelized to registered recyclers, while non-recyclable plastic waste must be utilized in road construction, energy recovery, or other environmentally safe applications.

Extended Producer Responsibility (EPR)

One of the landmark features of the PWM Rules, 2016, is the introduction of the EPR. The rules place the primary responsibility of post-consumer plastic packaging waste collection and recycling on PIBOs who introduce plastic packaging into the market. These stakeholders are required to:

- Establish reverse logistics systems to collect back the plastic packaging waste generated by their products.
- Submit a plastic waste management plan to State Pollution Control Boards (SPCBs) outlining their strategy for collecting and processing plastic waste.
- Ensure that the collected waste is recycled, co-processed, or scientifically disposed of without harming the environment.

The rules mandate that multilayered plastics, which are often non-recyclable, must be phased out within two years, unless producers can demonstrate alternative recycling or energy recovery mechanisms. This provision represents a significant shift towards producer accountability and incentivizes the adoption of eco-friendly product designs.

1.4.3 SOLID WASTE MANAGEMENT RULES 2026

The Solid Waste Management Rules, 2026, gazette on 27 January 2026 and effective from 1 April 2026, supersede the SWM Rules, 2016

and the Draft MSWM Rules, 2024. Framed under the Environment (Protection) Act, 1986, they extend coverage to both urban and rural local bodies and introduce a certificate-based Extended Bulk Waste Generator Responsibility (EBWGR) mechanism, a Centralized Online Portal for compliance tracking, and time-bound infrastructure targets anchored in the waste hierarchy, prevention, reduction, reuse, recycling, recovery, and disposal.
Key provisions and responsibilities

The rules assign differentiated obligations to waste generators, bulk waste generators, local bodies (urban and rural), state governments, sixteen Central Ministries, regulatory bodies, and facility operators. Key provisions include:

Universal application and four-stream segregation: Rules apply to all urban and rural local bodies, railways, airports, SEZs, defense establishments, and land owners. Every waste generator must segregate waste into wet, dry, sanitary, and special care streams at source and hand over segregated waste to authorized collectors.
Extended Bulk Waste Generator Responsibility (EBWGR): Bulk waste generators, entities with ≥20,000 sq.m. built-up area, ≥40,000 litres/day water consumption, or ≥100 kg/day waste generation (including residential societies, hotels, hospitals, institutions) must register with local bodies, process wet waste on-site, and procure EBWGR certificates for the total solid waste generated. Annual returns must be filed by 30 June each year.

Decentralized wet waste processing: New bulk waste generators must set up on-site wet waste processing (composting, bio methanation, or other approved technologies). Existing generators unable to comply may obtain an exemption and procure EBWGR certificates. Urban local bodies must set up zone-wise composting units, with preference given to decentralized processing to minimize transport costs.

Centralized Online Portal and digital monitoring: CPCB must establish the portal within six months of commencement. All entities bulk waste generators, facility operators, local bodies, and SPCBs must register and file quarterly and annual returns. The portal serves as the single public data repository for waste generation, processing, disposal, and EBWGR certificate transactions.

MRFs, waste-to-energy, and RDF mandate: Local bodies must establish Material Recovery Facilities as per population-based timelines (Schedule I). Non-recyclable waste with calorific value ≥1500 kcal/kg cannot be landfilled and must go to RDF or waste-to-energy. Industries within 100–400 km of RDF plants must substitute 6 per cent of solid fuel intake with RDF immediately, rising to 15 per cent after six years.

Sanitary landfills and legacy dumpsite remediation: Landfills are restricted to inert, non-recyclable, non-combustible residual waste. Unsegregated or unprocessed waste attracts a higher landfill user fee. All existing dumpsites must be mapped by 31 October 2026 and subjected to time-bound biomining/bioremediation with quarterly progress reporting on the portal.

Informal sector integration: Local bodies must register waste pickers and informal collectors, integrate them into door-to-door collection and MRF operations, and maintain ward-wise databases on the portal updated annually by 30 June. MRFs are designated as drop-off points for e-waste, sanitary waste, and EPR-governed streams.

Multi-tier action plans, by-laws, and enforcement: Urban local bodies must prepare ward-level Solid Waste Action Plans within one year of state policy notification and frame by-laws by 31 March 2027. Cities with population above 5 lakh must establish central control rooms with GPS-based vehicle tracking. Environmental Compensation under the polluter-pays principle is levied by SPCBs for non-compliance; funds are held in escrow for SWM infrastructure.

Compost promotion and circular economy: Urban local bodies must replace chemical fertilizers with compost in all parks and gardens. The Department of Fertilizers is directed to co-market compost with chemical fertilizers in a 3-4:6-7 bag ratio. The Department of Agriculture must update Fertilizer Control Order standards and issue organic manure quality guidelines by 30 June 2026.

1.4.4 EXTENDED PRODUCER RESPONSIBILITY FOR PAPER, GLASS, METAL, AND SANITARY WASTE

While the Plastic Waste Management Rules, 2016 (and its subsequent amendments) focus specifically on plastic waste, India has simultaneously begun to broaden the scope of EPR through other regulatory mechanisms to include additional packaging waste streams such as paper, glass, metal, and sanitary waste. These materials are being addressed under a parallel EPR framework led by the Ministry of Environment, Forest and Climate Change (MoEF&CC) through supplementary policy directions and draft guidelines.

This expansion signals a systemic shift towards a multi-material EPR architecture, aligning with India's ambition to transition into a circular economy. By including non-plastic packaging materials, the government aims to close long-standing policy and operational gaps in post-consumer waste management, ensuring that producers across sectors are held accountable for the environmental and financial externalities of their packaging choices.

The move also responds to growing evidence that materials such as paper and glass, while often perceived as benign, still impose significant environmental and logistical burdens when not collected, sorted, or recycled properly. Similarly, sanitary waste although not conventionally classified as packaging has been brought into the EPR discussion due to its growing volumes, hazardous characteristics, and poor recovery rates.

Although the operationalization of EPR for these waste streams is still evolving, (as of the rules' draft/notification stage, with compliance obligations phased in from 2026-27 onward), its inclusion under India's broader waste policy landscape represents an important step toward integrated resource recovery, cost internalization, and lifecycle responsibility across the packaging ecosystem.

Key provisions and responsibilities

The amended rules extend EPR obligations to producers, importers, and brand owners (PIBOs) that introduce packaging materials made from paper, glass, metal, and sanitary products into the market. The key provisions of the expanded EPR framework include:

- **Mandatory registration and action plans:** All PIBOs covered under the new EPR framework must register on the centralized EPR portal developed by the CPCB. Producers are required to submit detailed waste management action plans, outlining their strategies for waste collection, recycling targets, and financing mechanisms.

- **Waste collection and reverse logistics systems:** Producers are mandated to establish reverse logistics systems to collect post-consumer waste generated by their products. The collected materials must be directed to authorized recyclers or waste processing facilities through partnerships with ULBs, producer responsibility organizations (PROs), and the informal waste sector.

- **Recycling targets for paper, glass, and metal waste:** The rules introduce phased annual recycling targets for paper, glass, and metal packaging waste. PIBOs are required to meet minimum collection and recycling rates, with obligations increasing gradually over the years. The rules also promote the incorporation of recycled content into packaging materials to reduce reliance on virgin resources and enhance circularity.

- **Special provisions for sanitary waste:** The framework includes dedicated responsibilities for producers of sanitary waste products such as diapers, sanitary napkins, and other hygiene items. Producers must set up collection systems for used sanitary products and ensure their safe and environmentally sound disposal through partnerships with authorized waste management service providers.

- **Credits-based compliance:** The framework allows for credit-based EPR compliance, enabling PIBOs to meet their obligations by purchasing verified credits equivalent to the quantity of packaging waste collected and processed on their behalf. These credits are expected to be generated by authorized recyclers, PROs, or waste management agencies that achieve validated recovery and recycling outcomes.

- **Reporting and monitoring:** All registered entities must submit annual returns on the quantity of packaging waste introduced into the market, the amount collected, and the proportion recycled. The CPCB will oversee compliance and independently verify data submitted through the centralized EPR portal.

1.5 OBJECTIVES OF THE STUDY

In light of these recent advancements the study aims to:

1. Quantify the full cost of dry and plastic packaging waste management in diverse Indian contexts.
2. Analyze disparities between actual costs and EPR credit rates.
3. Highlight unique regional challenges in urban, rural, and coastal areas.
4. Provide actionable recommendations to improve EPR implementation and bridge funding gaps.

The research is anchored in five case studies: Indore, Pune, Dharamshala, Goa, and Sri Vijaya Puram (previously called Port Blair). Each city/state represents distinct geographical, operational, and socio-economic contexts, offering a comprehensive view of India's plastic waste management landscape.

2 SCOPE AND METHODOLOGY

The selection of Indore, Pune, Goa, Dharamshala, and Sri Vijaya Puram reflects India's diverse waste management contexts—enhancing the study's policy relevance by grounding it in real-world complexity.

The study breaks down costs by collection, processing, and transport, enabling granular geographic comparisons, and acknowledging unmonetized indirect costs like environmental and health impacts.

A blend of primary data (field visits, stakeholder interviews) and secondary sources (government and academic literature) ensures data triangulation. Transparent cost attribution and city-specific adjustments make it a robust model for national benchmarking.

2.1 SCOPE OF THE STUDY

The complexity of the dry and plastic waste management crisis in India necessitates a multi-dimensional examination of its financial, geographic, and policy facets. This study aims to provide actionable insights to address key challenges in the sector, focusing on five representative urban and regional contexts: Indore, Pune, Dharamshala, Goa (state-wide), and Sri Vijaya Puram. Each of these locations has been carefully selected to capture the diversity of waste management scenarios across India, offering a comprehensive understanding of the challenges posed by dry and plastic waste.

2.1.1 GEOGRAPHIC SCOPE

The geographic diversity of the study spans densely populated urban centres, semi-urban regions, ecologically sensitive areas, and remote territories. Each city presents unique characteristics that influence waste generation and management:

1. **Indore**: A densely populated metropolitan area recognized for its innovative waste management practices, Indore serves as a benchmark for understanding the potential of advanced systems in high-density environments.
2. **Pune**: A large metropolitan city, Pune is known for its strong integration of the informal sector into waste management services. Pune's decentralized collection model and cooperative-based approach offer insight into cost-sharing, labour dynamics, and social inclusion in waste recovery.
3. **Dharamshala**: A semi-urban, tourism-dependent town in a hilly region where seasonal population flux and geographic constraints pose significant challenges for waste logistics and operational efficiency.
4. **Goa**: A globally renowned coastal tourism hub that experiences large seasonal variations in waste generation, Goa represents the dual challenge of maintaining high service standards while protecting ecologically fragile marine and coastal ecosystems.
5. **Sri Vijaya Puram**: A remote island jurisdiction that highlights the compounded logistical and infrastructural challenges of managing plastic waste in geographically isolated territories with limited processing infrastructure and high transportation costs.

Together, these locations offer a rich spectrum of perspectives on dry and plastic waste management across varying economic, demographic, and environmental contexts.

2.1.2 FINANCIAL SCOPE

The study highlights a thorough assessment of the direct costs linked to dry and plastic waste management, whether incurred directly or indirectly by Urban Local Bodies (ULBs). These costs are categorized into four primary components:

1. **Collection**: Expenditure related to door-to-door and secondary collection of dry and plastic waste, including manpower, fuel, vehicle operation, and maintenance.
2. **Transportation**: Costs associated with hauling waste from collection points to transfer stations, MRFs, and final processing/disposal sites.
3. **Pre-processing**: Costs incurred at MRFs, covering manual or mechanized sorting, cleaning, and segregation to prepare plastic waste for downstream processing or recycling.
4. **Disposal**: Costs associated with transportation of the refuse-derived fuel (RDF).

While the study focuses primarily on quantifiable direct costs, it acknowledges the critical importance of indirect costs, such as environmental degradation, cost of greenhouse gas (GHG) emission, public health impacts, and opportunity costs. Although these factors are not directly calculated due to their complex and often intangible nature, they are integral to the broader discourse on sustainable plastic waste management.

2.1.3 POLICY SCOPE

From a policy perspective, this study critically evaluates India's EPR cost framework. EPR is a cornerstone policy designed to make producers accountable for managing the lifecycle of their post-consumer plastic packaging waste. The study focuses on three key dimensions:

1. **Alignment with actual costs**: Analyzing the extent to which EPR credit rates match the real-world costs of management of plastic packaging waste.

2. **Incentives for sustainability**: Assessing whether EPR fosters sustainable practices, such as product redesign for recyclability and investments in waste management infrastructure.
3. **Implementation gaps**: Identifying barriers to effective EPR implementation, including issues of compliance, monitoring, and stakeholder coordination.

The ultimate aim is to provide evidence-based recommendations that can enhance the credibility, financial integrity, and environmental impact of India's EPR system transforming it from a reporting obligation into a strategic driver of circularity and municipal cost recovery.

2.2 LIMITATION OF THE STUDY

This study provides valuable insights into the cost of managing dry and plastic waste under the EPR framework. However, there are certain limitations of the study

1. **Non-exclusive cost attribution to dry or plastic waste**
   The cost of managing plastic waste cannot be fully disaggregated from the broader costs of MSW management. At the collection and transportation stages, expenditures account for the handling of mixed waste streams, including organic waste, plastics, paper, metals, and other recyclables. It is only at the post-transfer station level that costs become more specific to dry waste management.

2. **Variability in cost structures across cities**
   The study captures cost variations across selected case study cities, but these findings may not be fully representative of cost structures in all Indian cities. Factors such as geographic terrain, economic conditions, informal sector participation, and local policy enforcement introduce significant variability. As a result, the cost estimates provided in this study should be interpreted within the context of the sampled cities rather than generalized nationwide.

These limitations highlight the complexity of attributing waste management costs exclusively to dry or plastic waste and the need for future research to refine cost calculations for specific waste categories under EPR. Despite these constraints, the study's findings provide a robust foundation for understanding the economic dimensions of plastic waste management and related policy interventions.

2.3 METHODOLOGY

This study adopts a systematic and multi-faceted methodology, combining quantitative and qualitative approaches to provide a holistic understanding of plastic waste management in India. The methodology is structured into five core components: city selection, data collection, cost analysis, comparative evaluation, and integration of findings into actionable recommendations.

2.3.1 CITY SELECTION FRAMEWORK

The selection of cities was guided by a multi-dimensional framework to ensure representation of diverse contexts and challenges in plastic waste management. The key criteria for selection included:

1. **Population density and urbanization levels**
    - **High-density urban centres**: Indore and Pune were selected to analyze the challenges and opportunities in densely populated areas with advanced waste management systems.
    - **Smaller rural centres**: Dharamshala represents a less urbanized area, providing insights into waste management in semi-urban contexts with logistical challenges.
2. **Topography and geographic context**
    - **Coastal regions**: Goa highlights issues like marine plastic pollution and seasonal waste surges due to tourism.
    - **Remote islands**: Sri Vijaya Puram brings attention to the unique logistical complexities of plastic waste management in isolated territories.
    - **Hilly regions**: Dharamshala highlights the issue of management of plastic waste in hilly regions.

3. **Waste generation patterns**
    - **High plastic waste generation**: Pune, Goa and Indore, with significant volumes of plastic waste, provide a perspective on managing large-scale waste.
    - **Moderate to low waste generation**: Dharamshala represents cities generating smaller volumes yet facing equally significant challenges.
4. **Informal sector engagement**
    - Pune, a city with a vibrant informal sector, was included to assess the integration of informal waste pickers and aggregators into formal systems.
5. **Ecological sensitivity**
    - Goa, Sri Vijaya Puram, and Dharamshala, both ecologically sensitive and tourism-driven regions, were chosen to explore tailored waste management strategies that balance environmental conservation with economic activities.
6. **Logistical complexity**
    - Sri Vijaya Puram and Dharamshala underscores the importance of designing scalable solutions for areas with significant logistical constraints.

2.3.2 DATA COLLECTION

The study utilized a combination of primary and secondary data sources to ensure the accuracy and contextual depth of findings.

1. **Primary data**:
    - Field visits and direct engagements with stakeholders, including municipal authorities, waste management companies, NGOs, and informal sector workers, provided firsthand insights into operational practices and challenges.
    - Structured interviews and focus group discussions with community members and policymakers helped identify local perspectives and policy implementation barriers.
2. **Secondary data**:
    - Policy reports, government publications, academic research, and other authoritative references were analyzed to contextualize primary data within broader trends and frameworks.

2.3.3 COST ANALYSIS FRAMEWORK

A comprehensive cost analysis framework was developed to quantify the financial burden of dry waste management. Costs were categorized into:

1. **Direct costs**
    - **Primary collection**: Expenses related to labour, fuel, and equipment for door-to-door waste collection.
    - **Secondary collection**: Expense related to labour, equipments, operational, and infrastructure cost.
    - **Pre-processing**: Expenses related to labour, equipments, operational, and infrastructure cost.
    - **Disposal**: Cost of transportation from MRFs to end of life disposal facilities.

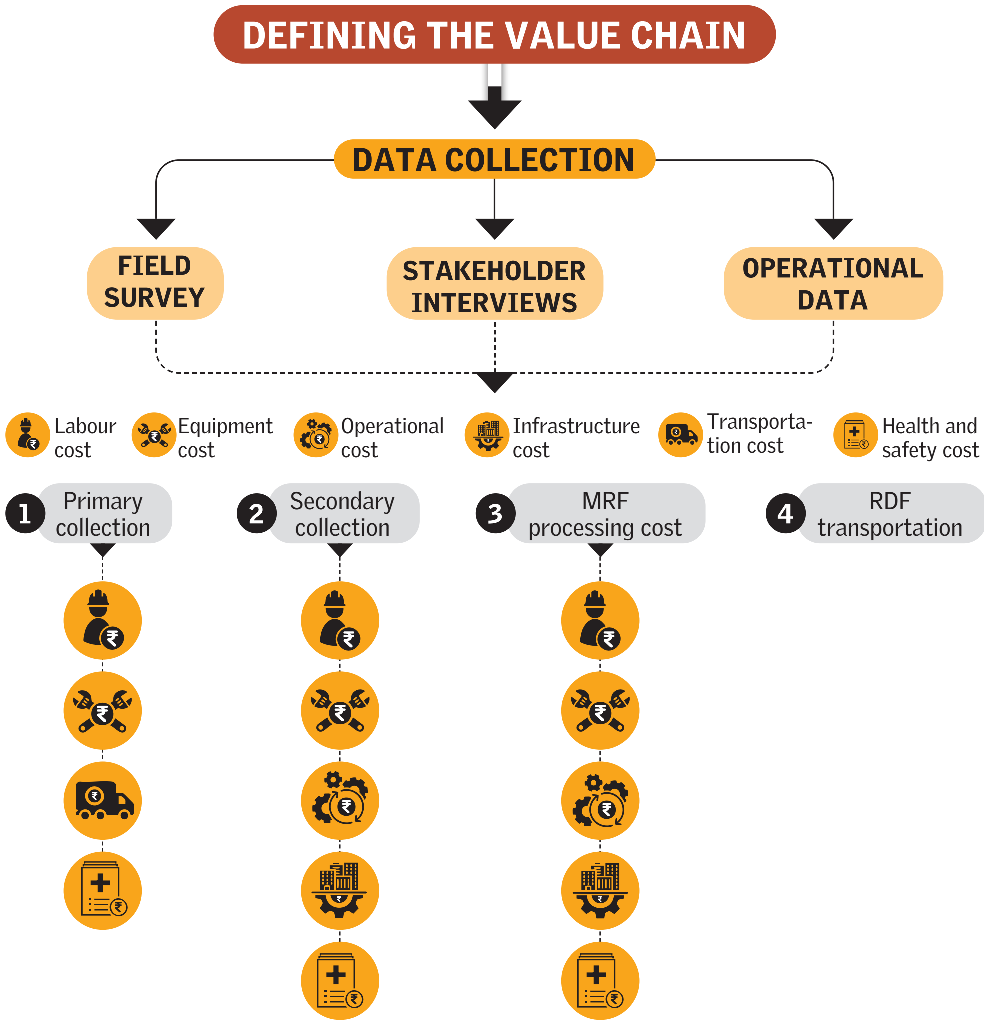
2. **Indirect costs**

Although not directly quantified in this study, the indirect costs associated with plastic waste such as environmental degradation, public health impacts, and social inequities represent critical considerations due to their far-reaching implications. Secondary literature provides valuable insights into these dimensions.

Plastic waste is particularly concerning due to its persistence in the environment. It takes hundreds to thousands of years to fully degrade, breaking down into increasingly smaller particles, which makes recovery and removal extremely challenging. As a result, plastic remains in ecosystems, continuing to incur additional costs over time. For instance, it is estimated that the plastic waste produced in 2019 that becomes marine pollution will impose a lifetime cost of approximately USD 3.1 trillion (±USD one trillion) due to the reduction in ecosystem services provided by marine ecosystems.[2]

Furthermore, greenhouse gas (GHG) emissions generated across the plastic lifecycle are estimated to impose a global cost exceeding USD 171 billion, highlighting the climate impact of plastic production and disposal. Additionally, the financial burden

Figure 1: Flowchart of the methodology



of managing plastic waste encompassing collection, sorting, disposal, and recycling amounted to over USD 32 billion in 2019 alone, underscoring the immense resources required to address the growing plastic waste crisis.[7] These figures underscore the broader economic and environmental challenges posed by plastic waste and highlight the need for comprehensive strategies that account for both direct and indirect costs in policy and decision-making.

2.3.4 COMPARATIVE EVALUATION

A comparative evaluation was conducted to benchmark the actual costs of management of plastic packaging waste against EPR credit disbursements. This analysis revealed gaps between financial support provided under the EPR system and the real-world expenses incurred by municipalities and waste management entities.

2.3.5 INTEGRATION AND FINAL ASSESSMENT

The findings from city-specific analyses, cost evaluations, and comparative assessments were synthesized to present a comprehensive understanding of plastic waste management in India. This integration facilitated the development of actionable recommendations, focusing on:

- Enhancing policy frameworks, particularly the EPR system.
- Improving operational efficiency and cost recovery mechanisms.
- Ensuring financial sustainability for municipalities and other stakeholders.

2.3.6 SAMPLE COST CALCULATION FOR DRY WASTE MANAGEMENT

To illustrate the methodology for calculating the cost of managing dry waste on a per kilogram basis, a hypothetical example is provided. This calculation uses assumed costs for simplicity and demonstrates the financial implications at different stages of plastic waste management. It is important to note that the actual data gathered during the study is not explicitly shared here due to professional confidentiality agreements and the proprietary nature of the findings.

Hypothetical scenario:

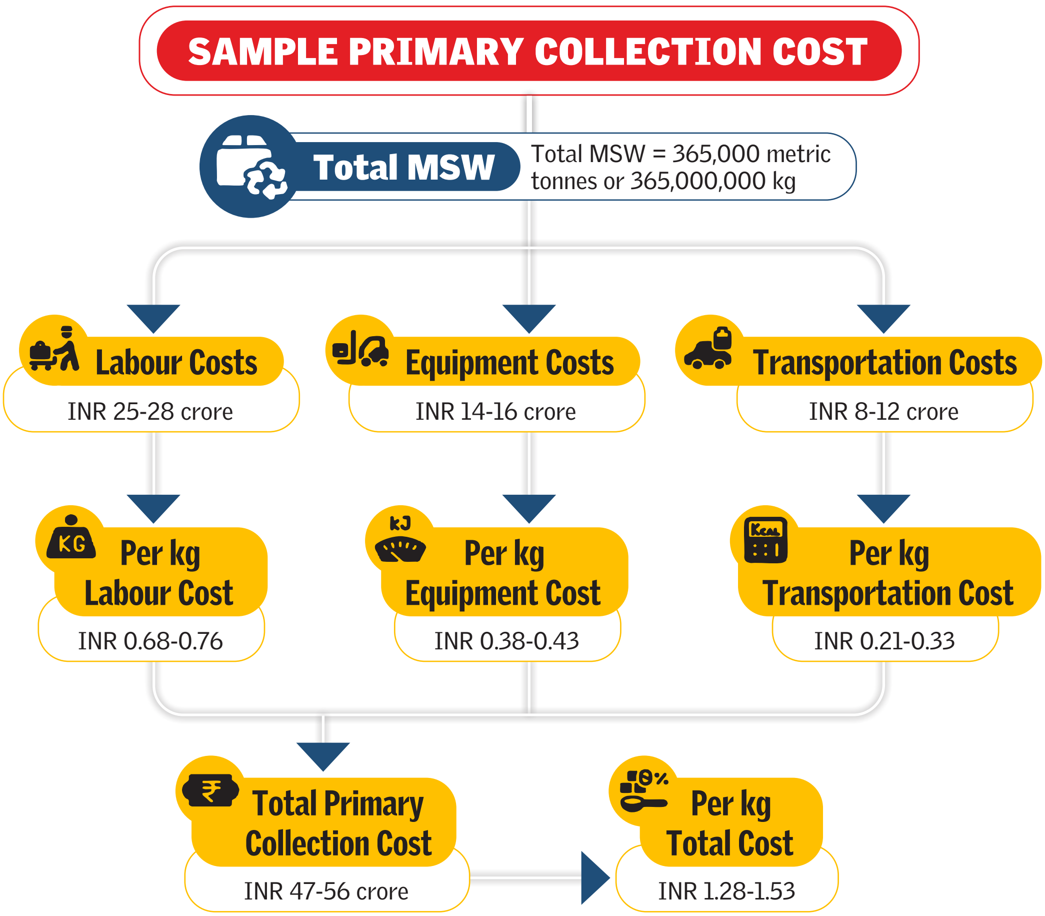
- **City**: ABC
- **Annual Municipal Solid Waste Generation**: 365,000 metric tonne (365,000,000 kg)
- **Annual Dry Waste Generation**: 146,000 metric tonne (146,000,000 kg)

- **Annual Non-Recyclable Disposal**: 60,000 metric tonne (60,000,000 kg)

Cost categories and detailed assumptions

1. Primary collection
Includes labour, equipment, and transportation costs.
(*Base: Total MSW = 365,000 metric tonnes or 365,000,000 kg*)

- **Labour costs**: INR 25.0–28.0 crore
    - o **Per kg cost**: INR 25.0 crore ÷ 365,000,000 kg = INR 0.68–28.0 crore ÷ 365,000,000 kg = INR 0.76 per kg
- **Equipment costs**:
    - o Pushcarts, bins, and bags: INR 6.0–7.0 crore
    - o Vehicle purchase and replacement: INR 8.0–9.0 crore



- o **Per kg cost**: (INR 6.0 crore + INR 8.0 crore) ÷ 365,000,000 kg = INR 0.38 – (INR 8.0 crore + INR 9.0 crore) ÷ 365,000,000 kg = INR 0.43 per kg
- **Transportation costs**: Fuel and vehicle maintenance: INR 8.0–12.0 crore
  - o **Per kg cost**: INR 8.0 crore ÷ 365,000,000 kg = INR 0.21–12.0 crore ÷ 365,000,000 kg = INR 0.33 per kg

  Total primary collection cost: INR 47.0–56.0 crore
  - o **Per kg total**: INR 47.0 crore ÷ 365,000,000 kg = INR 1.28–56.0 crore ÷ 365,000,000 kg = INR 1.53 per kg

2. Secondary collection

Includes labour, equipment, operational, and infrastructure costs. (*Base: Total dry waste = 146,000 metric tonnes or 146,000,000 kg*)

- **Labour costs**: INR 4.0–5.6 crore
  - o **Per kg cost**: INR 4.0 crore ÷ 146,000,000 kg = INR 0.27–5.6 crore ÷ 146,000,000 kg = INR 0.38 per kg
- **Equipment costs**:
  - o Collection vehicles (trucks, compactors): INR 3.0–4.0 crore
  - o Fuel and maintenance: INR 1.0–1.5 crore
  - o **Per kg cost**: (INR 3.0 crore + INR 1.0 crore) ÷ 146,000,000 kg = INR 0.27 – (INR 4.0 crore + INR 1.5 crore) ÷ 146,000,000 kg = INR 0.38 per kg
- **Operational costs**: Communication systems and administrative expenses: INR 1.5 crore–2.0 crore
  - o **Per kg cost**: INR 1.5 crore ÷ 146,000,000 kg = INR 0.10–2.0 crore ÷ 146,000,000 kg = INR 0.14 per kg
- **Infrastructure costs**: Transfer stations and equipment: INR 2.0–3.0 crore
  - o **Per kg cost**: INR 2.0 crore ÷ 146,000,000 kg = INR 0.14–3.0 crore ÷ 146,000,000 kg = INR 0.21 per kg
- **Total secondary collection cost**: INR 11.5–16.1 crore
  - o **Per kg total**: INR 11.5 crores ÷ 146,000,000 kg = INR 0.79–16.1 crores ÷ 146,000,000 kg = INR 1.10 per kg

3. Processing

Includes labour, equipment, infrastructure, and operational costs.

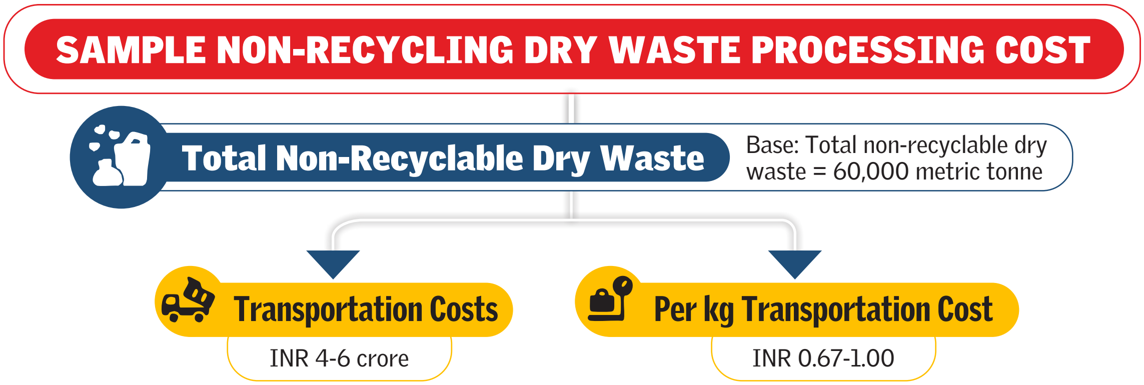
(*Base: Total dry waste = 146,000 metric tonne or 146,000,000 kg*)

- **Labour costs**: INR 6.0–9.0 crore
  - **Per kg cost**: INR 6.0 crore ÷ 146,000,000 kg = INR 0.41–9.0 crore ÷ 146,000,000 kg = INR 0.62 per kg
- **Equipment costs**:
  - Sorting lines, shredders, conveyors: INR 3.0–4.5 crore
  - Energy consumption (electricity/diesel): INR 1.0–1.5 crore
  - **Per kg cost**: (INR 3.0 crore + INR 1.0 crore) ÷ 146,000,000 kg = INR 0.27 – (INR 4.5 crore + INR 1.5 crore) ÷ 146,000,000 kg = INR 0.41 per kg

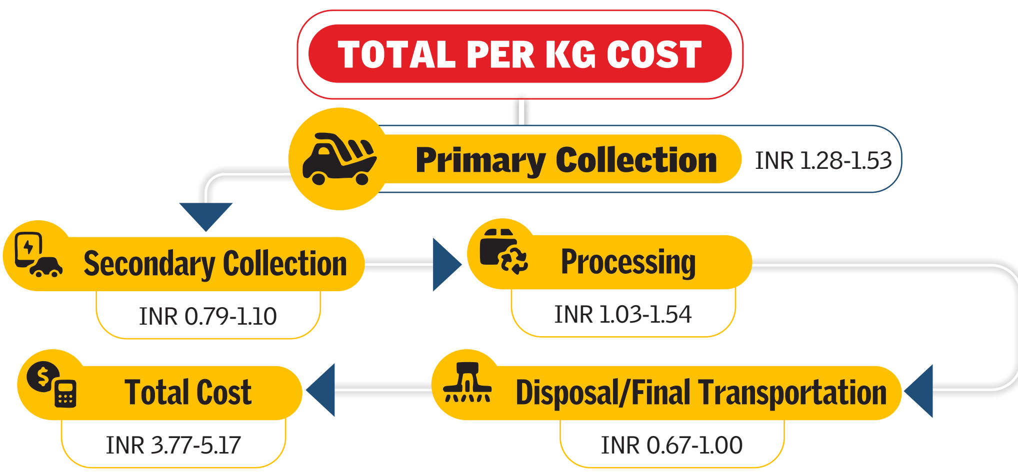
- **Infrastructure costs**: Construction and maintenance of facilities: INR 4.0–6.0 crore
    - o **Per kg cost**: INR 4.0 crore ÷ 146,000,000 kg = INR 0.27–6.0 crore ÷ 146,000,000 kg = INR 0.41 per kg
- **Operational costs**: IT systems and administrative expenses: INR 1.0–1.5 crore
    - o **Per kg cost**: INR 1.0 crore ÷ 146,000,000 kg = INR 0.07–1.5 crore ÷ 146,000,000 kg = INR 0.10 per kg
- **Total processing cost**: INR 15.0–22.5 crore
    - o **Per kg total**: INR 15.0 crore ÷ 146,000,000 kg = INR 1.03–22.5 crore ÷ 146,000,000 kg = INR 1.54 per kg

4. Disposal/final transportation
Includes costs for RDF transportation to end-of-life facilities.
(*Base: Total non-recyclable dry waste = 60,000 metric tonne or 60,000,000 kg*)

- **Transportation costs**: INR 4.0–6.0 crore
  - **Per kg cost**: INR 4.0 crore ÷ 60,000,000 kg = INR 0.67–6.0 crore ÷ 60,000,000 kg = INR 1.00 per kg
- **Total disposal cost**: INR 4.0–6.0 crore
  - **Per kg total**: INR 0.67–1.00 per kg



The total per kg cost for managing the waste for city ABC is (per kg cost) = Primary collection cost + Secondary collection cost + Processing cost + Disposal/Final transportation
Total cost (lower bound) =1.28+0.79+1.03+0.67 = 3.77
Total cost (upper bound) = 1.53+1.10+1.54+1 = 5.17
Therefore, the total cost for managing the plastic waste in city ABC is INR 3.77–5.17



3

CITY-LEVEL CASE STUDIES

With GPS-tracked vehicles, high segregation, and tiered user fees, Indore has institutionalized efficiency—achieving 100 per cent waste processing at among the lowest per kg costs in India.

Pune's SWaCH model integrates informal waste pickers into municipal systems, demonstrating how decentralized governance and livelihood inclusion can drive cost-effective, inclusive waste management.

In Shri Vijaya Puram, transport costs exceed CPCB's credit rates by 2–7 times due to limited infrastructure and isolation—exposing how uniform EPR frameworks disadvantage remote municipalities.

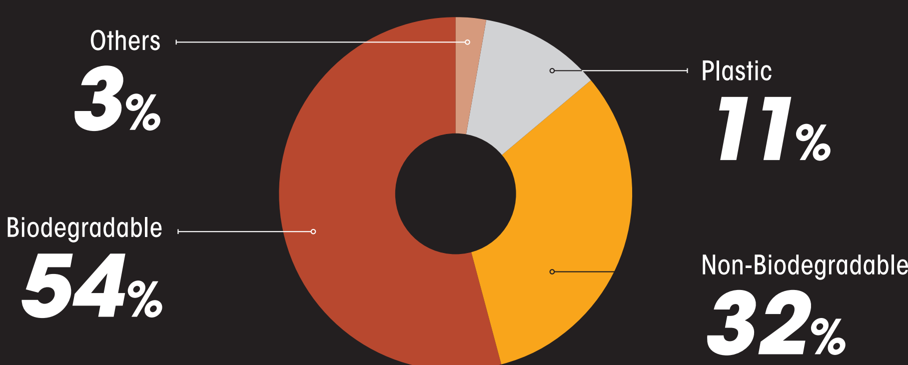
MADHYA PRADESH

INDORE

Indore leads India in solid waste management through meticulous six-way segregation, 100 per cent door-to-door collection, and high processing efficiency, supported by private-public partnership.

Waste composition in Indore

Total waste **1,200 TPD**



Population (2011 Census)
1,994,397

Estimated current population
2,915,000

Estimated floating population (daily)
300,000

Area (sq km)
276

No. of households (2021)
490,000

Number of wards
85

Population density
10,561

MSW generation (TPD)
1,100-1,200

Number of sanitation workers
2,854

Plastic waste generation (TPD)
120-130

Waste management vehicle fleet size
829

Percentage of households covered under door-to-door waste collection
100

Percentage of households segregating waste
100

Percentage of waste processed
100

Source: Indore Municipal Corporation

Indore, known for its exemplary waste management practices, has implemented a comprehensive and efficient plastic waste value chain. The city is divided into 19 zones and 85 wards, with approximately 6,000 households and 600 commercial establishments per ward.

To support its waste management system, Indore Municipal Corporation (IMC) collects user fees, which vary based on income groups and property types. Residential households pay INR 60–180, while commercial establishments pay INR 180–300. The city is divided into five rate zones, with fees being lowest in slums and highest in high-income areas. IMC is transitioning to a new system where charges are based on the square footage of properties, though fees for slums will remain unchanged. These user charges are collected alongside property taxes, while charges for bulk waste collection are levied separately.

Door-to-door collection in Indore is carried out using GPS-enabled vehicles, each designed with compartment for six-way segregation (i) Dry waste, (ii) Wet waste, (iii) Domestic hazardous waste and (iv) Domestic bio-medical waste [used mask, gloves, sanitary napkins, diaper, waste medicines etc.], (v) E-waste and (vi) Plastic waste. Once collected, waste is transported to garbage transfer stations (GTS) for compaction and further processing.

The GTS system comprises ramp-based static stations, portable compactor-based stations,

Material recovery facility in Indore

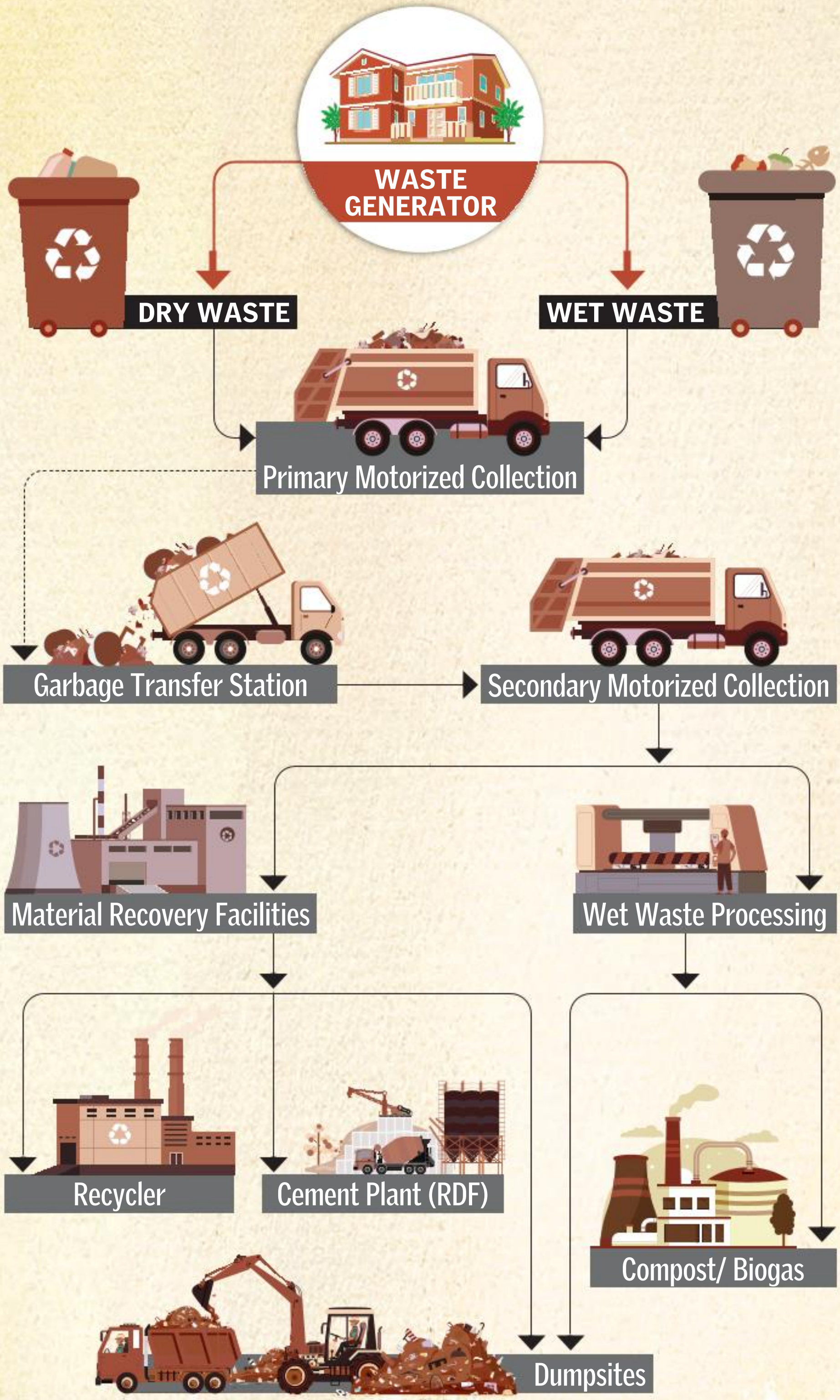
and semi-portable compactor-based stations, all supporting segregated waste handling. Green hoppers are designated for wet waste and blue hoppers for dry waste. Once the hoppers are full, they are lifted using hook loaders and transported to the next stage. Wet waste is directed to the centralized composting unit or biogas facility, while dry waste is sent to the MRF located at the Devguradia trenching ground.

The MRF, operated by NEPRA under a public-private partnership (PPP) model, has a processing capacity of 400 tonne per day (TPD). The facility uses advanced technologies such as optical sorting and robotics to segregate waste into 13 different fractions, enabling efficient recovery and recycling. NEPRA pays an annual royalty of INR 1.67 crore to IMC, which, in turn, ensures the supply of 400 TPD of segregated waste to the facility. The non-recyclable dry waste is sent to the co-processing plant near Karnataka around 400 km away.

Table 3: Cost analysis (per kg) for management of dry waste in Indore

Indore	Cost per kg (₹)
Primary collection	1.2 to 1.9
Secondary collection	1.8 to 2.6
MRF	1.6 to 2.4
RDF transportation cost	0.5 to 1.1
Overall cost	5.1 to 8.0

Figure 2: Flowchart of the value chain of MSW in Indore



MAHARASHTRA

PUNE

Pune's inclusive model integrates informal wastepickers through SWaCH, enabling decentralized collection, strong source segregation, and cost-effective dry waste recovery.

Waste composition in Pune

Total waste **2,400 TPD**

Population (2011 Census)
3,132,143

Estimated current population
4,569,000

Estimated floating population (daily)
200,000

Area (sq km)
516

No. of households (2021)
930,000

Number of wards
42

Population density
8,854

MSW generation (TPD)
2,300-2,400

Number of sanitation workers
14,087

Plastic waste generation (TPD)
350–370

Waste management vehicle fleet size
753

Percentage of households covered under door-to-door waste collection
100

Percentage of households segregating waste
100

Percentage of waste processed
100

Source: Pune Municipal Corporation

Pune Municipal Corporation (PMC), one of the largest municipal bodies in Maharashtra. It administers 42 wards across five zones, that are further subdivided into prabhags and kothis, with 152 kothis forming the foundational administrative units. The city's waste management system is supported by a user fee structure managed by SWaCH, a cooperative of waste pickers. Fees vary by income level, with INR 85 charged to non-slum households, INR 170 to commercial establishments, and INR 65 to slum households, the latter supplemented by a subsidy of INR 25 from PMC to support informal workers.

Solid waste collection and transportation are conducted through a well-organized fleet of vehicles and dumper-placers. Door-to-door collection is managed by SWaCH, which handles 52.5 per cent of the city's municipal solid waste (1,050 TPD) through its waste picker network. Government vehicles collect 17.5 per cent (350 TPD), private operators handle 10 per cent (200 TPD), and 7.5 per cent (150 TPD) is collected via community bins and containers. Despite these efforts, approximately 5 per cent of waste (100 TPD) remains uncollected, while another 7.5 per cent (150 TPD) is composted at source by citizens. Wet and dry waste are collected separately, with recyclable dry waste segregated at source and directed to scrap shops, then to aggregators and recyclers. Non-recyclable dry waste, along with other waste stream components, is transported to transfer stations for further sorting.

In the transfer station the waste is further segregated and the wet waste is sent in bigger dumpers and compactors to a compost or biogas plant and the dry waste is channelized to the MRF. The dry waste in the MRF is then further segregated into different

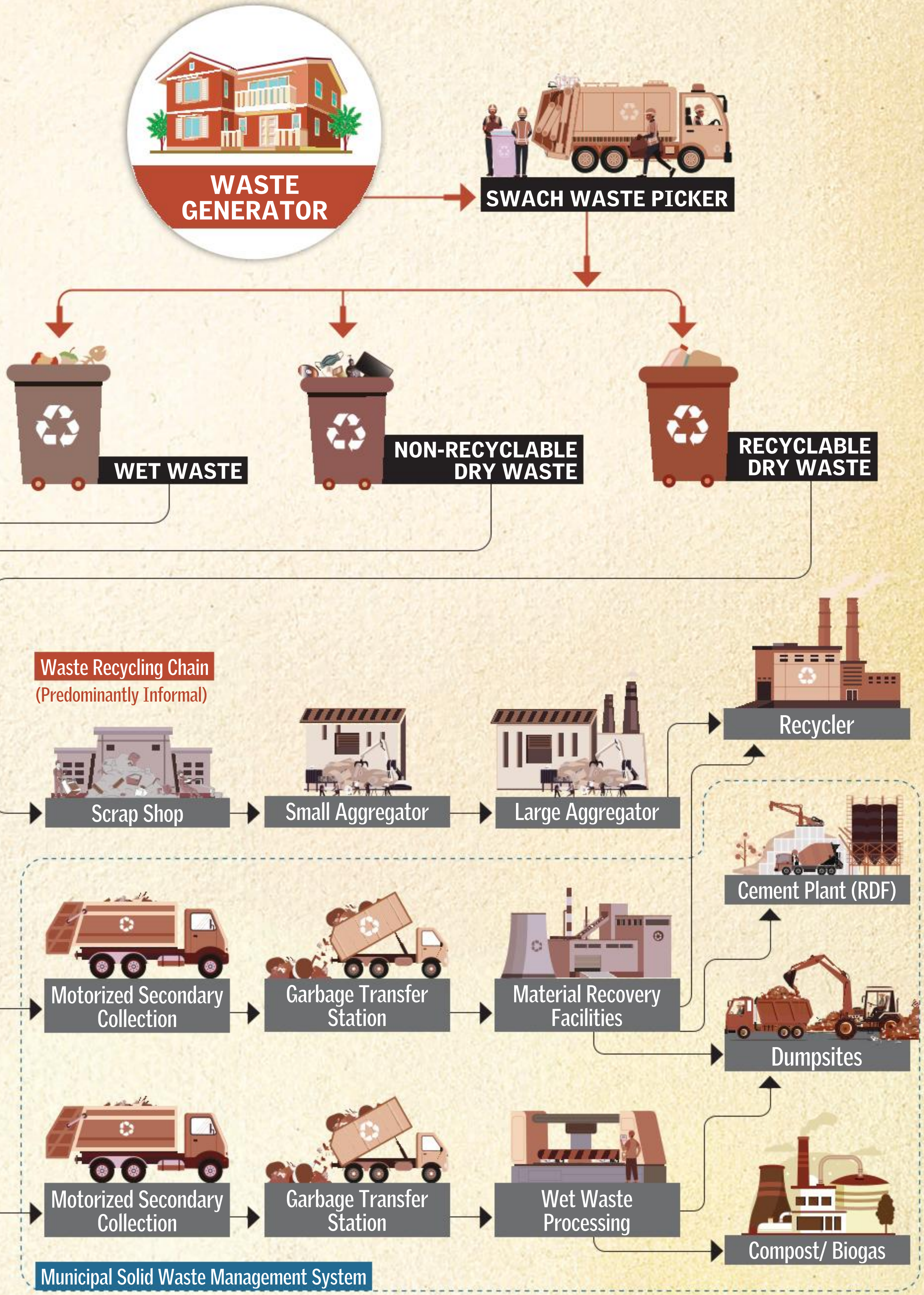
Scrap shop in Pune

components with the recyclable waste being channelized to the recyclers and the non-recyclable waste being channelized to the co-processing plant. Pune operates eight MRFs with capacities ranging from 25 TPD (three facilities), 50 TPD (three facilities), 75 TPD (one facility), to 100 TPD (one facility). The non-recyclable waste is sent to the co-processing plant in Katni, Madhya Pradesh around 600 Km away from the MRF plant.

Table 4: Cost analysis (per kg) of dry waste management in Pune

Pune	Cost per kg (₹)
Primary collection	2.3 to 3.1
Secondary collection	1.1 to 2.3
MRF	1.7 to 2.2
RDF transportation cost	0.7 to 1.3
Overall cost	5.8 to 8.9

Figure 3: Flowchart of the value chain of MSW in Pune

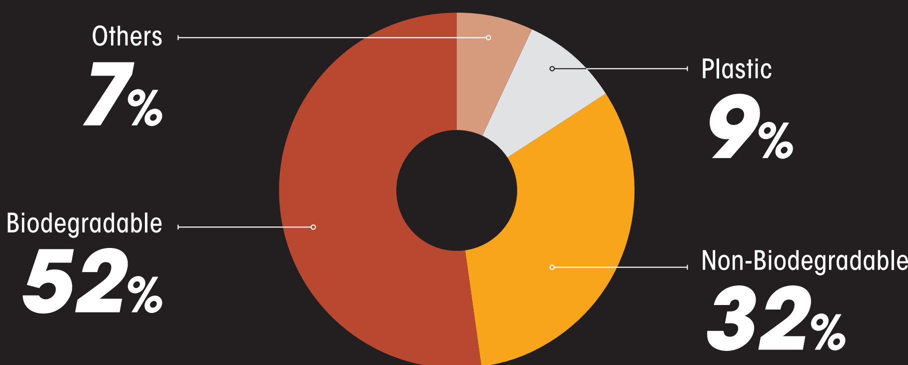


GOA

Goa employs a hybrid system combining centralized processing and decentralized collection, adapted to coastal tourism, dynamics and supported by the Goas Waste Management Corporation

Waste composition in Goa

Total waste **800 TPD**



Population (2011 Census)
1,458,545

Estimated current population
1,590,000

Estimated floating population (daily)
300,000

Area (sq km)
3,702

No. of households (2021)
353,420

Number of wards
225

Population density
429

MSW generation (TPD)
750–800

Number of sanitation workers
14,087

Plastic waste generation (TPD)
70–80

Waste management vehicle fleet size
753

Percentage of households covered under door-to-door waste collection
100

Percentage of households segregating waste
100

Percentage of waste processed
100

Source: Goa Municipal Corporation

Goa, characterized by its mix of urban municipalities and rural panchayats, adopts a multi-faceted strategy to manage plastic waste. The state comprises 14 ULBs, including one municipal corporation in Panaji and 191 panchayats. Due to the limited financial capacity of its panchayats, the Goa Waste Management Corporation (GWMC) was established to centralize and streamline waste management operations.

The state operates two centralized Solid Waste Management Facilities (SWMFs): a 250 TPD facility in Saligao catering to the panchayats and municipalities in North Goa, and a 100 TPD facility in South Goa. Additionally, there are 14 MRFs across Goa, with capacities ranging from 1–22 TPD of Panaji and a combined capacity of 210 TPD. Goa follows three distinct models of waste collection and processing.

1. MODEL 1: ULB-DRIVEN COLLECTION

In this model, ULBs manage door-to-door segregated waste collection using their own vehicles, transporting waste directly to SWMFs. This approach is prevalent among 30–35 local bodies, with seasonal fluctuations depending on tourism activity. While the exact user fee was not disclosed during interactions, it was noted that residential households are charged nominal fees, with commercial establishments subsidizing a significant portion of the costs. In the SWMF, wet waste is processed at biogas plants, recyclable dry waste is directed to recyclers, and non-recyclable plastics are sent to co-processing facilities.

MRF facility at Mapusa, Goa

Goa Waste Management Corporation MRF facility

2. MODEL 2: PANCHAYAT-LED DECENTRALIZED COLLECTION

This model caters to panchayats without access to SWMFs. Panchayats handle door-to-door segregated collection, with waste stored temporarily at small storage facilities or mini-MRFs where high-value items are recovered. GWMC subsequently collects the remaining waste and transports it to SWMFs for further processing. Wet waste is converted into biogas, recyclable dry waste is sent to recyclers, and non-recyclable waste is sent to the co-processing plant.

3. MODEL 3: ULBS AND URBANIZED PANCHAYATS

This model is specific to larger municipal councils and urbanized panchayats. The local bodies handle door-to-door collection and transport waste to their respective MRFs, where recyclable waste is sorted and bailed, and non-recyclable fractions are sent for co-processing. The transportation of non-recyclable fractions is handled by the GWMC and is sent to the co-processing plant in Wadi, Karnataka.

The cost of RDF transportation from MRFs to co-processing plants is INR 3–4 per kg. However, under an MoU with co-processing plants, GWMC covers INR 1–1.5 per kg, with the remaining cost borne by the plants in exchange for claiming EPR credits. This cost-sharing arrangement reduces the financial burden on local authorities.

Table 5: Cost analysis (per kg) of dry waste management in Goa

Goa	Cost per kg (₹)		
	1st Model	2nd	3rd
Primary collection	2.1 to 3.8	4.3 to 6.1	6.1 to 8.2
Secondary collection	NA	NA	NA
MRF	2.9 to 3.7	2.9 to 3.7	NA
RDF transportation cost	2.5 to 3.1	2.5 to 3.1	2.5 to 3.1
Overall cost	7.5 to 10.6	9.7 to 12.9	8.6 to 11.3

Figure 4: Flowchart of the MSW value chain in Goa (Model 1)

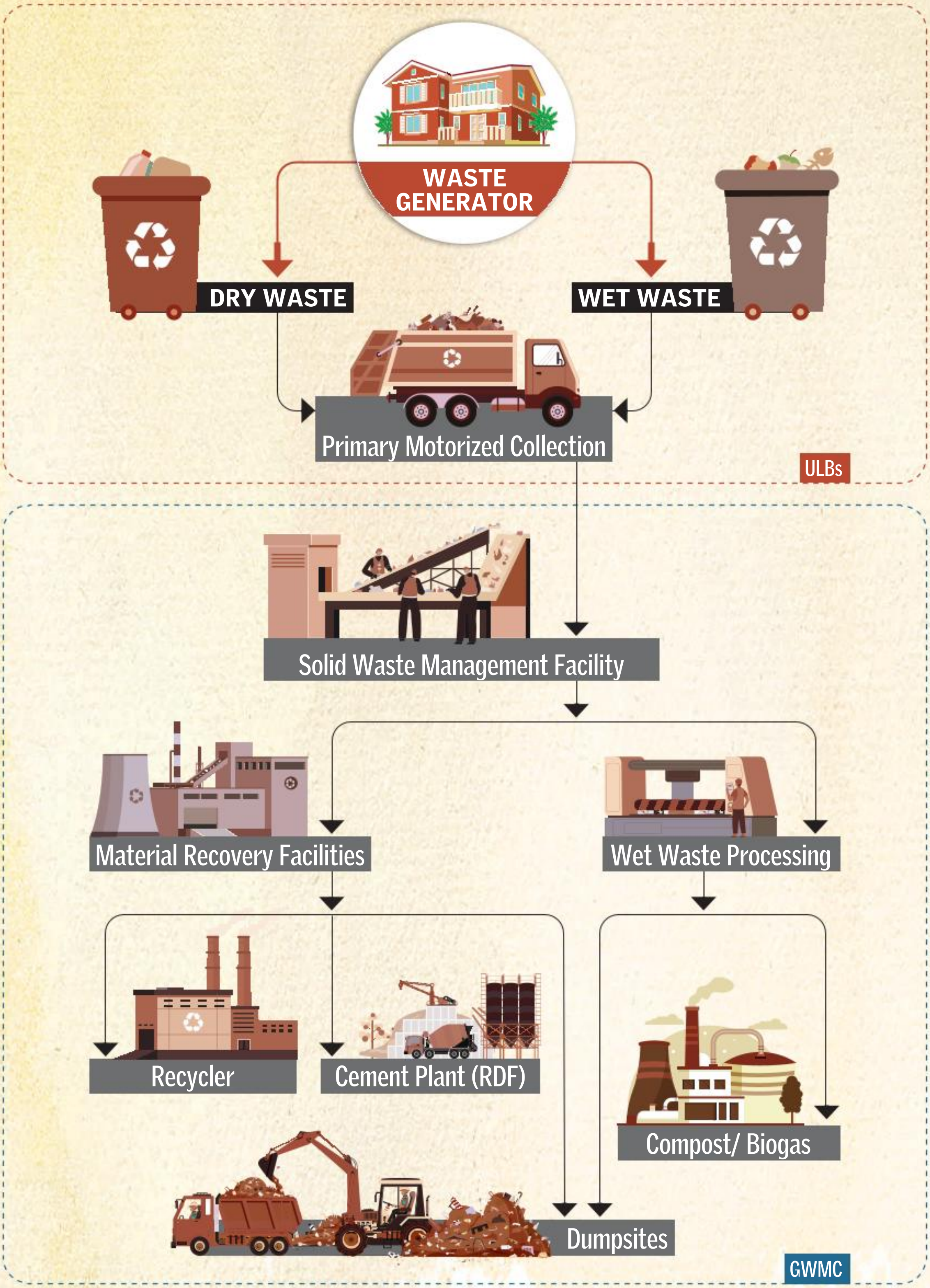


Figure 4.1: Flowchart of the MSW value chain in Goa (Model 2)

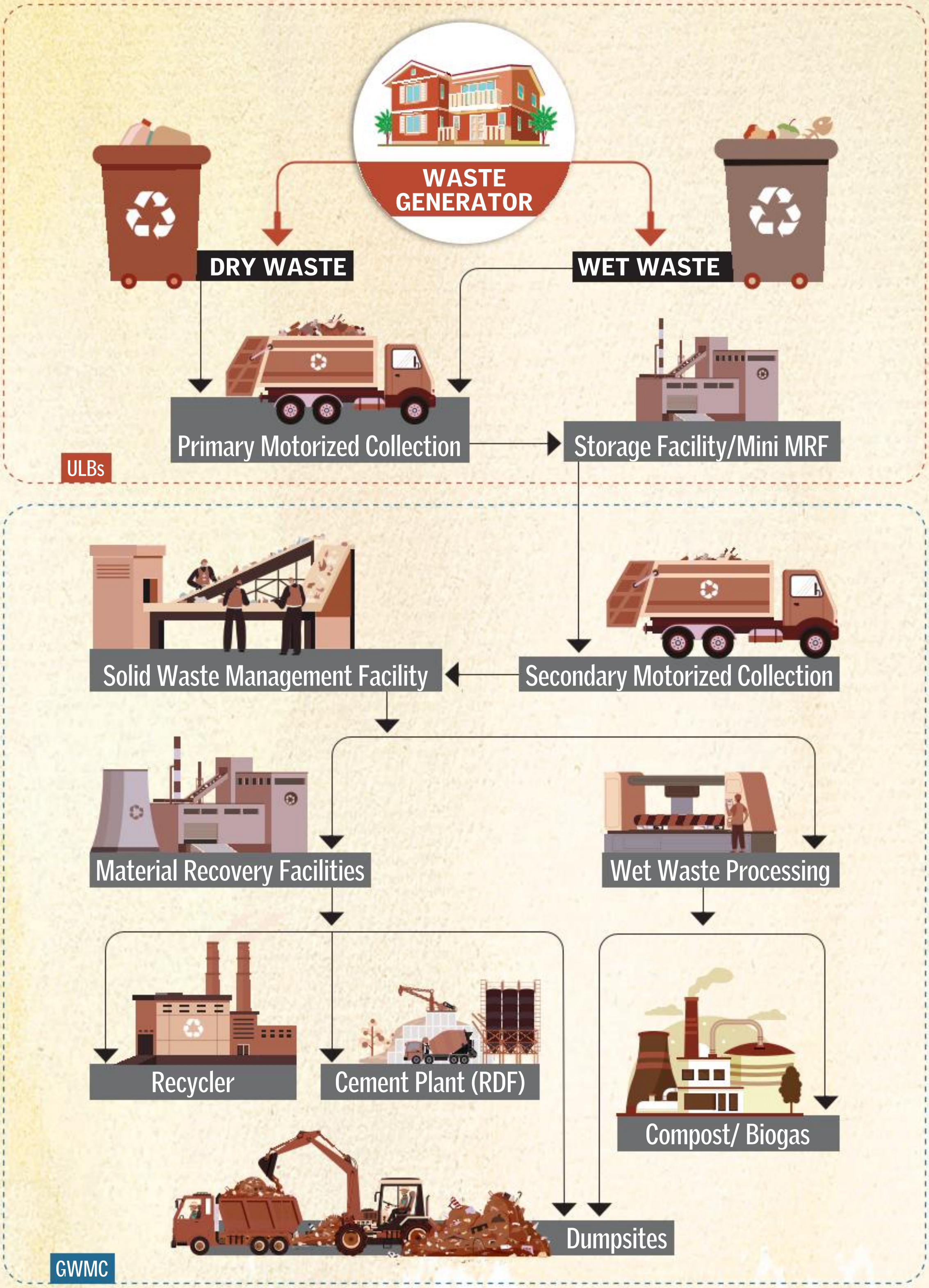
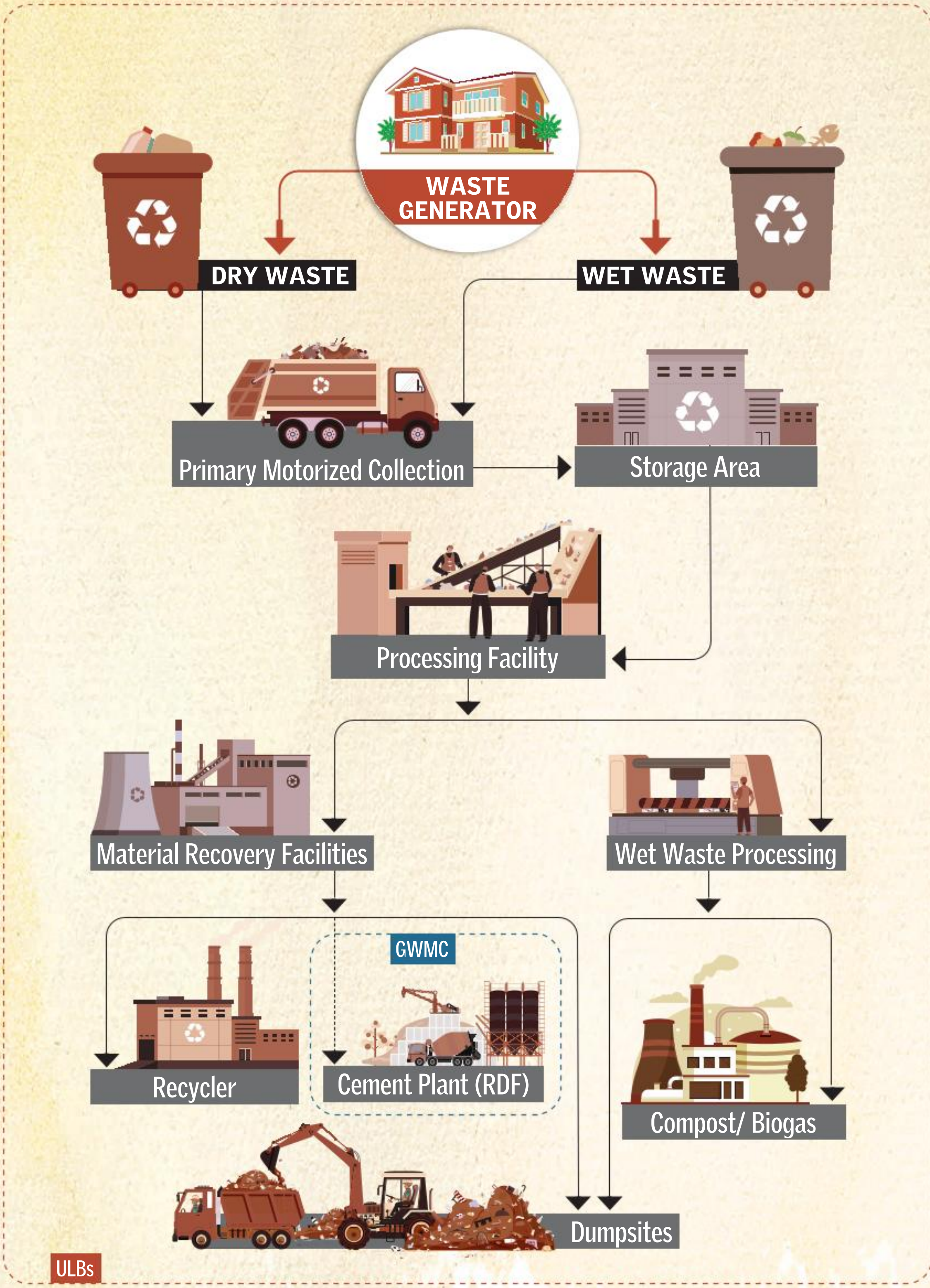


Figure 4.2: Flowchart of the MSW value chain in Goa (Model 3)



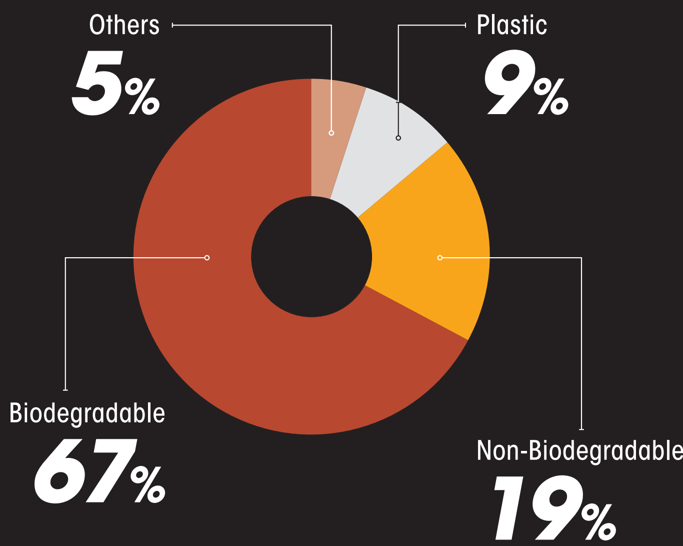
ANDAMAN AND NICOBAR ISLANDS

SRI VIJAYA PURAM

Sri Vijaya Puram faces unique logistical hurdles as a remote island city, where RDF transport cost and limited infrastructure demand context-specific waste management strategies

Waste composition in Sri Vijaya Puram

Total waste **55 TPD**



Population (2011 Census)
108,058

Estimated current population
156,000

Estimated floating population (daily)
10,000

Area (sq km)
41

No. of households (2021)
50,462

Number of wards
24

Population density
3,805

MSW generation (TPD)
50-55

Number of sanitation workers
548

Plastic waste generation (TPD)
4-5

Waste management vehicle fleet size
53

Percentage of households covered under door-to-door waste collection
100

Percentage of households segregating waste
100

Percentage of waste processed
87

Source: Port Blair Municipal Council

Sri Vijaya Puram falls under the jurisdiction of the Port Blair Municipal Council (PBMC) and consists of 24 wards, with approximately 50,462 households and 6,045 commercial establishments. Unlike most cities in the mainland, PBMC does not currently collect user charges from households for waste management services.

Door-to-door waste collection is carried out by the municipal council using a fleet of 26 hired vehicles. However, most of these vehicles don't have separate compartments for wet and dry waste. As a result, even when households try to segregate waste at the source, it often ends up mixed during transportation. The lack of transfer stations makes things worse; waste is manually segregated by workers at roadside spots before being sent for processing.

PBMC follows a decentralized model for waste management. Wet waste is first taken to composting units. There are ten across the city, with a total capacity of 32.5 tonnes per day (TPD). This includes one electric composter at Junglighat, which has a small capacity of 0.25 TPD. Dry waste, on the other hand, is sent to 18 dry resource centres (DRCs), which together handle about 24.2 TPD. Most of these centres are quite small, with only two having a capacity of more than 1 TPD. At the DRCs, dry waste is sorted: recyclables are shipped out to the mainland, while non-recyclables are dumped locally due to the lack of disposal infrastructure on the island.

One of the DRCs in Port Blair

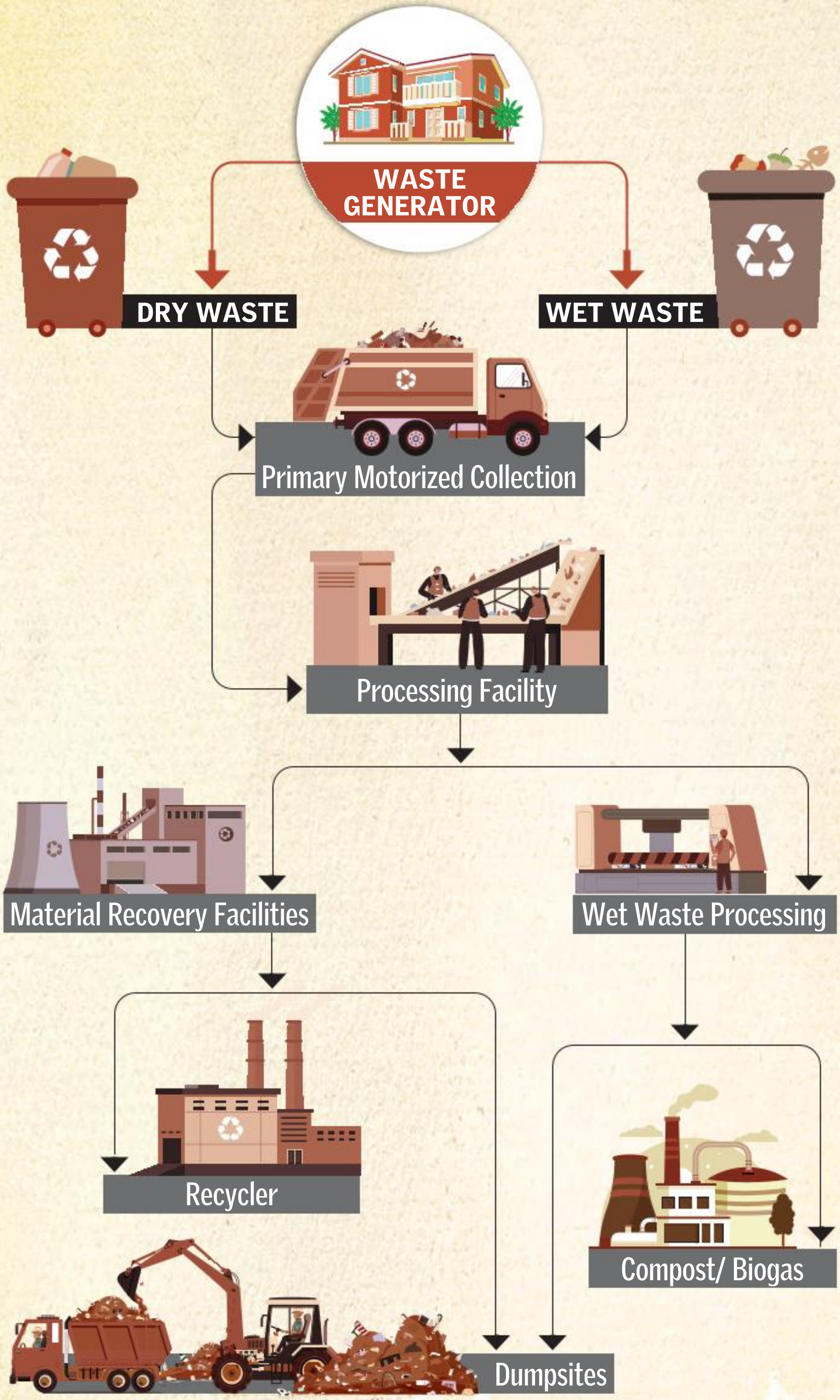
The cost of managing waste in Sri Vijaya Puram reflects the realities of its remote island setting. Ideally, non-recyclable plastic waste should be sent to co-processing facilities, such as cement kilns, for proper disposal. But given the high cost and logistical difficulty of transporting waste from the island to the mainland, this isn't a feasible option.

For this study, the cost of transporting non-recyclable plastic waste is assumed to be equivalent to that of recyclables. While this may not be entirely precise, it serves as a practical estimate given the lack of co-processing infrastructure and the significant transport challenges faced by the city.

Table 6: Cost analysis (per kg) of dry waste management in Sri Vijaya Puram

Sri Vijaya Puram	Cost per kg (₹)
Primary collection	9.8 to 11.6
Secondary collection	NA
MRF	4.8 to 5.7
RDF transportation cost	11.4 to 13.8
Overall cost	26 to 31.1

Figure 5: Flowchart of the MSW value chain in Sri Vijaya Puram

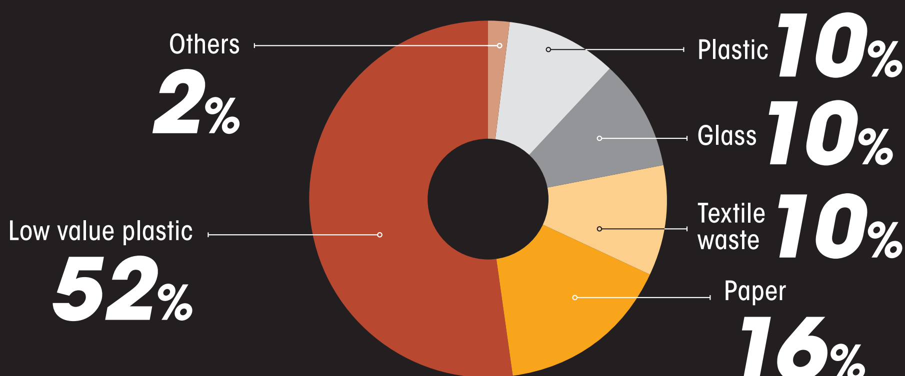


DHARAMSHALA

Dharamshala emphasizes localized, community-driven waste management system suited to its hilly terrain, with NGO partnership playing a key role in dry waste management

Waste composition in Dharamshala

Total waste **19 TPD**



Population (2011 Census)
30,764

Estimated current population
43,000

Estimated floating population (daily)
15,000

Area (sq km)
30

No. of households (2021)
10,978

Number of wards
17

Population density
1,433

MSW generation (TPD)
17–19

Plastic waste generation (TPD)
1–2

Percentage of households covered under door-to-door waste collection
100

Percentage of households segregating waste
100

Percentage of waste processed
100

Source: Waste Warriors

Dharamshala, nestled in the Kangra district of Himachal Pradesh, has embraced a decentralized and community-driven waste management model, with Waste Warriors (WW) leading the initiative. The programme focuses exclusively on dry waste collection and processing, covering six panchayats in the Dharamshala block. The waste collection schedule in rural Dharamshala varies based on the panchayat, with frequencies ranging from weekly to every 10–15 days. Nearly 50 per cent of the primary collection cost is attributed to manpower, while transportation and administrative costs account for the remaining portion.

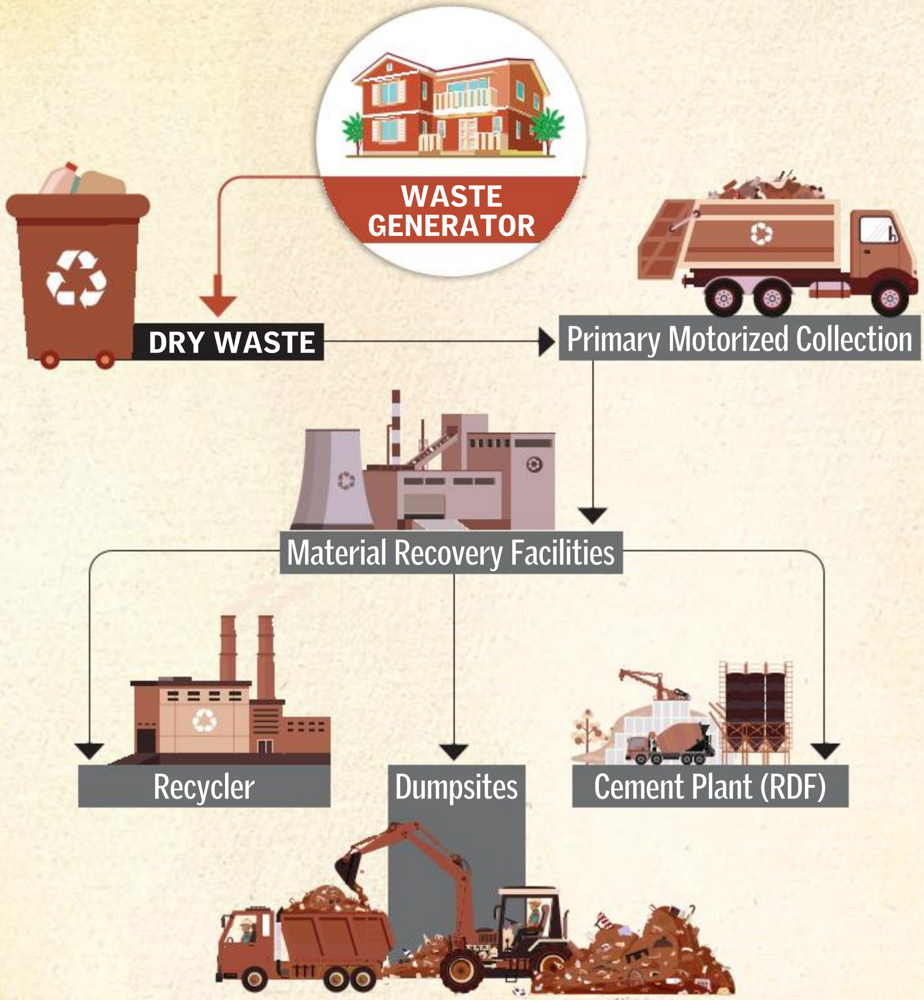
The collected dry waste is transported to a rented MRF in Dharamshala. The facility has a modest processing capacity of 13 MT per month. The processing costs are high due to factors such as high labour expenses, the operational challenges of a rented facility, and limited capacity, which restricts efficiency and economies of scale. Within the MRF, recyclable materials are segregated and sent to designated recyclers, while non-recyclable plastics are transported to Ultratech Cement's co-processing plant in Baga or Darlaghat.

Table 7: Cost analysis (per kg) of dry waste management in Dharamshala

Dharamshala	Cost per kg (₹)
Primary collection	7 to 9
Secondary collection	NA
MRF	7 to 8
RDF transportation cost	3.5 to 4.5
Overall cost	17.5 to 21.5

Material Recovery Facility in Dharamshala

Figure 6: Flowchart of the MSW value chain in Dharamshala



4

COMPARATIVE COST ANALYSIS OF PLASTIC WASTE MANAGEMENT

Plastic packaging waste management costs range from INR 5.1–8/kg in Indore to INR 26–31.1/kg in Sri Vijaya Puram, driven by geography, infrastructure, and scale of operations.

CPCB's EPR credit rates fall short for multilayered plastics, with cost recovery as low as 24 per cent in Sri Vijaya Puram and 32 per cent in Dharamshala, compared to 101–215 per cent in Indore.

Market EPR rates cover just 10–14 per cent of multilayered plastic and 16-24 per cent of the flexible plastics cost in remote cities.

India's waste management systems vary widely across cities due to differences in geographic conditions, population densities, and urban planning paradigms across cities. This chapter provides a detailed comparative analysis of the costs associated with the dry waste management, including primary, secondary collection, MRF processing, and RDF transportation. Furthermore, it evaluates the sufficiency of current EPR credit rates (CPCB recommended and prevailing market rates) in offsetting these costs. However, assessing the adequacy of EPR credit rates requires a nuanced approach, particularly in light of the actual expenditures incurred by municipalities in managing the entire dry waste stream, which comprises plastics alongside other recyclable and non-recyclable materials. Given that EPR credit rates are currently applicable solely to plastic packaging waste and that no formal credit mechanisms have yet been instituted for other waste streams it becomes imperative to isolate and determine the specific costs attributable to plastic packaging waste before drawing comparisons with EPR credit rates.

4.1 PRIMARY COLLECTION

The cost of primary waste collection demonstrates considerable variation across cities, influenced by factors such as urban density, geographical conditions, and the operational efficiency of waste management systems. Indore achieves the lowest costs, ranging between INR 1.2–1.9 per kg, owing to its high population density and advanced infrastructure. The city's use of GPS-enabled vehicles ensures optimized route planning, which reduces fuel consumption and manpower requirements. In Pune, the cost ranges from INR 2.3–3.1 per kg. Although Pune benefits from the SWaCH cooperative, which plays a crucial role in integrating informal waste pickers into the formal waste management system and enhancing service efficiency, the collection cost appears higher than in Indore. However, this cost reflects the true value of an inclusive and decentralized waste management approach. Unlike in Indore, where municipal operations are directly funded, the user fee collected by SWaCH Pune sustains its workforce, ensuring fair wages and financial security for waste pickers.

Moreover, by reducing dependence on municipal subsidies and fostering community participation, the system delivers long-term economic and environmental benefits. When factoring in social equity, livelihood generation, and the reduced burden on municipal finances, the actual cost burden on the city is significantly optimized, making the model both effective and economically viable.

Goa's primary collection varies across three distinct models. The first model incurs a cost ranging from INR 2.1–3.8 per kg, while the second and third models have higher cost ranges of INR 4.3–6.1 and INR 6.1–8.2 per kg, respectively. The differences are driven by a combination of urban-rural divides, seasonal tourism-induced waste surges, and logistical inefficiencies in rural panchayats.

In Dharamshala, the cost escalates to INR 7–9 per kg. This increase is attributed to the city's mountainous terrain and dispersed rural population, which complicate logistics and extend collection times. The reliance on labour-intensive methods further drives up costs, as longer travel distances require additional manpower and fuel.

Sri Vijaya Puram records the highest primary collection cost, ranging between INR 9.8–11.6 per kg. The island's unique geography poses significant logistical challenges, including limited road infrastructure and dependence on hired vehicles, most of which lack segregated compartments. These inefficiencies result in higher transportation and labour expenses, compounded by the additional effort required to manually segregate waste at roadside points.

4.2 SECONDARY COLLECTION

The cost of secondary collection, which involves transporting waste from transfer stations or interim collection points to MRFs or processing plants, shows significant variation across cities, depending on factors such as infrastructure, population density, and geographic characteristics. In Indore, the secondary collection cost ranges from INR 1.8–2.6 per kg, reflecting the city's efficient waste management infrastructure. The presence of a well-established network of garbage transfer stations (GTS) and optimized transportation routes helps minimize the overall cost. Additionally, the city benefits from a compact urban layout and relatively high population density, which reduces transportation distances and associated costs.

In Pune, the secondary collection cost ranges from INR 1.1–2.3 per kg. Pune's cost is influenced by its larger urban area and somewhat lower population density compared to Indore. However, Pune has a decentralized waste management system with multiple transfer stations and an efficient fleet of vehicles, which helps mitigate the cost of longer transportation routes. This decentralized approach ensures that the waste is handled efficiently despite the city's greater spatial spread.

Goa, Dharamshala and Sri Vijaya Puram do not incur expenses related to secondary waste collection, as neither city/state has formal transfer stations. This is primarily due to the relatively small geographical size of these cities or direct collection model, which eliminates the necessity for such infrastructure. In these cases, waste is collected directly and transported to processing facilities.

4.3 MRF/PROCESSING COST

The cost of processing dry waste at MRFs varies considerably across cities, influenced by factors such as facility capacity, technological infrastructure, labour expenses, and differing operational models. In Indore, the processing cost at the MRF is INR 1.6–2.4 per kg. The city benefits from a highly advanced and centralized facility with a processing capacity of 400 tonnes per day (TPD). The use of state-of-the-art technology, such as optical sorting and robotics, along with its public-private partnership (PPP) model with NEPRA, enables efficient operations and economies of scale, thereby keeping costs relatively low.

Pune's MRF processing cost ranges from INR 1.7–2.2 per kg. The city operates eight MRFs with capacities ranging from 25–100

TPD. Although Pune's decentralized network of MRFs prevents the same degree of scale efficiency seen in Indore, the active involvement of SWaCH and an efficient segregation network that integrates the informal waste sector contribute to minimizing costs. Despite the smaller individual facility capacities compared to Indore, Pune manages to maintain cost efficiency through streamlined operations.

Goa, on the other hand, incurs significantly higher MRF processing costs of INR 2.9–3.7 per kg. The state's 14 decentralized MRFs have relatively small capacities, ranging from 1–22 TPD, limiting operational efficiency. Furthermore, geographical challenges, including logistical complexities and seasonal tourism-related waste fluctuations, elevate labour and operational costs.

Dharamshala faces even higher processing costs of INR 7–8 per kg. This is driven by the operation of a small-scale, rented MRF with a capacity of only 13 metric tonnes per month. The lack of economies of scale, combined with high labour expenses and the inefficiencies of operating in a rented facility, contributes to the elevated cost.

Sri Vijaya Puram also incurs high processing costs of INR 4.8–5.7 per kg, largely influenced by its geographical isolation. The city's waste management relies on 18 Dry Resource Centers (DRCs) with a combined capacity of 24.2 TPD, most of which are small-scale operations with limited sorting efficiency.

4.4 RDF TRANSPORTATION COST

The cost of transporting RDF across cities exhibits significant variability, shaped by factors such as logistical infrastructure, distances to co-processing facilities, waste volumes, and geographical conditions.

In Indore, RDF transportation costs range from INR 0.5–1.1 per kg, reflecting the city's efficient logistical network and proximity to co-processing plants. Indore's robust public-private partnership

(PPP) with NEPRA facilitates streamlined waste handling and transport. Additionally, the high volume of waste generated ensures economies of scale, reducing per-unit costs. These efficiencies underscore the benefits of a centralized and well-integrated waste management system.

Similarly, Pune incurs RDF transportation costs of INR 0.7–1.3 per kg, aligning closely with Indore. Pune's decentralized waste management framework includes multiple MRFs strategically located across the city, which minimizes transport distances. Agreements with co-processing plants further enhance logistical efficiency.

In Goa, RDF transportation costs are higher, ranging from INR 2.5–3.1 per kg. The state's reliance on two centralized SWMFs in Saligao and South Goa necessitates transporting RDF over greater distances to co-processing facilities. Seasonal variations in waste generation, driven by tourism, and the dispersed geographic nature of waste sources increase logistical complexity. While the GWMC subsidizes a portion of these costs under unique financial agreements, the state's inherent logistical challenges keep RDF transportation expenses elevated.

Dharamshala, with its decentralized waste management model and limited scale of operations, faces RDF transportation costs of INR 3.5–4.5 per kg. The city's remote location in the mountainous Kangra district of Himachal Pradesh and the significant distance to Ultratech Cement's co-processing plant in Baga, Bilaspur, are primary contributors to the higher costs. Additionally, Dharamshala's small waste volumes limit the potential for economies of scale. The challenging terrain and less developed transport infrastructure further exacerbate costs, reflecting the financial burden of managing waste in hilly and remote regions.

Sri Vijaya Puram, isolated in the Andaman and Nicobar Islands, has the highest RDF transportation costs, estimated at INR 11.4–13.8 per kg. The island's geographical separation from the mainland necessitates the shipment of non-recyclable waste to co-processing facilities, significantly increasing transportation expenses. While non-recyclable waste should ideally be sent to mainland co-processing plants for proper disposal, the prohibitive costs render this approach infeasible. For calculation purposes, the cost of transporting non-recyclable waste is assumed to be the same as that of recyclable waste. Sri Vijaya Puram's logistical constraints, including reliance on sea transport, limited waste volumes, and the high cost of freight, make RDF transportation economically challenging. Consequently, non-recyclable waste is disposed of locally, which poses environmental concerns, and the cost related to the environmental damage will be much higher than this.

Table 8: Comparative cost analysis of dry waste management in case study cities

	Pune	Indore	Goa			Dharamshala	Sri Vijaya Puram
			1st Model	2nd	3rd		
Primary collection (₹)	2.3 to 3.1	1.2 to 1.9	2.1 to 3.8	4.3 to 6.1	6.1 to 8.2	7.0 to 9.0	9.8 to 11.6
Secondary collection (₹)	1.1 to 2.3	1.8 to 2.6	NA	NA	NA	NA	NA
MRF (₹)	1.7 to 2.2	1.6 to 2.4	2.9 to 3.7	2.9 to 3.7	NA	7.0 to 8.0	4.8 to 5.7
RDF transportation cost (₹)	0.7 to 1.3	0.5 to 1.1	2.5 to 3.1	2.5 to 3.1	2.5 to 3.1	3.5 to 4.5	11.4 to 13.8
Overall cost (₹)	5.8 to 8.9	5.1 to 8	7.5 to 10.6	9.7 to 12.9	8.6 to 11.3	17.5 to 21.5	26 to 31.1

All cost is depicted in INR per kg

4.5 COMPARATIVE ANALYSIS OF EPR CREDIT RATES AND WASTE MANAGEMENT COSTS

EPR for plastic waste management is built on the 'polluter pays' principle, intending to make producers, importers, and brand owners (PIBOs) accountable for the post-consumer management of plastic packaging waste. In this section, we build upon the preceding cost analysis to evaluate whether the current EPR credit rates are sufficient to cover the actual costs incurred by municipalities in managing plastic packaging waste.

Drawing from the detailed methodology outlined earlier, the overall dry waste management costs have been systematically adjusted to isolate the specific costs attributable to plastic packaging waste in each case study city. These isolated costs are then compared against both the CPCB-recommended EPR credit rates and prevailing market rates observed through CSE research, providing an empirical basis to assess cost recovery and financial sufficiency.

4.5.1 CURRENT EPR CREDIT RATES

The compliance cost for PIBOs (Producers, Importers, and Brand Owners) under the EPR framework comprises two key components:

1. **Portal compliance costs:**
   Activities such as registration, invoicing, and reporting are either managed internally or through Producer Responsibility Organizations (PROs). These costs typically range between INR 0.5–1 per kg of plastic placed on the market.

2. **EPR certificates for compliance:**
   PIBOs purchase certificates from plastic waste processors (PWPs) as proof of compliance. The cost of these certificates is based on the environmental compensation and varies based on the category of plastic:
   Category I (rigid plastics): INR 0.87–2.9 per kg
   Category II (flexible plastics): INR 1.5–5.00 per kg
   Category III (multilayered plastics or MLP): INR 2.37–7.9 per kg

However, the cost of EPR credits as per CSE research for different categories of plastics was significantly lower as shown below.[8]

Category I: INR 0.5–0.75 per kg
Category II: INR 0.75–1 per kg
Category III: INR 1–1.25 per kg

The Central Pollution Control Board (CPCB) initially did not play a role in determining EPR credit costs. As a result, there was a race to the bottom where the pricing lacked regulation and consistency. Recognizing the need for a more structured approach, the CPCB introduced a methodology in its amendment to the Plastic Waste

Management Rules, 2016 (amended on 14 March, 2024). Under Clause 8.9 of the amended rules, the CPCB established upper and lower price ceilings for EPR credits for different plastic categories. This methodology aimed to standardize EPR credit pricing and prevent undercutting.

According to the amendment:

- The highest price for EPR certificates is fixed at 100 per cent of the Environment Compensation leviable on obligated entities for non-fulfilment of EPR obligations.
- The lowest price is set at 30 per cent of the same Environment Compensation.

This regulatory intervention of environmental compensation is discussed in detail in subsequent sections of the chapter.

4.5.2 COMPARISON OF EPR RATES AND ACTUAL PLASTIC PACKAGING WASTE MANAGEMENT COSTS

This section presents a detailed comparison between the actual municipal costs of managing plastic packaging waste and the EPR credit rates notified by the Central Pollution Control Board (CPCB), alongside rates observed in voluntary EPR credit markets (as per CSE research). The aim is to evaluate whether EPR credits adequately reflect the on-ground economic burden of plastic packaging waste management.

The analysis is underpinned by a structured methodology designed to isolate plastic packaging waste management costs from overall dry waste management expenditures.

4.5.2.1 Methodology for isolating plastic packaging waste management costs

The estimation of actual category wise plastic packaging waste management costs across cities involved four systematic steps:

Step 1: Accounting for the added complexity of plastic waste

Plastic waste differs fundamentally from other dry waste streams like paper, glass, or metal—not only in its composition but also in its behaviour during collection and processing. Unlike heavier materials, plastics are lightweight and bulky, occupy more space in collection vehicles, and are often scattered or contaminated, making them more expensive to collect, transport, sort, and process per kilogram. To reflect this operational complexity, we applied a dynamic adjustment factor to the base dry waste management cost. The purpose of this factor is to translate the added logistical and material-handling difficulty of plastics into cost terms.

Instead of using a one-size-fits-all multiplier, we introduced a formula-based adjustment that varies with the plastic composition of each city's dry waste:

$$\mathrm{AF} = 1 + \left(k \times \left(1 - \frac{\text{Percentage Plastic in Dry Waste}}{100}\right)\right)$$

Where:
AF is adjustment factor
k is sensitivity constant set as 0.5, based on operational field insights and expert consultations.

This formula is designed to strike a balance between operational complexity and cost proportionality. It reflects two key principles:

This formula captures an inverse relationship between plastic prevalence and unit handling cost. When plastic makes up a smaller share of the dry waste, the system incurs a higher cost per kilogram of plastic managed. This is because the plastic is more scattered, requiring greater effort for identification, separation, and collection. Conversely, when plastics constitute a larger share of dry waste, the system gains efficiency, recovery is more streamlined, and marginal effort per kilogram decreases.

The adjustment factor dynamically reflects this operational logic. For example, in Sri Vijaya Puram, where plastics account for only 22 per cent of the dry waste stream, the adjustment factor is 1.39, indicating high marginal cost. In contrast, Dharamshala, with

RATIONALE BEHIND APPLYING A SENSITIVITY CONSTANT OF 0.5 TO PLASTIC WASTE

Plastic waste isn't just another dry waste stream it's fundamentally different in the way it behaves, and in how much effort it takes to collect, sort, and manage. That's why, in this study, we've applied a sensitivity constant of 0.5 to the base dry waste management cost to better reflect the actual burden of plastic.

The number is based on what happens on the ground, observations from collection teams, waste managers, and facility operators across cities. Here's why plastics require more effort and cost to handle than materials like paper, glass, or metal:

- **Takes more space, but weighs less**
  A kilogram of plastic occupies significantly more space than a kilogram of metal or glass. As a result, collection vehicles reach capacity more quickly while transporting far less weight, leading to increased trips, greater fuel consumption, and higher transportation costs.
- **Takes longer to collect**
  Because plastic is light and often scattered or trapped in odd places, collecting one kilogram of plastic takes longer than other recyclables. This drives up labour time and operational costs per kilogram.
- **Harder to sort and clean**
  Plastic often comes mixed with food waste or other contaminants such as chip packets or yogurt containers. Sorting and cleaning this waste at MRFs requires more manual effort and time, especially for flexible and multilayered plastics.
- **Comes in too many forms**
  Rigid, flexible, multilayered, and countless resin types, plastic is diverse and unpredictable. This adds to the complexity of sorting and reduces the efficiency of processing.
- **Low resale value**
  Many plastics, particularly multilayered types, have little or no resale value. This means municipalities bear the full cost of collection and disposal, with almost no cost recovery.
- **More prone to scattering and re-littering**
  Being lightweight, plastic waste is easily blown away during storage or transport, which often leads to re-collection or extra street sweeping efforts.

45 per cent plastic in dry waste, has an adjustment factor of 1.27, reflecting the reduced per-unit effort needed in a system already optimized for plastic-heavy loads.

Second, the formula helps avoid double-counting. The base dry waste management cost already reflects the average cost of managing a mixed stream of materials. The adjustment factor accounts only for the incremental burden imposed specifically by plastics. It scales down where plastic costs are already implicitly covered (high plastic content) and scales up where their complexity is underrepresented (low plastic content).

Step 2: Estimating the plastic waste share

Using waste composition studies from each city, we then identified the approximate proportion of plastics within the dry waste stream. For example, in Indore, plastic constitutes about 27 per cent of the dry waste collected. This percentage was applied to the adjusted dry waste management cost from Step 1 to estimate the indicative cost of managing plastic waste specifically. While this does not account for the exact cost of each material, it provides a proportional allocation that reflects the volume of plastics being handled.

Step 3: Isolating plastic packaging waste

Not all plastic waste is packaging. Items such as containers, buckets, and footwear also fall under plastic waste but are not considered packaging for the purposes of EPR obligations. Based on national estimates, approximately 46 per cent of all plastic waste in urban areas is attributable to packaging materials such as wrappers, pouches, bottles, and plastic bags.[9] We used this proportion to further refine the cost estimate from Step 2, arriving at the estimated cost of managing plastic packaging waste in each city.

Step 4: Disaggregating packaging waste by type

While Step 1 applied a dynamic adjustment factor to account for the higher cost of managing plastic waste compared to other dry waste streams, it is also important to differentiate between the types of plastic packaging, as each category imposes a different operational and financial burden on the waste management system.

To refine the cost estimates further, the total plastic packaging waste management cost was disaggregated across three categories of plastic packaging, in line with CPCB's, 'Revised Guidelines for Assessment of Environment Compensation.' These guidelines define category-specific EC factor ratios, which reflect the relative difficulty, cost, and environmental damage associated with managing each type of plastic packaging waste.

The cost distribution is applied as follows:
- Category I – Rigid plastics: Multiplied by 0.2
- Category II – Flexible plastics: Multiplied by 1.25
- Category III – Multilayered plastics (MLP): Multiplied by 2.7

These ratios are based on CPCB's methodology, which considers three key aspects:
- **Generation factor ratio**: Reflects the proportion of each plastic type in the total waste stream.
- **Availability factor ratio at disposal site**: Indicates the proportion of each waste type that successfully reaches the disposal or processing facility.
- **Collection factor ratio**: Captures the ease or difficulty of collecting each type of plastic waste from the source.

These multipliers serve a dual purpose—they not only estimate the operational costs but also proxy the potential environmental harm caused by the improper disposal or leakage of different plastic types into ecosystems. Multilayered plastics, due to their low recovery, poor recyclability, and mixed composition, carry the highest multiplier. Rigid plastics, on the other hand, are easier to collect and recycle, hence assigned the lowest.

This final step enables a more granular, category-specific estimation of plastic packaging waste management costs, offering a realistic basis for comparing these costs with the respective EPR credit rates across different plastic types.

Addressing the outlier: Dharamshala

Dharamshala presented a methodological anomaly owing to its high plastic content within the dry waste stream, estimated at 45 per cent. When subjected to the dynamic adjustment factor designed to reflect the added operational complexity of managing plastics and subsequently disaggregated using category-wise EC multipliers, the resultant plastic packaging waste management cost exceeded the city's total dry waste management cost per kilogram. This outcome, while technically plausible under conditions of high plastic density and category-specific environmental impact, risked distorting comparative analyses across cities.

The EC multipliers as prescribed under CPCB's guidelines are intended not only to differentiate operational handling costs across rigid, flexible, and multilayered plastic categories, but also to internalize the environmental externalities associated with their mismanagement. Consequently, in contexts where plastic packaging dominates the dry waste stream, the compounded effect of operational adjustments and environmental risk attribution may yield disproportionately high cost estimates.

To maintain methodological consistency and comparability across cities, and to avoid overestimation in cost apportionment, this study adopts an upper cap of 60 per cent of the total dry waste management cost for the estimation of plastic packaging waste management costs in Dharamshala. This cap is empirically grounded, based on observations from other case study cities, where the share of plastic packaging waste costs is around 60 per cent of the total dry waste management cost for similar cities.

4.5.2.2 Cost coverage of value chain by EPR credits

In this section, the actual costs incurred by municipalities in managing plastic packaging waste are compared against the CPCB-recommended EPR credit rates for different categories of plastic

Table 9: Consolidated plastic packaging waste management cost

City	Dry waste management cost (C1)	Adjustment factor (C2)	% plastic in dry waste (C3)	% Plastic packaging (C5)	Plastic packaging category I cost (C6 = C4 * C5 * 0.2)	Plastic packaging category II cost (C7 = C4 * C5 * 1.25)	Plastic packaging category III cost (C8 = C4 * C5 * 2.7)
Indore	5.1–8.0	1.36	27%	46%	0.17–0.27	1.09–1.70	2.35–3.67
Pune	5.8–8.9	1.35	29%	46%	0.21–0.32	1.31–2.01	2.71–4.34
Goa (1st Model)	7.5–10.6	1.38	24%	46%	0.23–0.32	1.44–2.03	3.10–4.38
Goa (2nd Model)	9.7–12.9	1.38	24%	46%	0.30–0.39	1.85–2.46	4.00–5.32
Goa (3rd Model)	8.6–11.3	1.38	24%	46%	0.26–0.34	1.65–2.15	3.56–4.65
Sri Vijaya Puram	26.0–31.1	1.39	22%	46%	0.73–0.88	4.57–5.48	9.87–11.83
Dharamshala (Adjusted)	17.5–21.5	1.27	45%	46%	0.55–0.67	3.45–4.23	7.45–9.15

packaging. The percentage cost recovery is calculated using the following formula

$$\text{Percentage Cost Recovery}\left(\%\right) = \left(\frac{\text{EPR Credit Rates}}{\text{Actual Cost}}\right) \times 100$$

The comparison highlights significant disparities in cost recovery across cities and plastic categories. For Category I (rigid plastics), the analysis reveals that municipalities in cities like Indore, Pune, and Goa could recover well beyond their actual costs. For example, in Indore, the actual cost of managing rigid plastic packaging waste ranges between INR 0.17–0.27 per kg, while the corresponding EPR credits could result in a recovery of 512 per cent to as high as 1,074 per cent. Similar trends are observed in Pune and Goa, where recoveries could reach up to 906 per cent, indicating considerable financial surplus. Even in high-cost regions like Dharamshala and Sri Vijaya Puram, Category I plastics could still achieve recoveries ranging from 158–433 per cent and 119–330 per cent, respectively, demonstrating the relative sufficiency of the current EPR credits for rigid plastic waste.

For Category II (flexible plastics) and Category III (multilayered plastics), the projected cost recovery becomes much more variable. While cities like Indore and Pune could see recoveries of up to 294 per cent and 249 per cent, cities with more complex logistics or higher operational costs fare less favourably. In Dharamshala, for example, Category III plastics may only see recoveries between 32 per cent and 86 per cent, while Sri Vijaya Puram may recover just 24 per cent to 67 per cent of actual costs. These gaps suggest that even with the proposed rates, municipalities in certain geographies would continue to face under-recovery of costs, when dealing with flexible and multilayered plastics, that are harder to collect, transport, and process.

The case of Goa, with its three distinct operational models, highlights how differences in local systems can shape financial outcomes. Model 1 and Model 3, which benefit from lower processing costs, could achieve recoveries of up to 853 per cent for Category I plastics. In contrast, Model 2, which operates under higher cost conditions, would see much lower recovery particularly for Category III plastics, where projected cost coverage falls to between 59 per cent and 148 per cent. This underlines how even within the same state, cost efficiency and operational design significantly influence the extent to which EPR credits could support actual municipal expenses.

The findings clearly suggest that while CPCB's standardized EPR credit rates provide a financial buffer for urban municipalities, they fail to fully address the elevated costs associated with managing flexible and multilayered plastics, particularly in cities with logistical, geographical, or infrastructural challenges. The disproportionate compensation across plastic categories further underscores the need to recalibrate EPR rates, ensuring that financial support aligns more closely with the actual waste management costs of each plastic stream. Without such adjustments, municipalities will continue to face funding shortfalls for difficult-to-recycle plastics, ultimately undermining the effectiveness of EPR in addressing plastic packaging waste management.

Table 10: Cost covered by CPCB recommended EPR credit rates vs the cost of plastic packaging waste in different cities

City	Category	Actual cost (₹/kg)	CPCB EPR credit rate (₹/kg)	% Cost recovery (range)
Indore	Cat I	0.17–0.27	0.87–2.9	512%–1074%
	Cat II	1.09–1.70	1.5–5	138%–294%
	Cat III	2.35–3.67	2.37–7.9	101%–215%
Pune	Cat I	0.21–0.32	0.87–2.9	414%–906%
	Cat II	1.31–2.01	1.5–5	115%–249%
	Cat III	2.71–4.34	2.37–7.9	87% – 182%
Goa (Model 1)	Cat I	0.23–0.32	0.87–2.9	378%–906%
	Cat II	1.44–2.03	1.5–5	104%–246%
	Cat III	3.10–4.38	2.37–7.9	76%–180%
Goa (Model 2)	Cat I	0.30–0.39	0.87–2.9	290%–744%
	Cat II	1.85–2.46	1.5–5	81%–203%
	Cat III	4.00–5.32	2.37–7.9	59%–148%
Goa (Model 3)	Cat I	0.26–0.34	0.87–2.9	335%–853%
	Cat II	1.65–2.15	1.5–5	91%–233%
	Cat III	3.56–4.65	2.37–7.9	67%–170%
Sri Vijaya Puram	Cat I	0.73–0.88	0.87–2.9	119%–330%
	Cat II	4.57–5.48	1.5–5	33%–91%
	Cat III	9.87–11.83	2.37–7.9	24%–67%
Dharamshala	Cat I	0.55–0.67	0.87–2.9	158%–433%
	Cat II	3.45–4.23	1.5–5	43%–118%
	Cat III	7.45 – 9.15	2.37–7.9	32%–86%

4.5.2.3 Cost coverage of value chain components by EPR credits as per CSE research

A comparison between the actual costs of managing plastic packaging waste and the market-traded EPR credit rates, as estimated in CSE research, highlights a consistent and often significant shortfall in cost recovery. For Category I plastics, cities such as Indore, Pune, and Goa may achieve recovery between 167 per cent and 294 per cent of their costs, offering some degree of financial relief. However, this margin narrows significantly in high-cost or geographically isolated locations such as Dharamshala and Sri Vijaya Puram, where recoveries fall between 91–112 per cent and 68–85 per cent, respectively.

The situation is more concerning for Categories II and III plastics. For flexible plastics (Category II), cost recovery across most cities remains notably low, generally well below full cost coverage. Indore records recoveries between 59–69 per cent, while Pune ranges from 50–57 per cent. In high-cost areas, the gap is more pronounced—Dharamshala shows recovery between 22–24 per cent, and Sri Vijaya Puram achieves only 16–18. These levels reflect the growing financial strain municipalities face in handling lightweight, low-value plastic packaging materials that often require extensive processing.

Multilayered plastics (Category III), known for their complex composition and challenging end-of-life treatment, consistently exhibit the lowest cost recovery rates across all cities. In Indore, the projected recovery lies between 34–43 per cent, while Pune falls between 29–37 per cent. Goa's recovery for Category III varies between 23–29 per cent, depending on the operational model. The challenge intensifies in Dharamshala, where recovery remains between 13–14 per cent, and in Sri Vijaya Puram, where only 10–11 per cent of the actual costs are recoverable under current market-linked EPR credit rates.

These findings underscore the limitations of the unregulated, market-driven pricing mechanism that existed prior to CPCB's regulatory intervention. The consistently inadequate cost recovery, particularly for Category I and Category III plastic and in cities with higher logistical burdens, highlights the critical need for standardized floor rates to ensure municipalities are sufficiently compensated for the actual costs incurred in managing plastic packaging waste. Without such regulatory oversight, the financial burden remains disproportionately high on local bodies,

Table 11: Cost covered by prevailing EPR credit rates vs the cost of plastic packaging waste in different cities

City	Category	Actual cost (₹/kg)	Market EPR credit rate (₹/kg)	% Cost recovery (range)
Indore	Cat I	0.17–0.27	0.5–0.75	294% – 278%
	Cat II	1.09 –1.70	0.75–1.0	69% – 59%
	Cat III	2.35–3.67	1.0–1.25	43% – 34%
Pune	Cat I	0.21–0.32	0.5–0.75	238% – 234%
	Cat II	1.31–2.01	0.75–1.0	57% – 50%
	Cat III	2.71–4.34	1.0–1.25	37% – 29%
Goa (Model 1)	Cat I	0.23–0.32	0.5–0.75	217% – 234%
	Cat II	1.44–2.03	0.75–1.0	52% – 49%
	Cat III	3.10–4.38	1.0–1.25	32% – 29%
Goa (Model 2)	Cat I	0.30–0.39	0.5–0.75	167% – 192%
	Cat II	1.85–2.46	0.75–1.0	41% – 41%
	Cat III	4.00–5.32	1.0–1.25	25% – 23%
Goa (Model 3)	Cat I	0.26–0.34	0.5–0.75	192% – 221%
	Cat II	1.65–2.15	0.75–1.0	45% – 47%
	Cat III	3.56–4.65	1.0–1.25	28% – 27%
Sri Vijaya Puram	Cat I	0.73–0.88	0.5–0.75	68% – 85%
	Cat II	4.57–5.48	0.75–1.0	16%–18%
	Cat III	9.87–11.83	1.0–1.25	10%–11%
Dharamshala	Cat I	0.55–0.67	0.5–0.75	91%–112%
	Cat II	3.45–4.23	0.75–1.0	22%–24%
	Cat III	7.45–9.15	1.0–1.25	13%–14%

jeopardizing the sustainability and efficiency of plastic packaging waste management systems.

4.5.2.4 Critical comparative assessment of cost recovery: CPCB-recommended rates vs market-traded EPR credit rates

A comparative evaluation of the CPCB-recommended EPR credit rates and unregulated, market-based pricing model reveals measurable improvements in cost recovery across several plastic waste streams. However, it also underscores fundamental shortcomings particularly for Category III plastics (MLPs) that persist even within the regulated framework. The data makes it increasingly clear that while CPCB's intervention brings a welcome structure and rationality to EPR pricing, uniform credit bands do not reflect the full diversity of municipal realities or waste complexity.

For Category I plastics (rigid packaging), the CPCB-prescribed rates offer a strong degree of cost coverage. In cities with well-functioning waste systems such as Indore, Pune, and Goa, projected recoveries range from 290–1,074 per cent, far exceeding the actual cost of managing rigid plastic packaging waste. This level of coverage, while positive, also suggests the possibility of overcompensation in certain cases.

The picture is somewhat mixed for Category II plastics (flexible packaging). In Indore, Pune, and Goa, cost recovery remains adequate under the proposed rates, ranging between 81–294 per cent, indicating that CPCB's benchmarks are generally sufficient in these urban contexts. However, in Dharamshala and Sri Vijaya Puram, which contend with higher logistics costs, limited infrastructure, and smaller waste volumes, the rates are less effective. Recovery in these cities drops to 43–118 per cent and 33–91 per cent, respectively. This contrast highlights a key structural issue: a uniform credit framework cannot account for the varied cost structures that exist across urban India, especially when it comes to medium and small municipalities or those located in challenging terrains.

The most significant concern, however, remains with Category III plastics (multilayered packaging). These materials, often composed of complex laminates and low-value polymers, are not only difficult to recycle but also expensive to manage due to the lack of local processing options. Under CPCB's proposed rate structure, even the more efficient cities like Indore and Pune achieve only 101–215 per cent and 87–182 per cent recovery, respectively. In high-cost environments such as Dharamshala and Sri Vijaya Puram, cost recovery drops substantially, with CPCB rates covering just 32–86 per cent and 24–67 per cent of actual costs. When assessed against historical market rates, these figures are even more concerning, with recovery for MLPs falling as low as 13–14 per cent and 10–11 per cent in the same cities. Such levels of under-recovery are clearly insufficient to support sustainable waste operations.

Even within a single state, the difference in financial feasibility can be substantial. In Goa, the three operational models show varying degrees of efficiency and cost recovery. Models 1 and 3 achieve relatively high recovery rates for Category I plastics, exceeding 800 per cent, while Model 2 characterized by higher processing and transportation costs records much lower recovery, particularly for multilayered plastics, where cost coverage ranges between 59–148 per cent.

The core of this challenge lies in the material and logistical complexity of Category III plastics. These waste streams typically require long-distance transport to specialized co-processing or incineration facilities, incurring costs that are significantly higher than those for rigid or flexible plastics. For smaller or geographically isolated cities, this cost burden becomes disproportionately high, rendering the existing EPR rates inadequate.

Another critical issue relates to the enforceability of CPCB's pricing structure. While the introduction of price bands is a step toward transparency and stability, there is currently no formal mechanism in place to ensure compliance. In the absence of a robust monitoring system, it remains uncertain whether actual credit transactions are occurring within the prescribed rates, particularly for low-value waste streams like multilayered plastics. These risks perpetuating the under-compensation that defined the earlier, market-driven regime.

While the CPCB-recommended EPR rates offer a clear improvement over historical practices, particularly for Category I and to some extent Category II plastics, they do not fully reflect the operational realities of managing complex and geographically dispersed waste streams. There is a compelling case for further refinement of the credit structure through differentiated pricing for difficult-to-manage plastics, regional adjustments to account for cost variability, and stronger enforcement mechanisms. Without these reforms, the financial viability of plastic packaging waste management especially for Category III materials will remain uncertain, ultimately limiting the effectiveness of India's EPR framework.

4.6 ANALYSIS OF THE CPCB ENVIRONMENTAL COMPENSATION METHODOLOGY

The methodology proposed by the CPCB for calculating Environmental Compensation (EC) as part of plastic waste management and EPR compliance represents a significant policy initiative aimed at addressing the pressing issue of plastic waste in India. However, several methodological and practical shortcomings in the framework need to be addressed to enhance its scientific rigor and effectiveness. A critical flaw lies in the CPCB's determination of the cost incurred in managing plastic waste, which has been pegged at INR 4,000 per ton. The cost for collection and transportation, set at INR 2,000 per tonne, does not adequately account for regional and logistical variances. For instance, data from case studies demonstrate that even advanced urban areas with robust waste management systems incur significantly higher costs due to factors such as rising fuel prices, wage inflation, and logistical inefficiencies. This underestimation is even more pronounced in regions with unique geographic challenges, such as Dharamshala's hilly terrain and Sri Vijaya Puram's Island logistics, where the collection and transportation costs exceed the reported average by a significant margin.

Similarly, the allocation of INR 150 per tonne for setting up MRFs reflects a methodological oversimplification that undermines the accuracy of the estimate. The CPCB calculation is based on a linear division of INR 7 crores for a 100 TPD facility over 15 years, translating to INR 7 lakhs per TPD annually. However as per CSE research this cost is highly understated, with Swachh Bharat Mission (SBM) placing the cost at INR 8.5 crore for a 100 TPD facility. Moreover, it fails to consider the non-linear scaling of costs, as smaller facilities experience higher per-ton capital expenditures due to diseconomies of scale. Additionally, Operational and Maintenance (O&M) costs, which are integral to lifecycle cost analysis, have been excluded entirely from the calculations. These include expenses related to labour, energy consumption, equipment maintenance, and consumables key contributors to the sustainability of MRF operations.

The methodology also integrates the cost of setting up RDF facilities and their operational expenses but omits the costs associated with recycling plants. Recycling, being a critical option alongside RDF, incurs substantial costs for setup, O&M, and transportation. This selective inclusion creates an incomplete and biased representation of overall processing costs. A scientifically balanced methodology should either include both recycling and RDF or exclude them entirely to ensure equity and accuracy in cost assessments.

The framework's approach to cost-sharing between Urban Local Bodies (ULBs) and Producers, Importers, and Brand Owners (PIBOs) also requires re-evaluation. Tier-2 and Tier-3 cities, where ULBs face significant financial and infrastructural constraints, are disproportionately burdened compared to PIBOs, which generally have greater financial capacity. The uniform 50:50 cost-sharing model fails to reflect these disparities. Additionally, the application of a 2.5x deterrent multiplier to calculate EC is conceptually sound but does not adequately account for the financial limitations of ULBs, potentially exacerbating implementation challenges.

The introduction of price ranges for EPR credits, setting a floor at 30 per cent and a ceiling at 100 per cent of EC, represents a progressive step. However, the minimum price is unrealistically low. For instance, the minimum price of INR 2370 per tonne for Category III plastics is insufficient to incentivize effective compliance or cover actual costs, as evidenced by regional case studies. This inadequacy risks undermining the effectiveness of the EPR credit trading mechanism.

Further inconsistencies emerge in the calculation of EC for collection, transportation, and processing. While the deterrent cost is based on INR 2,000 per tonne for collection and transportation, the EC for processing is calculated at INR 2,500 per tonne. Yet, in the final computation, INR 2,500 is inexplicably added to the collection and transportation costs, creating ambiguity and a lack of transparency. This inconsistency diminishes stakeholder trust and poses risks of misinterpretation during implementation.

5

IMPLICATIONS OF INADEQUATE EPR CREDITS

With credits limited to plastic waste processors, urban local bodies (ULBs) that bear actual waste management costs are excluded from financial flows. This forces diversion of scarce municipal funds from critical sectors like health and infrastructure to subsidize plastic waste services.

Open dumping in cities like Sri Vijaya Puram fuels ecosystem damage and health risks. Without targeted support, marine pollution, biodiversity loss, and microplastic spread continue to worsen.

The current framework lacks incentives for eco-design, sustainable alternatives, and informal sector integration. Ignoring regional and social disparities weakens trust and limits transformational impact.

Extended Producer Responsibility (EPR) serves as a cornerstone of global efforts to address the escalating plastic waste crisis. Anchored in the 'polluter pays' principle, EPR mandates that Producers, Importers, and Brand Owners (PIBOs) bear the financial and operational responsibility for managing post-consumer plastic packaging waste. This policy mechanism is designed to foster a shift towards sustainable production, efficient waste management systems, and reduced environmental footprints. Globally, EPR has proven to be a transformative mechanism for fostering sustainable production, enhancing waste management systems, and reducing environmental footprints.

However, in India, the implementation of EPR has fallen short of its transformative potential. The inadequacy of EPR credit rates significantly below the actual costs of managing plastic waste has triggered cascading repercussions across financial, environmental, social, and systemic dimensions. Furthermore, while EPR credits in India could be pivotal for funding waste management operations, the current framework restricts credit generation exclusively to plastic waste processors. The absence of provisions or mechanisms allowing municipalities and other stakeholders to access credits has led to significant gaps in the financial and operational value chain. Consequently, municipalities, informal waste workers, and other critical stakeholders are unable to derive any tangible benefits, limiting the transformative potential of EPR.

5.1 FINANCIAL IMPLICATIONS

5.1.1 INCREASED FINANCIAL BURDEN ON MUNICIPALITIES

Municipalities play a pivotal role in plastic waste management, overseeing tasks such as waste collection, segregation, and transportation. Despite incurring substantial costs, they are currently excluded from directly benefiting from EPR credits due to the absence of a formal mechanism for sharing credits between stakeholders. For instance:

- Pune, incurs a cost of INR 2.71–4.34 per kg for managing cat III plastic packaging waste, while the EPR credit for cat III hovers at a mere INR 1-1.25 per kilogram.
- Sri Vijaya Puram, due to its remote geography, incurs a costs for RDF transportation at INR 11.4–13.8 per kilogram astronomically higher than available credit provisions.

Without access to EPR funds, municipalities are forced to divert limited resources from essential services such as healthcare, education, and infrastructure. Smaller towns and rural regions face compounded challenges, as their fiscal reserves are already stretched thin.

5.1.2 OVERRELIANCE ON GOVERNMENT SUBSIDIES AND EXTERNAL FUNDING

In the absence of adequate EPR support, municipalities depend heavily on subsidies from state and central governments. While grants and loans provide temporary relief, they do not address systemic inefficiencies or encourage innovation. External funding from international organizations or developmental agencies is similarly limited and often tied to conditions that may not align with local priorities.

The unpredictability of such funding mechanisms deters long-term investments in sustainable infrastructure, such as advanced processing plants, advanced MRFs, and modernized recycling technologies. Municipalities are left vulnerable to fluctuating budgets, resulting in inconsistent waste management services.

5.1.3 ECONOMIC STRAIN ON LOCAL BODIES

The current EPR framework disproportionately benefits plastic waste processors, leaving municipalities, waste pickers, and other stakeholders with limited financial incentives. This disparity disrupts the financial sustainability of the entire waste management system, reducing the effectiveness of the value chain.

5.2 ENVIRONMENTAL IMPLICATIONS

5.2.1 INEFFECTIVE WASTE MANAGEMENT AND ENVIRONMENTAL DEGRADATION

A significant portion of India's plastic waste remains uncollected or improperly managed due to funding constraints. This leads to:

- **Open dumping**: Inadequately managed waste ends up in informal dumpsites, causing soil, water contamination, and open burning of waste.
- **Landfill overload**: Overburdened landfills emit greenhouse gases such as methane and leach harmful chemicals into groundwater.

These outcomes not only contribute to climate change but also undermine ecosystem health. Cities such as Dharamshala and Sri Vijaya Puram, which struggle with geographic and logistical challenges, face amplified environmental risks, including the proliferation of microplastics.

5.2.2 MARINE POLLUTION AND BIODIVERSITY LOSS

Coastal areas like Goa and Sri Vijaya Puram are particularly vulnerable to marine plastic pollution. The high cost of transporting waste to mainland processing facilities often results in improper disposal practices. Plastic waste in oceans:

- Threatens marine biodiversity, with species suffering from ingestion, entanglement, and habitat disruption.
- Harms coral reefs by facilitating pathogen growth.

The environmental damage caused by inadequate waste management diminishes ecosystem services, affecting livelihoods dependent on fisheries and tourism.

5.3 SOCIAL AND HEALTH IMPLICATIONS

5.3.1 PUBLIC HEALTH RISKS

The open burning and improper disposal of plastic waste release toxic pollutants such as dioxins, furans, and heavy metals. These pose significant health risks to communities, particularly those living near waste dumps. Consequences include:

- Respiratory illnesses and cardiovascular diseases.
- Long-term exposure risks, including cancer and neurological disorders.

Residents of urban slums and peri-urban areas are disproportionately affected, as they often resort to self-managed waste disposal methods like open burning, exacerbating local pollution.

5.3.2 MARGINALIZATION OF INFORMAL WASTE WORKERS

The informal sector, which plays a significant role in India's recycling efforts, is excluded from EPR benefits. Waste pickers and aggregators operate under hazardous conditions without financial support, perpetuating socio-economic marginalization. The inadequacy of EPR credits leads to:

- **Depressed demand**: Low credit rates discourage investments in recycling, reducing the demand for collected plastic waste.
- **Hazardous working conditions**: Waste pickers lack safety equipment, social security, and access to healthcare, leaving them vulnerable to occupational hazards.

5.4 IMPACT ON CIRCULAR ECONOMY GOALS

5.4.1 DISRUPTION OF RECYCLING AND RESOURCE RECOVERY INITIATIVES

The financial shortfalls in EPR funding disrupt the development of recycling systems, particularly for challenging materials like Multilayer Plastics (MLPs). Instead of being recycled, MLPs are often incinerated or co-processed in cement kilns, a practice that prioritizes waste elimination over resource recovery. This undermines the principles of a circular economy, where the focus is on retaining material value within the economy through reuse and recycling.

5.4.2 REDUCED INCENTIVES FOR SUSTAINABLE PRODUCT DESIGN

The low cost of EPR compliance for producers fails to create sufficient pressure for adopting sustainable practices. As a result:

- Unsustainable packaging materials continue to dominate the market.
- Producers have little motivation to invest in eco-friendly designs or biodegradable alternatives.

This perpetuates a cycle of increased plastic waste generation, overwhelming already strained waste management systems.

5.5 GEOGRAPHIC INEQUITIES IN EPR IMPLEMENTATION

5.5.1 CHALLENGES IN REMOTE AND DIFFICULT TERRAINS

Municipalities in remote and challenging terrains, such as Dharamshala and Sri Vijaya Puram, face disproportionately higher costs for waste management due to factors like sparse populations, difficult terrain, and logistical complexities. However, EPR credit rates remain uniform across regions, failing to account for these variances.

5.5.2 EXACERBATION OF REGIONAL DISPARITIES

This one-size-fits-all approach deepens disparities between urban centres and remote areas. Cities like Indore and Pune, with efficient systems and economies of scale, can partially offset costs, while smaller or remote municipalities are left underserved.

5.6 BROADER SYSTEMIC IMPLICATIONS

5.6.1 EROSION OF PUBLIC TRUST

Visible failures in waste management systems, such as overflowing landfills and polluted water bodies, erode public confidence in both local governments and producers. This lack of trust hampers community participation in segregation and recycling initiatives.

5.6.2 MISSED OPPORTUNITIES FOR INNOVATION AND GLOBAL LEADERSHIP

Inadequate funding stifles innovation in waste management technologies and sustainable design. India, despite its significant contributions to global plastic production, risks missing the opportunity to emerge as a leader in circular economy practices.

6

KEY FINDINGS

Municipalities across India are spending up to INR 11.83/kg to manage Category III plastic waste (e.g., Sri Vijaya Puram), yet EPR trading rates average only INR 1.00–1.25/kg. Even efficient cities like Pune and Indore recover less than 50 per cent of actual costs.

Cities like Dharamshala (INR 9.15/kg) and Sri Vijaya Puram (INR 11.83/kg) face 3–5 times higher waste management costs than urban centers but receive identical EPR credit rates. The current geography-agnostic framework penalizes geographically challenging areas, creating systemic disincentives for investment and performance in such regions.

Transportation of Refuse-Derived Fuel (RDF) to cement plants is the single most expensive cost component in remote areas—reaching INR 13.8/kg in Sri Vijaya Puram. However, this cost is excluded from EPR and EC calculations, forcing ULBs to either absorb the financial burden or resort to landfilling non-recyclables, violating core environmental mandates.

This report set out to answer a seemingly simple question: *What does it actually cost to manage dry and plastic waste in India?* The answer turned out to be anything but simple and what we uncovered along the way reveals critical gaps in policy, finance, and data that demand urgent attention. Our research reveals not just numbers, but a deeper, systemic misalignment between mandates and means, ambition and accountability. Below are the key findings:

1. **ULBs are mandated to disclose waste data but most do not report costs**

   Under the 74th Constitutional Amendment Act, ULBs are responsible for planning and delivering waste management services. This includes the generation and dissemination of data relevant to public service delivery. However, while some performance metrics (e.g., collection coverage or processing rates) are published, financial data particularly cost of managing waste is almost entirely absent from the public domain.

   In most cases, the only route available to access this data is through the Right to Information (RTI) Act, indicating a serious transparency deficit. This gap violates the principles of fiscal and functional devolution and undermines efforts to institutionalize data-led decision-making.

2. **Reclassification of multilayered plastics in the 2024 Amendment—a backdoor for EPR dilution**

   The reclassification of Multilayered Plastics (MLP) in the March 2024 amendment to India's Plastic Waste Management Rules marks a significant shift in regulatory approach, with far-reaching implications for producer responsibility and environmental outcomes. Previously, under the PWM Rules 2016, MLP was defined as "any material used or to be used for packaging and having at least one layer of plastic as the main ingredient in combination with one or more layers of material such as paper, paperboard, polymeric materials, metalized layers or aluminium foil either in the form of laminate or co-extruded structure." This complex composition rendered MLPs largely non-recyclable, and they were accordingly classified under Category III, subjecting producers to stricter EPR obligations.

However, the March 2024 amendment redefined MLP as 'Multi-layered plastic (MLP),' means material used or to be used for packaging and having at least one layer of plastic. This allowed products like chips, biscuits, and sachets which often use metallized plastic layers to be reclassified under Category II (flexible plastic packaging). As a result, PIBOs are now able to fulfil their EPR obligations through less stringent and less costly means, such as co-processing in cement plants, rather than investing in genuine recycling or sustainable alternatives. This reclassification has caused a surge in Category II plastic volumes, as the market remains saturated with MLP, while recycling mandates for Category II stayed unchanged at 30 per cent. Consequently, PIBOs can meet targets without recycling MLP at all, avoiding systemic investments in collection, aggregation, and recycling infrastructure that would have been mandatory under Category III. The shift dilutes producer accountability, reduces the financial and operational burden on PIBOs, and transfers the responsibility and costs of managing non-recyclable MLP waste onto municipalities and the informal sector. Moreover, it undermines the polluter-pays principle and stifles innovation in sustainable packaging, ultimately resulting in continued environmental harm from the widespread incineration and improper disposal of low-value MLP waste.

3. **EPR credit rates are far below the actual cost of plastic waste management**
   A detailed cost assessment across diverse urban contexts reveals a persistent and structural mismatch between the notified EPR credit rates issued by the CPCB and the actual cost incurred by municipal systems in managing plastic packaging waste. This gap is neither incidental nor uniform it is systemic,

category-specific, and particularly acute in geographies with logistical and infrastructural challenges.

When disaggregated by category, the gap becomes even more pronounced, particularly in challenging geographies and for harder-to-recycle plastics:

Table 12: Category wise cost of management of plastic packaging waste in case study cities

City	Category I (₹/kg)	Category II (₹/kg)	Category III (₹/kg)
Indore	0.17–0.27	1.09–1.70	2.35–3.67
Pune	0.21–0.32	1.31–2.01	2.71–4.34
Goa – Model 1	0.23–0.32	1.44–2.03	3.10–4.38
Goa – Model 2	0.30–0.39	1.85–2.46	4.00–5.32
Goa – Model 3	0.26–0.34	1.65–2.15	3.56–4.65
Dharamshala	0.55–0.67	3.45–4.23	7.45–9.15
Sri Vijaya Puram	0.73–0.88	4.57–5.48	9.87–11.83

Now compare this with the CPCB-notified EPR credit rate bands:

- **Category I**: INR 0.87–2.90
- **Category II**: INR 1.50–5.00
- **Category III**: INR 2.37–7.90

Although the CPCB rates nominally intersect with municipal cost ranges, a closer analysis highlights three critical shortcomings in the current rate framework:

1. For cities with difficult logistics like Dharamshala and Sri Vijaya Puram, actual costs exceed the maximum limit of the CPCB prescribed credit rates for category III and are three to five times higher than the minimum CPCB rate. In Sri Vijaya Puram, the cost of managing Category III waste reaches ₹11.83/kg, while the CPCB cap is INR 7.90 per kg a shortfall of nearly INR 4 per kg, which the local authority must absorb.
2. Even in high-performance cities like Indore and Pune, managing Category III waste costs up to INR 3.67 per kg

and INR 4.34 per kg, which is well above the lower credit range and pushes against the upper bound. This suggests that even efficient systems are being under-compensated, particularly for multilayered and flexible plastics.
3. The CPCB rates offer no flexibility for location-specific cost realities, despite sharp geographic variation.

In short, the current EPR pricing framework is underpowered, geography-agnostic, and category-insensitive. It fails to reflect real-world cost structures, especially for low-density, remote, or hilly regions, and for low-value, high-handling packaging materials. Without urgent correction, the system risks reinforcing inequality, disincentivizing difficult geographies, and weakening municipal participation in plastic waste management.

4. **On-ground EPR trading rates are far below both notified rates and actual costs exposing a broken market.**
While the CPCB has notified reference EPR credit rates for different categories of plastic packaging, this study finds that actual trading rates in the market are significantly lower than both the notified rates and the real cost of plastic waste management. This disparity reveals a deep structural flaw in the current EPR credit trading ecosystem.

As per ground-level assessments:
- **Category I** credits are trading at INR 0.50–0.75/kg
- **Category II** at INR 0.75–1.00/kg
- **Category III** at INR 1.00–1.25/kg

These rates are substantially lower than CPCB's notified credit ranges:
- **Category I: INR 0.87–2.90**
- **Category II: INR 1.50– 5.00**
- **Category III: INR 2.37–7.90**

And they are drastically below the actual cost incurred by ULBs, especially for Category II and III plastics, which dominate the municipal plastic waste stream and are the most expensive to manage. For example:

- Dharamshala spends up to INR 9.15 per kg to manage Category III plastics, yet the actual market pays only INR 1.00–1.25 per kg just 13–14 per cent of the real cost.
- Sri Vijaya Puram bears a cost of INR 9.87–11.83/kg for Category III plastics, while current trading rates remain below INR 1.25/kg.
- Even efficient cities like Indore and Pune are losing nearly 50 per cent or more of the actual cost through current trading values.

This widening gap between market and reality has three serious implications:

i. The EPR market is functioning without regulatory price enforcement, making it susceptible to undercutting and negotiation that favours large producers over financially constrained municipalities.
ii. ULBs are being systematically underpaid, absorbing significant unfunded mandates that distort municipal budgets and demotivate performance improvements.
iii. The current EPR trading framework lacks transparency, standardization, and accountability, raising fundamental concerns about its ability to support circular economy objectives in a fair and scalable manner.

The findings point to a critical need for market correction mechanisms such as:

- Minimum floor rates for credit trading based on audited cost data;
- State or regional reference pricing to account for geographic cost differentials;
- Regulatory oversight to ensure that actual cost recovery not market bargaining defines the value of plastic recovery and processing.

Without such interventions, the EPR credit market risks becoming a race to the bottom, where the lowest bidder dictates the price and municipalities are left to bridge the gap through informal labour, inconsistent service delivery, or long-term debt on environmental performance.

5. **Uniform EPR rates perpetuate geographic and operational inequities**
   Current EPR policies apply a single rate across all geographies, without considering variation in terrain, waste generation volumes, logistical complexities, or infrastructure gaps. This approach leads to unintended and inefficient outcome:
   - Remote areas (e.g., Sri Vijaya Puram) face high collection and transportation costs due to geographical isolation.
   - Hilly towns (e.g., Dharamshala) incur additional labour and fuel costs due to dispersed settlements and difficult terrain.
   - Yet all these places receive the same EPR compensation as a well-networked metro like Indore.

   This approach effectively penalizes cities in challenging environments, disincentivizing improvements and widening the urban-regional divide in waste infrastructure and service delivery.

6. **The informal sector provides subsidized services but remains invisible in cost accounting**
   In cities like Pune, informal worker cooperatives like SWaCH have helped build low-cost, high-efficiency waste collection systems, especially for dry and plastic waste. These systems ensure source segregation, reduce contamination, and operate with minimal public subsidies.

   Yet, their financial contributions are not formally recognized in the EPR mechanism, nor are their operations included in most ULB budget calculations. This not only undervalues the role of informal workers but also represents a lost opportunity to integrate cost-effective systems into formal waste governance structures.

7

RECOMMENDATIONS

Institutionalizing the annual disclosure of waste management costs by ULBs via MoHUA directives and SBM-U's MIS platform will strengthen planning, enable inter-city comparisons, and reinforce accountability.

A uniform credit regime fails to capture India's diverse cost realities. Implementing a Weighted Adjustment Factor (WAF) tied to geographic and operational cost clusters and dynamically revising credit rates can ensure financial fairness and sustainability for ULBs operating in high-cost terrains.

To avoid concentration of EPR funds among processors, the system should reward all stakeholders, including informal workers, MRFs, and ULBs. A multi-stakeholder credit mechanism can promote equity and inclusive circular economy goals.

The inadequacy of EPR credits has profound implications for waste management in India, necessitating a transformative approach to align financial, operational, and policy mechanisms with ground realities.

7.1 MANDATING COST DISCLOSURE BY ULBS TO INSTITUTIONALIZE THE DATA-DRIVEN DECISION-MAKING

To strengthen evidence-based planning and financial accountability in MSW management, the Solid Waste Management (SWM) Rules and Urban Local Body (ULB) service-level guidelines should be amended to mandate the annual disclosure of cost data by all ULBs. The Ministry of Housing and Urban Affairs (MoHUA) should issue a directive requiring ULBs to incorporate solid waste management budget within their annual municipal budgets and performance reports.

Standardized cost reporting templates should be integrated into the Swachh Bharat Mission - Urban (SBM-U) Management Information System (MIS) platform to enable structured data submission and inter-city comparability.

Validation of cost submissions should be undertaken by State-Level Monitoring Committees (SLMCs), and a performance-linked enforcement mechanism comprising penalties for non-compliance and incentives for timely and accurate disclosures should be institutionalized.

7.2 REVERSE THE DILUTION OF MLP CLASSIFICATION IN PWM RULES

The 2024 amendment to the PWM Rules diluted the classification of multilayered plastics (MLPs), weakening regulatory control over materials with limited recyclability and high environmental impact. To restore accountability and promote environmentally sound end-of-life treatment, the pre-2024 classification of MLPs under Category III should be reinstated. This classification could discourage sole reliance on co-processing and instead promote material redesign and transition toward recyclable and compostable alternatives.

7.3 REVISING EPR CREDIT RATES

A key shortcoming of the current Extended Producer Responsibility (EPR) framework lies in the misalignment between credit rates and the actual costs of managing plastic waste across its lifecycle.

7.3.1 DYNAMIC GEOGRAPHIC AND COST-BASED ADJUSTMENTS

Plastic waste management costs in India vary widely across regions due to factors such as infrastructure, population density, and geographic conditions. A Weighted Adjustment Factor (WAF) applied to base EPR credit rates can account for these disparities, ensuring equitable distribution of financial responsibilities.

Framework for geographic adjustments

Cost cluster classification:

- Identify clusters based on geographic features (e.g., urban, rural, hilly, and coastal).
- Conduct periodic assessments to update cost differentials based on infrastructure, logistics, and local waste management conditions.

Adjustment mechanism:

Apply a weighted factor to the base EPR rates to reflect the actual costs incurred in different geographic clusters:

$$\text{Adjusted rate} = \text{Base rate} \times (1 + \text{WAF})$$

Example:

In Dharamshala (hilly terrain), if the base rate for MLP is INR 10 per kg and the WAF is 0.3 (30 per cent additional cost due to terrain challenges), the adjusted rate would be INR 13 per kg.

7.3.2 NATIONAL COST-BASED BENCHMARKING

To ensure that EPR credit rates are aligned with real-world waste management costs, a benchmarking system should be established.

- **Framework for benchmarking:**

- » Identify key components of the waste management value chain, including collection, processing, and RDF transportation.
- » Establish average cost benchmarks for each component in representative cities.
- » Update these benchmarks annually to reflect changes in operational costs.

7.4 LOCALIZED EPR FRAMEWORK

A localized framework ensures financial equity and operational feasibility for underserved regions.

7.4.1 REGIONAL CREDIT OBLIGATIONS

- **Mandatory obligations**: Producers must purchase EPR credits from Plastic Waste Processors (PWPs) in regions where their products are consumed.
- **Fallback mechanism**: If regional PWPs are unavailable, credits must be sourced from facilities processing waste from that region, verified via digital tagging systems.

7.4.2 DYNAMIC GEOGRAPHIC WEIGHTAGE

The share of local credit purchase obligations is determined using a weighted formula based on regional waste management costs, environmental vulnerability, and infrastructure availability.

Framework for implementation

- **Regional plastic waste assessments:** Conduct periodic studies to identify regions with high waste management costs and insufficient infrastructure.
- **Geographic weightage formula:** Develop a formula to determine the local EPR obligation percentage

$$\mathrm{LOP}\left(\%\right) = \left(\frac{\mathrm{AR} - \mathrm{NA}}{\mathrm{MR} - \mathrm{NA}}\right) \times 100$$

LPO- Localized plastic obligation
AR- Average regional cost
NA- National average cost
MR- Maximum regional cost
This formula is applicable only if average regional cost is greater than the national average

Example calculation:
Sri Vijaya Puram
AR= INR 12,000 per tonne
NA= INR 6,000 per tonne
MR= INR 15,000 per tonne

$$\text{LOP}\left(\%\right) = \left(\frac{12000 - 6000}{15000 - 6000}\right) \times 100 = 67\%$$

PIBOs will have to purchase 67 per cent of the EPR credits form PWPs of Sri Vijaya Puram.

Implementation framework for Local Obligation Percentage (LOP)

- **National database of regional costs:** A centralized authority (e.g., CPCB) maintains an updated database of regional waste management costs to calculate LOPs dynamically.
- **Dynamic credit allocation tool:** Producers input their plastic distribution data into a tool that automatically calculates their regional obligations based on the LOP.
-

7.5 EXPANDING EPR BENEFITS ACROSS THE VALUE CHAIN

The current EPR system in India disproportionately benefits plastic waste processors (PWPs), leaving other key stakeholders waste collectors, informal sector workers, material recovery facilities, and ULBs without adequate financial support. To ensure an equitable distribution of EPR funds, the framework should be redesigned to incentivize every segment of the waste management ecosystem.

➢ **Multi-stakeholder EPR credit allocation**

A restructured, tiered distribution framework should be adopted where EPR credits are shared among all operational stakeholders in proportion to their functional role, cost burden, and contribution to verified plastic packaging waste recovery.

- **Informal sector and collection systems**: A significant portion of EPR credits should support door-to-door collection systems and informal waste pickers. This is essential to recognize their role in high-volume, low-cost recovery—particularly in areas underserved by formal systems.
- **Recycling and processing units**: A substantial share should be allocated to MRFs, recyclers, and co-processors, which bear the financial and operational load of sorting, pre-processing, and final disposal or recovery.
- **Urban Local Bodies (ULBs)**: A dedicated portion should support municipal systems and decentralized infrastructure, enabling ULBs to recover costs related to collection, waste transportation, infrastructure maintenance, and public engagement.
- **Innovation and decentralized solutions**: A specific component of EPR credits should be earmarked for supporting R&D efforts in material innovation, circular economy models, traceability platforms, and small-scale decentralized processing technologies.

The exact allocation can be determined based on transparent parameters such as cost data, functional contribution, geographic disadvantage, and material category handled.

➢ **Decentralized fund disbursement:**

- Establish state-level EPR fund distribution mechanisms to ensure equitable financial flows.
- Funds should be released based on performance metrics such as collection rates, processing efficiencies, and environmental impact.

➢ **Incentivizing the informal sector:**

- **Digitized waste collector payments:** Develop a direct-payment mechanism for waste pickers linked to verified waste collection through traceable systems (e.g., digital platforms).
- **Microfinancing for waste collectors and entrepreneurs:** Provide low-interest loans for waste collectors and small recycling entrepreneurs to enhance processing capacity.

7.6 STRENGTHENING EPR COMPLIANCE AND ENFORCEMENT

Effective Extended Producer Responsibility (EPR) implementation hinges on robust compliance and enforcement mechanisms.

Enhancing monitoring and reporting

- **Real-time data integration:** Modernize the CPCB reporting portal to support automatic updates from municipal systems, recyclers, and waste processors.
- **Third-party verification system:**
    - Accredited third-party auditors must verify compliance through biannual audits.
    - Public disclosure of audit reports ensures transparency.

ANNEXURE

Stakeholders	Cost incured
Waste generator	**User fee**
Primary collection	**Labour cost (salaries and other benefits)**
	Equipment cost:
	Pushcarts, bins, and bags for collection
	Personal protective equipment (PPE) such as gloves, masks, and uniforms
	Transportation cost:
	Fuel, maintenance, and depreciation of vehicles used for collection
	Licensing and insurance for vehicles
	Health and safety cost:
	Health insurance and medical check-ups for waste pickers
	Safety equipment and accident insurance
Secondary collection entities (Municipal Corporation or private contractors	**Labour cost (salaries and other benefits)**
	Equipment cost:
	Collection vehicles (trucks, compactors)
	Vehicle maintenance and repair
	Fuel and lubricants
	Operational cost:
	Administrative costs
	Communication and IT systems for tracking and coordination
	Infrastructure cost:
	Costs for transfer stations, including land, construction, and maintenance
	Equipment at transfer stations (conveyors, compactors)
	Health and safety cost:
	Health insurance and medical check-ups for waste pickers
	Safety equipment and accident insurance

Processing and sorting facilities (MRF, DWCC)	**Labour cost (salaries of workers in sorting, processing, and maintainance)**
	Equipment cost:
	Sorting lines, conveyors, shredders, and balers
	Maintenance and repair of machinery
	Energy consumption (electricity, diesel for generators)
	Infrastructure cost:
	Land acquisition or rental costs.
	Construction and maintenance of facilities
	Operational cost:
	Administrative expenses.
	IT systems for managing operations and tracking materials
	Health and safety costs:
	PPE for workers
	Health insurance and medical check-ups
	Safety training and equipment
RDF transportation cost	

REFERENCES

1 Careen Abb, Nettie Abbot, Alejandra Acevedo-De-los-Ríos et al. 2024. *Global waste management outlook 2024 - Beyond an age of waste.* United Nations Environment Programme. Nairobi. Accessible at https://wedocs.unep.org/20.500.11822/44939

2 Laura Silver, Christine Huang and Laura Clancy 2023. *Key facts as India surpasses China as the world's most populous country.* Pew Research Center. Accessible at https://www.pewresearch.org/short-reads/2023/02/09/key-facts-as-india-surpasses-china-as-the-worlds-most-populous-country/

3 Anon 2022. *Economic Survey 2021-22.* Ministry of Finance Department of Economic Affairs Economic Division, Government of India. Accessible at https://www.indiabudget.gov.in/budget2022-23/economicsurvey/doc/echapter.pdf

4 Anon 2023. Annual Report 2022-23. Ministry of Housing and Urban Affairs, Government of India. Accessible at https://mohua.gov.in/upload/uploadfiles/files/2688HUA-ENGLISH-19-4-2023.pdf

5 Anon (n.d). Swachh Bharat Mission- Urban. Ministry of Housing and Urban Affairs, Government of India. Accessible at https://sbmurban.org/

6 Anon 2021. *Annual Report 2020-21 on implementation of Solid Waste Management Rules, 2016.* Central Pollution Control Board. Accessible at: //cpcb.nic.in/uploads/MSW/MSW_AnnualReport_2020-21.pdf

7 Wijnand DeWit, Erin Towers Burns, Jean-Charles Guinchard and Nour Ahmed 2021. *Plastics: The costs to society, the*

environment and the economy. World Wide Fund for Nature (WWF). Accessible at https://wwfint.awsassets.panda.org/downloads/wwf_pctsee_report_english.pdf

8 Siddharth Ghanshyam Singh, Aniket Chandra and Atin Biswas 2024. *Unpacking EPR for Plastic Packaging in India: Navigating Challenges and Unlocking Opportunities*, Centre for Science and Environment, New Delhi. Accessible at https://www.cseindia.org/unpacking-epr-for-plastic-packaging-in-india-12442

9 Shafeeq Ahmed Syed Ali, I.M.S.K. Ilankoon, Lian Zhang and Jully Tan 2024. *Packaging plastic waste from e-commerce sector: The Indian scenario and a multi-faceted cleaner production solution towards waste minimisation.* Journal of Cleaner Production. Accessible at https://www.sciencedirect.com/science/article/pii/S0959652624008928#:~:text=The%20packaging%20industry%20accounts%20for,Association%20of%20India%2C%202023

India stands at a pivotal juncture in its battle against plastic waste. *Policy, Practice, and Plastic: Cost of Managing Plastic Waste in Indian Cities* is a first-of-its-kind study that uncovers the true financial cost of plastic packaging waste management across diverse urban, coastal, and remote geographies. Based on fieldwork in five different cities, the report uncovers a significant disconnect between what cities actually spend and what they recover through current Extended Producer Responsibility (EPR) mechanisms.

With insightful case studies and policy analysis, the report makes a strong case for rethinking how EPR is designed and implemented in India. It argues for a system that better reflects local cost structures, ensures fair cost recovery, and supports the country's broader move toward a circular economy.

Whether you're a policymaker, development practitioner, or international partner, this report offers practical, data-driven guidance for building more equitable and sustainable plastic waste solutions both in India and beyond.

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