

Epr – Constrained in Indian Market

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Abstract—The implementation of Extended Producer Responsibility (EPR) in the Indian market represents a critical shift toward a circular economy, yet it remains significantly constrained by systemic, regulatory, and infrastructural bottlenecks. This research investigates the multi-dimensional challenges hindering EPR effectiveness in India, particularly following the 2026 Plastic Waste Management (Amendment) Rules. Using a qualitative approach supported by stakeholder interviews and a systematic review of current policy frameworks, the study identifies that while the Central Pollution Control Board (CPCB) has tightened compliance through centralized portals and mandatory recycling targets, the market suffers from a fragmented informal waste sector and a lack of standardized traceability mechanisms. Key constraints identified include the financial burden on MSMEs, the scarcity of high-quality recycled feedstock, and the "leakage" of waste into unorganized channels that bypass official documentation. Furthermore, the 2026 withdrawal of End-of-Life (EOL) certificates for meeting recycling targets has intensified pressure on Brand Owners to secure genuine recycling credits. The findings suggest that for EPR to move beyond mere "paper compliance," India must integrate the informal sector into the formal value chain, invest in regional recycling infrastructure, and harmonize state-level enforcement to eliminate geographical disparities. This study provides actionable insights for policymakers and industry leaders to optimize EPR strategies within the evolving South Asian regulatory landscape

Index Terms—Circular Economy; Central Pollution Control Board (CPCB); EPR Authorization; Informal-Formal Linkages; MSME Sustainability; Plastic Waste Management (PWM) Rules 2026; Producer Responsibility Organizations (PRO); Reverse Logistics Infrastructure; Traceability and Blockchain; Waste Governance.

I. INTRODUCTION

The global transition toward a Circular Economy (CE) has necessitated a paradigm shift in waste governance, moving away from "end-of-pipe" solutions toward integrated life-cycle management. At the forefront of this transition is Extended Producer Responsibility (EPR), a policy principle that holds manufacturers, brand owners, and importers (PIBOs) physically and financially accountable for the post-consumer stage of their products. In the Indian context, the implementation of EPR has evolved rapidly from a conceptual framework to a mandatory regulatory requirement, governed primarily by the Plastic Waste Management (Amendment) Rules 2026 and the E-Waste (Management) Rules. Despite the government's proactive stance through the Central Pollution Control Board (CPCB) and the launch of centralized digital tracking portals, the Indian market presents a unique set of constraints that complicate the seamless execution of these mandates.

The Indian waste landscape is characterized by a high degree of complexity, primarily due to the dominance of the informal sector, which handles nearly 90% of the country's waste collection and segregation. This creates a systemic "traceability gap," where material flows occur outside of documented channels, making it difficult for formal recyclers to secure a steady supply of high-quality feedstock and for producers to obtain authentic EPR certificates. Furthermore, the market is currently grappling with a significant infrastructure deficit; while the demand for recycled content is surging due to mandatory inclusion targets, the domestic capacity for high-grade processing remains localized and underfunded. For Micro, Small, and Medium Enterprises (MSMEs), these regulations pose an existential challenge, as the high costs of compliance and the complexity of digital reporting

create a disproportionate financial burden compared to larger multinational corporations.

Moreover, the lack of regional harmonization across State Pollution Control Boards (SPCBs) has led to a fragmented regulatory environment, where "leakage" and non-compliance are prevalent in jurisdictions with weaker enforcement. As India strives to meet its international climate commitments, the success of EPR is no longer just an environmental necessity but an economic imperative. This research paper aims to dissect these multi-dimensional constraints—ranging from logistical bottlenecks in reverse logistics to the socio-economic hurdles of informal sector integration. By analyzing the current market dynamics and the efficacy of the 2026 regulatory updates, this study seeks to propose a hybrid model that aligns industrial growth with sustainable waste management, ensuring that EPR serves as a catalyst for innovation rather than a mere administrative hurdle in the Indian market.

II. LITERATURE REVIEW

The existing body of literature on Extended Producer Responsibility (EPR) highlights its evolution as an effective environmental policy tool, while also emphasizing the contextual constraints observed in developing economies such as India. Early theoretical foundations by Lindqvist (2000) conceptualized EPR as a strategy to internalize environmental costs into product design and lifecycle management, thereby incentivizing producers to adopt eco-friendly practices. Subsequent studies by OECD (2016) and European Environment Agency reports have demonstrated the effectiveness of EPR in improving recycling rates and reducing landfill dependency in developed nations. However, scholars argue that the success of EPR is highly contingent on institutional capacity, regulatory enforcement, and stakeholder alignment.

In the Indian context, research indicates that despite a well-defined regulatory framework, the implementation of EPR faces significant structural and operational challenges. Khetriwal et al. (2017) and Gupta and Sahay (2015) emphasize that the dominance of the informal sector in waste collection and recycling creates a disconnect between formal EPR obligations and actual waste flows. Informal actors, although efficient in material recovery, often

operate outside legal compliance, making it difficult to track recycling targets and ensure accountability. Similarly, studies by Plastic Waste Management research groups (CPCB reports, 2019–2022) highlight issues related to data transparency, inconsistent reporting mechanisms, and the absence of robust monitoring systems.

Several researchers have also focused on the economic and logistical barriers associated with EPR implementation. Manomaivibool and Vassanadumrongdee (2012) argue that high compliance costs and inadequate reverse logistics infrastructure can discourage producer participation, particularly among small and medium enterprises. In India, this is further compounded by fragmented supply chains and regional disparities in waste management infrastructure. Additionally, Narayan and Shekdar (2018) point out that limited consumer awareness and participation in waste segregation significantly reduce the efficiency of take-back systems, thereby weakening the EPR framework.

Recent literature also critiques the digitalization of EPR compliance mechanisms in India, particularly the introduction of centralized online portals for registration and credit trading. While these platforms aim to enhance transparency and traceability, studies suggest that technical complexities, lack of stakeholder training, and frequent regulatory updates create compliance uncertainties (CPCB, 2022; TERI, 2021). Furthermore, concerns regarding "free riders" and fraudulent recycling certificates have been raised by multiple authors, indicating gaps in verification and audit processes.

Overall, the literature converges on the view that while EPR has strong theoretical and policy foundations, its effectiveness in India is constrained by institutional weaknesses, market informality, financial burdens, and behavioral factors. Scholars consistently recommend a more integrated approach involving stricter enforcement, inclusion of informal sector actors into formal systems, technological innovation for tracking waste flows, and enhanced public awareness campaigns to strengthen the EPR ecosystem in the Indian market.

III. METHODOLOGY

The present study adopts a qualitative and exploratory research methodology to examine the concept,

regulatory framework, operational workflow, and constraints associated with Extended Producer Responsibility (EPR) in the Indian market. The methodology is primarily based on secondary data sources, including government notifications (CPCB guidelines, MoEFCC rules), policy documents, research articles, industry reports, and official EPR portals. A descriptive and analytical approach is used to systematically address the following key research questions:

1. What is EPR?

Extended Producer Responsibility (EPR) is an environmental policy approach in which producers, importers, and brand owners (PIBOs) are held responsible for the entire lifecycle of their products, particularly for the take-back, recycling, and environmentally sound disposal of post-consumer waste. The methodology involves reviewing foundational theories and policy definitions from global organizations such as OECD and adapting them to the Indian regulatory context. Conceptual analysis is used to understand EPR as a tool for promoting circular economy practices and reducing environmental externalities.

2. EPR Regulations in the Indian Market

To analyze the regulatory landscape, this study reviews key legislative frameworks governing EPR in India, including:

- Plastic Waste Management Rules, 2016 (amended 2022)
- E-Waste Management Rules, 2016 (amended 2022)
- Battery Waste Management Rules, 2022

A document analysis method is applied to examine provisions related to registration, collection targets, recycling obligations, and compliance mechanisms. Comparative assessment is conducted across different rules to identify similarities, differences, and regulatory gaps. Official publications from the Central Pollution Control Board (CPCB) are used as primary references.

3. EPR Workflow as per Guidelines

The study maps the operational workflow of EPR implementation in India using process analysis. The typical workflow includes:

- Registration of PIBOs on the CPCB EPR portal
- Declaration of product details and annual targets
- Channelization of waste through authorized recyclers or Producer Responsibility Organizations (PROs)
- Collection, segregation, and transportation of waste
- Recycling or disposal through certified facilities
- Generation of EPR certificates/credits
- Submission of annual returns and compliance reports

Flowchart-based interpretation and sequential analysis are used to understand how responsibilities move across stakeholders. This helps in identifying bottlenecks and inefficiencies within the system.

4. Causes and Constraints in Following EPR Guidelines

To identify challenges, the study employs thematic analysis of literature, reports, and case studies. The constraints are categorized into major dimensions:

Institutional Constraints: Weak enforcement, lack of coordination among agencies, and regulatory ambiguities

Economic Constraints: High compliance costs, especially for SMEs, and limited financial incentives

Operational Constraints: Inadequate reverse logistics, fragmented waste collection systems, and dependence on the informal sector

Technological Constraints: Issues with digital EPR portals, lack of real-time tracking, and data inconsistencies

Behavioral Constraints: Low consumer awareness, poor waste segregation practices, and resistance to compliance

By synthesizing these aspects, the methodology provides a structured framework to evaluate the effectiveness and limitations of EPR implementation in India.

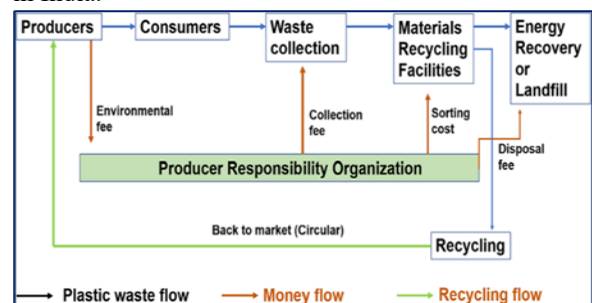


Fig. Flow Chart of EPR

IV. SCOPE OF THE PROJECT

The scope of this research is centered on analyzing the implementation and constraints of Extended Producer Responsibility (EPR) within the Indian market, with a focus on its regulatory, operational, and practical dimensions. The study covers key waste streams governed under EPR policies, including plastic waste, e-waste, and battery waste, as defined by the Ministry of Environment, Forest and Climate Change (MoEFCC). It examines the roles and responsibilities of major stakeholders such as Producers, Importers, Brand Owners (PIBOs), recyclers, and Producer Responsibility Organizations (PROs), along with regulatory bodies like the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs).

The project further extends to understanding the existing EPR regulatory framework in India by reviewing current rules, amendments, and compliance mechanisms. It includes an analysis of the EPR workflow—from registration and target setting to waste collection, recycling, and certification—highlighting how guidelines are implemented in real-world scenarios. Additionally, the study explores the integration of digital compliance systems such as EPR portals and credit trading mechanisms.

A significant part of the scope involves identifying and evaluating the constraints affecting effective EPR implementation, including institutional inefficiencies, economic burdens on businesses, operational challenges in reverse logistics, technological limitations, and behavioral issues like low consumer awareness and informal sector dominance. The research also considers comparative insights from global EPR practices to contextualize India's position and identify potential improvements.

However, the study is limited to secondary data and does not include primary field surveys or experimental validation. It focuses on policy analysis and system-level evaluation rather than detailed technical processes of recycling technologies. Despite these limitations, the project aims to provide meaningful insights and recommendations to enhance the efficiency, transparency, and sustainability of EPR implementation in India.

V. CONCLUSION

The study concludes that Extended Producer Responsibility (EPR) represents a transformative policy approach aimed at shifting the burden of waste management from public authorities to producers, thereby promoting sustainable production and consumption patterns in India. The analysis of the regulatory framework indicates that India has established a comprehensive and evolving set of rules covering key waste streams such as plastics, e-waste, and batteries. These regulations reflect strong alignment with global environmental practices and demonstrate the country's commitment toward a circular economy. However, the effectiveness of EPR implementation is significantly influenced by the gap between policy design and on-ground execution.

The findings reveal that the EPR workflow, though systematically defined through CPCB guidelines and digital platforms, faces multiple operational challenges. Issues such as inadequate reverse logistics infrastructure, lack of reliable data tracking systems, and procedural complexities in compliance mechanisms hinder smooth functioning. Additionally, the dominance of the informal sector in waste collection and recycling creates both opportunities and challenges, as it contributes to material recovery but remains largely unregulated within the formal EPR framework.

Furthermore, the study identifies several constraints including weak enforcement by regulatory bodies, financial and administrative burdens on small and medium enterprises, low levels of consumer awareness, and the presence of non-compliant entities or "free riders." Technological challenges related to digital EPR portals and inconsistencies in certification processes further complicate compliance. These factors collectively limit the overall efficiency and transparency of the EPR system in India.

In conclusion, while EPR has strong potential to drive sustainable waste management and resource efficiency, its success in the Indian market depends on strengthening institutional capacity, improving monitoring and verification mechanisms, integrating the informal sector into formal systems, and enhancing stakeholder awareness and participation. A more coordinated and technology-driven approach, supported by strict enforcement and policy clarity, is essential to overcome existing constraints and realize

the full potential of EPR as a cornerstone of environmental governance in India.

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