

A Recent Development of Plastic Waste Management in India

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ABSTRACT

Plastic pollution has emerged as a critical environmental challenge in India and the global environment. According to estimates, India produced more than 10,829,000 tonnes of plastic waste in 2023, which equates to 7.7 kg per person annually. To address this problem, the Government of India introduced the Plastic Waste Management Rules (2016), a landmark policy aiming to institutionalize sustainable plastic waste handling practices. This paper critically assesses the effectiveness of these rules from 2016, with a focus on key provisions such as Extended Producer Responsibility (EPR) and the roles of central and state-level regulatory bodies, including CPCB, SPCBs, and ULBs, and their subsequent amendments. An evaluation of implementation status across India highlights achievements as well as persistent challenges related to compliance, enforcement, public participation, and infrastructure. The paper showcases success stories and evaluates the role and responsibilities of the informal sector in plastic waste recovery. Also focuses on the recent development of PWM in India. Furthermore, the environmental and economic impacts are analyzed to understand the broader implications for a circular economy. The study concludes with strategic recommendations for improving policy outcomes and setting a roadmap for India's future plastic waste governance.

Graphical Abstract



Keywords: - Plastic Waste Management Rules 2016, Extended Producer Responsibility (EPR), Amendments, Circular Economy, Environmental Governance, Policy Implementation.

1. INTRODUCTION

Plastic is defined as a substance that consists primarily of a high polymer, including materials like polyethylene terephthalate, high-density polyethylene, vinyl, low-density polyethylene, polypropylene, polystyrene resins, and composite materials such as acrylonitrile butadiene styrene, polyphenylene oxide, polycarbonate, and polybutylene terephthalate^[1]. Because plastic is utilized in packaging, building and construction, textiles, consumer goods, transportation, healthcare, electrical and electronics, and industrial machinery, its use in every industry cannot be underestimated. Plastic's numerous uses emerge from its adaptability, high strength-to-weight ratio, affordability, longevity, low maintenance requirements, and resistance to corrosion^[2]. Due to its widespread use and efficiency, plastic waste, which is non-biodegradable and dangerous to both people and the environment, doubles. According to the PWM RULE 2016, "all plastic that is thrown, utilized, or after its intended use is over" is considered plastic garbage. According to online sources, the production of plastics is steadily rising, and by 2028, the global plastics market is projected to reach USD 750.1 billion at a compound annual growth rate (CAGR) of 3.4%^[3]. By 2060, the amount of improperly managed plastic trash in the environment could triple from its current level due to the rapid expansion and poor management of the plastics industry^[4].

The Indian government overcame this by enacting regulatory measures to safeguard public health and safety, encourage fair competition, address market failure, and guarantee moral behaviour. The PWM Rule 2016,

Extended Producer Responsibility (EPR), and phased prohibitions on single-use plastics are examples of regulatory actions in India. This study aims to critically assess the impact and efficacy of India's plastic pollution control measures, including the PWM Rules of 2016 and their subsequent changes. Examine the main clauses and changes to policy included in Rule 2016 and its updates. Additionally, legislative suggestions should be offered to improve adherence and accomplish sustainable PWM in India. This review evaluates the effectiveness of the PWM Rules, 2016 and their subsequent amendments in improving plastic waste governance in India by analyzing their impact on policy implementation, responsibilities of various stakeholders, and identifying key challenges and opportunities for strengthening the regulatory and operational bodies for sustainable PWM.

1.1 Plastic Waste Management Rule, 2016

The Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, notified the PWM Rule, 2016 to replace the earlier Plastic Waste (Management and Handling) Rules, 2011. This rule aimed to address the escalating issue of plastic pollution through a comprehensive regulatory framework.

1.1. 1. Key terms

Compostable plastics- plastic that doesn't leave any hazardous, visible, or detectable residue after being broken down by biological processes during composting, producing CO₂, water, inorganic chemicals, and biomass at a pace comparable to other known biodegradable materials, except traditional petro-based plastics.

Disintegration- the physical disintegration of a substance into tiny pieces.

Multilayered packaging- Any substance, whether in a laminate form or as a co-extruded composition, that is utilized or designed for packaging and consists of at least one layer of plastic as the main component combined with one or more layers of materials like paper, polymeric substances, paperboard, metalized layers, or aluminum foil.

Virgin plastic- plastic material that has never been used before and hasn't been mixed with garbage or scrap.

1.2 Roles and Responsibilities

Under the PWM Rules, 2016, various stakeholders have been assigned distinct roles and responsibilities to ensure effective management of plastic waste in India. The Central Pollution Control Board (CPCB) is responsible for formulating guidelines for the effective implementation of these rules, including those related to Extended Producer Responsibility (EPR). It monitors compliance by State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs), and maintains a centralized online portal for the registration of Producers, Importers, and Brand Owners (PIBOs) under the EPR framework. The SPCBs and PCCs play an important role at the state level. They are tasked with granting registration to plastic waste processors, manufacturers, and recyclers. They conduct regular inspections to ensure compliance with the regulations and submit annual compliance reports to the CPCB.

The ULBs and Gram Panchayats are responsible for the implementation of plastic waste management at the local level. They must establish systems for the segregation, collection, storage, transportation, and disposal of plastic waste. ULBs are also entrusted with enforcing the ban on plastic carry bags below 50 microns and ensuring that only registered vendors operate in the market. They play a crucial role in raising public awareness and encouraging community participation in proper plastic waste disposal. The PIBOs are mandated to take responsibility for the plastic waste generated by their products. Under the EPR framework, they must establish mechanisms for collecting and managing the waste, either independently or through Producer Responsibility Organizations (PROs). PIBOs must register with CPCB or SPCBs and comply with their assigned EPR targets. The Plastic Waste (Management and Handling) Rules, 2011 were published by the MoEFCC, empowering SPCBs to enforce regulations pertaining to plastic waste and assigning ULBs the duty of establishing and managing garbage collection, segregation, transportation, and disposal. PIBOs must be regularly verified, audited, and registered by SPCBs and the CPCB ^[5].

1.3 Extended producer responsibility

The EPR instrument, which was established by the PWM Rule in 2016, holds producers accountable for the plastic waste they release into the market. Extended producer's responsibility refers to a producer's obligation to manage a product in an environmentally responsible manner until the end of its useful life ^[1]. The EPR concept is founded on the polluter-pays principle, a circular economy framework, and the "management of the whole-life-cycle of products" approach. As a result, EPR pushes manufacturers to save raw materials, reevaluate technology, production methods, and product design, and take responsibility for the safe use and disposal of their products after purchase ^[6, 7]. Given the scope of the problem, the high levels of socioeconomic and cultural variety, the complexity of the population, and the anticipated difficulties in implementing it, the Indian EPR framework takes a very different approach than EPRs in developed nations. EPR in PWM Rule, 2016 focuses on assessing responsibilities assigned for producers, importers, and evaluating the effectiveness of promoting plastic waste collection, recycling, and disposal. Also, recommendations for strengthening the EPR mechanism in India should be given.

2. CASE STUDY

Dhanbad City, Jharkhand- Surveys and interactions were conducted regarding the current recycling pathways for PET and PE waste. About 30 rubbish pickers (rag-pickers/scavengers), 10 itinerant waste buyers (IWBs) (kabari walas with hand carts), and 4 scrap dealers were contacted and interviewed to identify the PET and PE waste recycling routes in the research area. Beginning with interactions with rag-pickers and scavengers at the Bartand MSW transfer station, the study then moved on to the Dhanbad train station and business locations such as Bank More and Hirapur ^[8].

Indore, Madhya Pradesh- Indore began implementing aggressive solid waste management strategies, which included a strong focus on plastic waste. The key steps of the city are door-to-door waste collection, conducting plastic collection drives, organizing citizen awareness campaigns, and co-processing of plastic waste in cement kilns. The initiatives also included partnerships with recyclers and citizens' awareness drives, resulting in a visibly cleaner city and laying the foundation for Indore's recognition as India's cleanest city in subsequent years. The 2016 rule becomes a crucial step in promoting responsible plastic use, setting the stage for future bans on single-use plastics and encouraging circular economy practices.

Kochi, Kerala- Adopted a decentralized PWM model by setting up community-level Material Recovery Facilities (MRFs) that sorted and processed plastic waste for recycling and reuse. The city also enforced strict bans on single-use plastics in public spaces.

Ambikapur, Chhattisgarh- Became a model for zero-landfill waste management by setting up 21 segregation centers, reusing plastic waste for eco-bricks and roads, and empowering women's self-help groups in the waste sector.

Sikkim- The state government had already banned plastic bags prior to 2016, and under the new rules, it promoted sustainable alternatives like cloth and jute bags while conducting statewide awareness programs.

Hyderabad, Telangana- Implemented EPR through partnerships with producers and recyclers, set up plastic collection kiosks and reverse vending machines, and used low-value plastics in road construction, all supported by digital tracking tools. These case studies showcase how decentralized planning, public participation, and effective policy execution can lead to sustainable plastic waste management. This review highlights successful case studies or models of plastic waste management adopted in various Indian cities or states.

2 AMENDMENT AND RECENT DEVELOPMENT

India has progressively strengthened its plastic waste management framework through a series of amendments that reflect the country's commitment to reducing plastic pollution and promoting sustainable practices, as shown in Table 1.

Table-1: Overview of PWM Rule Amendments with Policy Provisions and Implementation (2016-2024).

Year	Amendment / Rule	Key Changes	Official Reference Notification
2016	Plastic Waste Management Rules, 2016	Replaced 2011 rules. Extended coverage to rural areas. Banned plastic bags <50 microns. Introduced EPR. Local bodies are made responsible for waste management.	[1]
2018	Draft Amendments	Proposed phasing out multi-layered plastics. Tighter timelines for waste collection responsibilities by producers.	[9]
2021	PWM (Amendment) Rules, 2021	Prohibited the use of single-use plastic items by July 1, 2022. Increased thickness of plastic carry bags to 75 microns (Sept 2021) and 120 microns (Dec 2022). Strengthened EPR framework.	[10]
2022	PWM (Amendment) Rules, 2022	Implemented full-fledged EPR for plastic packaging. Introduced a central online portal for registration, reporting. Defined standards for biodegradable plastics.	[11]
2024	PWM (Amendment) Rules, 2024	Stricter compliance for biodegradable plastics. Expanded definition of "importer"- Obligated manufacturers to report and manage pre-consumer plastic waste. Local bodies are required to submit annual plastic waste infrastructure reports	[12]

4. IMPACTS

PWM Rule 2016 has had notable social and economic impacts in India, as shown in Fig. 1.



Fig -1: Impacts of the PWM Rule 2016 in social and economic aspects.

5. RECENT DEVELOPMENT IN INDIA

To tackle the intertwined issues of plastic pollution across environmental, social, and economic sectors, there is an increasing demand for a systems approach in researching plastic pollution ^[13], which provides useful, comprehensive methods for evaluating plastics at every stage of their life cycle. India's developments in tackling plastic waste have initiated multifaceted approaches such as combining policy reform, making urban planning, increasing engagement of communities, and technological innovation to create a cleaner environment. Some recent initiatives India has implemented are illustrated in Table 2.

Table-2: Recent development of PWM in various locations of India

Recent PWM Initiatives	Locations	References
Recykal's Digital Waste Management Platform (Facilitated recycling of over 1MT of waste with more than 620 brands and 675 recyclers)	Recykal, Hyderabad	[14]
Plastic-Free Braj Ki Raj' Campaign (Eliminate single-use plastics)	Madhura, Uttar Pradesh	[15]
Uttar Pradesh's Sustainable Infrastructure (Constructing roads using plastic waste)	Uttar Pradesh	[16]
Waterway Protection: Installation of Trash Booms (Protecting aquatic ecosystem by designing trash booms)	Mumbai, Maharashtra	[17]
Swachh Bharat Mission 2.0-Urban	India	[18]

6. CONCLUSION

The PWM Rule, 2016 marked a significant policy shift in India's approach to plastic waste, introducing key provisions like EPR and defining roles for CPCBs, SPCBs, and ULBs. While these rules have led to improved awareness and local initiatives in some cities, challenges remain in consistent implementation, enforcement, and infrastructure development. The informal sector continues to play a vital role in plastic waste recovery, yet lacks formal recognition and support. Case studies highlight both successes and persistent issues, particularly around complaints and public participation. To strengthen outcomes, there is a need for cleaner accountability under EPR, better coordination among stakeholders, and greater investment in recycling technologies. A more inclusive and efficient governance framework will be key to advancing sustainable plastic waste management and moving India closer to circular economy goals and sustainability.

7. REFERENCES

- [1] MoEF&CC. [Published In the Gazette of India, Part-II, Section-3, Sub-Section (ii)] Ministry of Environment, Forest and Climate Change NOTIFICATION New Delhi, the 29. **2016**, 317 (ii), 1–15.
- [2] Patrício Silva, A. L.; Prata, J. C.; Walker, T. R.; Campos, D.; Duarte, A. C.; Soares, A. M. V. M.; Barcelò, D.; Rocha-Santos, T. Rethinking and Optimising Plastic Waste Management under COVID-19 Pandemic: Policy Solutions Based on Redesign and Reduction of Single-Use Plastics and Personal Protective Equipment. *Sci. Total Environ.*, **2020**, 742, 140565. <https://doi.org/10.1016/j.scitotenv.2020.140565>.
- [3] Research and Market 2021. Research and Market 2021.
- [4] Lebreton, L.; Andrady, A. Future Scenarios of Global Plastic Waste Generation and Disposal. *Palgrave Commun.*, **2019**, 5 (1), 6. <https://doi.org/10.1057/s41599-018-0212-7>.
- [5] Gupta, D.; Dash, S. Challenges of Implementing Extended Producer Responsibility for Plastic-Waste Management: Lessons from India. *Soc. Responsib. J.*, **2023**, 19 (9), 1595–1612. <https://doi.org/10.1108/SRJ-08-2022-0326>.
- [6] Fadeeva, Z.; Van Berkel, R. ‘Unlocking Circular Economy for Prevention of Marine Plastic Pollution: An Exploration of G20 Policy and Initiatives.’ *J. Environ. Manage.*, **2021**, 277, 111457. <https://doi.org/10.1016/j.jenvman.2020.111457>.
- [7] Richter, J. L.; Koppejan, R. Extended Producer Responsibility for Lamps in Nordic Countries: Best Practices and Challenges in Closing Material Loops. *J. Clean. Prod.*, **2016**, 123, 167–179. <https://doi.org/10.1016/j.jclepro.2015.06.131>.
- [8] Aryan, Y.; Yadav, P.; Samadder, S. R. Life Cycle Assessment of the Existing and Proposed Plastic Waste Management Options in India: A Case Study. *J. Clean. Prod.*, **2019**, 211, 1268–1283. <https://doi.org/10.1016/j.jclepro.2018.11.236>.
- [9] Ministry of Environment Forest and Climate Change. Plastic Waste (Management and Handling) Rules. **2018**, 1986 (i).
- [10] GSR 571(E), August 12, 2021. सी.जी.-डी.एल.-अ.-12082021-228947. **2021**, 2021 (D), 1–6.
- [11] Jain, A. Plastic Waste Management (Amendment) Rules 2022. *Indian Pollut. Control Assoc.*, **2022**, 1–14.
- [12] Plastic Waste Management (Amendment) Rules, 2024. Plastic-Waste-Mangement-Rules-2024. **2024**, 2016 (D).
- [13] Courtene-Jones, W.; Clark, N. J.; Thompson, R. C. Plastic Pollution: The Science We Need for the Planet We Want. *Emerg. Top. Life Sci.*, **2022**, 6 (4), 333–337. <https://doi.org/10.1042/ETLS20220019>.
- [14] Ms Ekta Narain- Director 2021. Recykal Uses Digital Technology to Manage Waste in India-2021.
- [15] The Times of India 2025. Plastic Free Braj Ki Raj Campaign Launched in Madhura to Eliminate Single Use Plastic-May 09, 2025.
- [16] India-2025, T. T. of. UP Takes Green Stride through Miyawaki Forests, Plastic Roads and Solar Rooftops- May 11, 2025.
- [17] The Times Of India 2025. BMC Instal Trash Booms in Water Bodies- May 09, 2025.
- [18] Government of India 2025. Swachh Bhart Mission of India 2.0 March 2025.