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EXTENDED PRODUCER RESPONSIBILITY AND PLASTIC WASTE MANAGEMENT: REGULATORY CHALLENGES AND COMPLIANCE GAPS

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Abstract:
Extended Producer Responsibility (EPR) has emerged as a central pillar of global strategies to address the accelerating crisis of plastic waste, shifting end-of-life management obligations from the state and municipal bodies to producers, importers, and brand owners. This paper critically examines the EPR framework for plastic waste management, with particular focus on India's regulatory architecture under the Plastic Waste Management Rules, 2016, as substantially amended in 2022, and the compliance landscape that has emerged since the operationalisation of the CPCB's centralised EPR portal. Drawing on a comparative analysis of EPR models in the European Union, Germany, the United Kingdom, Japan, and the Philippines, the paper identifies the foundational principles, institutional designs, and financial mechanisms that determine EPR effectiveness. It then situates India's framework against this comparative backdrop, exposing critical compliance gaps including widespread non-registration of major polluters, systemic certificate fraud, undervaluation of recycling credits, infrastructural deficits in flexible plastic processing, and the exclusion of informal waste collectors and urban local bodies from the EPR value chain. The paper further examines how market-driven certificate trading has undermined the polluter pays principle that animates EPR regulation. It concludes with targeted recommendations for strengthening enforcement architecture, improving data integrity, integrating informal sector actors, and aligning India's EPR trajectory with its circular economy commitments under the United Nations Sustainable Development Goals.

Keywords: Extended Producer Responsibility, Plastic Waste Management, EPR Certificate Fraud, Circular Economy, Polluter Pays Principle.

1. Introduction

1.1 The Global Plastic Crisis and the Limits of Conventional Regulation

The proliferation of plastic waste has become one of the defining environmental crises of the twenty-first century. Global plastic production doubled from 234 million tonnes (Mt) in 2000 to 460 Mt in 2019, generating a corresponding surge in plastic waste from 156 Mt to 353 Mt over the same period (OECD, 2022a). Of this waste stream, only 9% was ultimately recycled after accounting for processing losses, while 19% was incinerated and nearly 50% was directed to sanitary landfills; the remaining 22% was disposed of in uncontrolled dumpsites, burned in open pits, or leaked into the environment (OECD, 2022a). By 2022, global plastic waste generation reached an estimated 268 Mt, with projections suggesting that this figure could exceed 700 Mt by 2060 in the absence of structural policy intervention (Houssini et al., 2025, as cited in World Bank, 2025). The social costs of plastic pollution including health impacts, ecological degradation, and the loss of productive use of contaminated land and water are estimated to run to hundreds of billions of dollars annually (Markl & Charles, 2022, as cited in OECD, 2023).

Conventional regulatory approaches to plastic waste relying on municipal solid waste management systems, post-consumer collection mandates, and end-of-pipe disposal controls have proven structurally inadequate to address a problem of this scale and complexity. Municipal bodies in most developing countries, including India, are chronically underfunded, lack technical capacity for waste segregation and processing, and operate within governance frameworks that provide no financial linkage between the entities that profit from plastic production and the entities responsible for managing its aftermath. This disconnect between private profitability and socialised waste costs constitutes a classic market failure, and it is precisely this failure that Extended Producer Responsibility (EPR) is designed to correct.

EPR, as defined by the Organisation for Economic Co-operation and Development (OECD), is an environmental policy approach that extends a producer's financial and/or physical responsibility for a product to the post-consumer stage of its lifecycle (OECD, 2008, as cited in Singh et al., 2024). By internalising waste management costs within the pricing and production decisions of manufacturers, EPR creates economic incentives for eco-design, packaging reduction, and recyclability interventions that act upstream rather than merely managing the downstream consequences of unsustainable material choices. Since Thomas Lindhqvist first articulated the concept in a 1990 report to the Swedish Environment Ministry, EPR has spread to over 400 schemes across more than 60 countries, covering packaging, electronics, batteries, tyres, and other product streams (OECD, 2023).

1.2 India's Plastic Problem and the EPR Response

India occupies a position of particular significance in this global challenge. As the world's most populous country and a rapidly industrialising middle-income economy, India accounts for approximately 6.4% of global plastic consumption, generating an estimated 3.5 million tonnes of plastic waste per year by official estimates though the CSE's analysis of CPCB portal data suggests the actual figure is closer to 8 Mt annually, indicating systemic underestimation (Centre for Science and Environment [CSE], 2024; Down to Earth, 2024). Approximately 66% of India's plastic packaging by volume consists of flexible plastics films, pouches, and multi-layer packaging which are among the most difficult categories to collect, sort, and mechanically recycle at scale (Waste Recycling Magazine, 2024). Nature's 2025 analysis estimated India's per capita plastic waste generation at 0.54 kg/day, dramatically exceeding the official government figure of 0.12 kg/day, pointing to profound underreporting of rural and informal sector waste (Insights on India, 2025).

India's legislative response to the plastic waste problem has evolved through the Plastic Waste Management (PWM) Rules, 2016, which introduced the EPR concept into Indian regulatory architecture, and the substantially amended PWM Rules of 2022 and subsequent amendments in 2023 and 2024, which significantly strengthened and operationalised the EPR framework. The 2022 amendments introduced the CPCB's Centralised EPR Portal for Plastic Packaging, established category-specific collection and recycling targets for Producers, Importers, and Brand Owners (PIBOs), created a certificate trading mechanism, and imposed mandatory registration obligations (Ministry of Environment, Forest and Climate Change [MoEFCC], 2022). Despite these ambitious formal provisions, the implementation record since April 2022 has revealed pervasive compliance gaps, institutional weaknesses, and most alarmingly systemic fraud that has fundamentally undermined the framework's credibility.

1.3 Objectives and Structure

This paper critically analyses India's EPR framework for plastic waste management against the backdrop of comparative international models, identifies the structural and operational compliance gaps that have emerged in the three years since the 2022 amendments, and proposes a set of evidence-based reforms. Section 2 establishes the conceptual and comparative framework, examining EPR models in the EU, Germany, the UK, Japan, and the Philippines. Section 3 analyses the structure, targets, and institutional

architecture of India's EPR regime. Section 4 identifies and examines the principal compliance and enforcement gaps. Section 5 presents conclusions and reform recommendations.

2. Conceptual Framework and Comparative Analysis

2.1 The Polluter Pays Principle and EPR

The theoretical foundation of EPR rests on the polluter pays principle (PPP), a norm of environmental law recognised in Principle 16 of the Rio Declaration on Environment and Development (1992) and embedded in the domestic environmental law of most OECD jurisdictions. PPP holds that the costs of pollution prevention, control, and remediation should be borne by those who generate pollution, rather than being externalised onto the state, taxpayers, or future generations. In the context of plastic waste, this principle requires that the economic cost of collecting, transporting, processing, and disposing of plastic packaging waste be borne by those who place it on the market producers, importers, and brand owners rather than by municipal bodies funded by public revenues (OECD, 2022a).

EPR operationalises PPP through various mechanisms: individual producer take-back obligations, collective schemes administered by Producer Responsibility Organisations (PROs), deposit-return systems, eco-modulated fees based on product recyclability, and market-based certificate or credit trading systems. The choice of mechanism reflects trade-offs between administrative simplicity, economic efficiency, environmental effectiveness, and equitable distribution of compliance costs (Linderhof et al., 2019, as cited in ScienceDirect, 2024). Common to all models, however, is the fundamental shift of financial accountability from the public sector to private industry a shift that, if properly enforced, creates sustained economic incentives for plastic reduction and design-for-recyclability at source.

2.2 The European Union Model: Directive-Driven Targets and Eco-Modulation

The European Union's EPR framework for plastic packaging is governed by the Packaging and Packaging Waste Directive (PPWD), first enacted in 1994 and most recently amended by Directive 2018/852, which mandated that all EU member states establish formal EPR schemes for all packaging categories by end-2024 (ScienceDirect, 2024). Germany, which introduced mandatory EPR for packaging under the Verpackungsgesetz (Packaging Act) in 1991, provides the earliest and most empirically documented example of EPR effectiveness in practice. Germany's packaging recycling rate rose from 37.7% in 1991, the year before implementation, to 76.2% by 2016 a near-doubling attributable in significant part to the EPR incentive structure (ScienceDirect, 2024). The German Duales System Deutschland, a collective PRO scheme, created a functioning secondary materials market by standardising collection infrastructure, quality specifications for recycled output, and eco-modulated fees that differentiate packaging based on recyclability (Ramasubramanian et al., 2023).

The United Kingdom introduced a Producer Responsibility Note (PRN) trading system in 1997, requiring packaging producers to demonstrate recycling activity through tradeable certificates a model with structural parallels to India's EPR certificate mechanism (Ramasubramanian et al., 2023). From 2024, the UK transitioned to a more robust EPR regime with producers paying directly for household packaging waste management, with fees adjusted annually based on recycling recovery rates (Ramasubramanian et al., 2023). The EU's Single Use Plastics Directive (2019/904) further strengthened the framework by imposing product bans, labelling requirements, and Extended Producer Responsibility for specific categories including tobacco filters, wet wipes, and fishing gear (OECD, 2023).

France's EPR scheme for textiles (Re_fashion) illustrates both the potential and the limitations of EPR beyond packaging. The scheme increased per capita textile collection from 2 kg in 2009 to 3.7 kg by 2019, significantly above the EU average collection rate of 22%, yet still fell short of France's own government-set target of 50% collection (OECD, 2024). This pattern of meaningful but incomplete progress against

ambitious targets is characteristic of EPR systems globally and underscores that well-designed EPR creates measurable improvement without guaranteeing full compliance in the absence of strong enforcement.

2.3 Japan and the Asia-Pacific Experience

Japan's EPR framework for containers and packaging, enacted under the Container and Packaging Recycling Law (1995, effective 1997), operates through a hybrid model combining producer financial obligations with municipal collection infrastructure. Producers pay recycling fees to designated PROs, which contract with recyclers to process materials collected by municipalities. This model has achieved high collection rates for glass and PET bottles but has faced criticism for its reliance on municipal infrastructure a dependence that creates cost-sharing ambiguity and limits producer incentives for upstream eco-design (OECD, 2022b). Japan's experience underscores a key principle for EPR design: when municipalities bear collection costs while producers bear processing costs, the incentive for producers to reduce plastic use at source is weakened (OECD, 2022b).

The Philippines' Republic Act No. 11898 (Extended Producer Responsibility Act, 2022) provides a valuable comparator for India given its developing-country context. By the end of 2023, 947 companies had registered under the scheme, recovering and diverting 163,000 tonnes of post-consumer plastic packaging surpassing the initial 20% compliance target (World Bank, 2025). However, this represented only approximately 6% of the Philippines' estimated annual plastic waste generation of 2.7 Mt, illustrating the large gap that can persist between reported compliance and actual environmental impact when baseline data is inadequate (World Bank, 2025). The Philippines' credit-based compliance mechanism, which allows producers to purchase diversion certificates from third-party verified collectors, directly parallels India's EPR certificate trading model and shares its vulnerability to fraud and inflated reporting.

2.4 Design Principles for Effective EPR

The comparative evidence yields a set of design principles that are directly relevant to evaluating India's framework. First, financial responsibility for the full cost of end-of-life plastic management including collection, transportation, sorting, and recycling must rest with producers, not be partially socialised onto municipal bodies (OECD, 2022a). Second, recycling targets must be calibrated to actual, verified recycling capacity rather than theoretical potential, to prevent nominal compliance without environmental benefit. Third, certificate trading mechanisms require robust anti-fraud infrastructure including physical capacity verification, GPS-enabled tracking, third-party audit, and real-time data validation to prevent the generation and sale of fraudulent credits. Fourth, eco-design incentives, such as eco-modulated fees that make recyclable packaging cheaper to produce and sell, are essential to drive upstream material change. Fifth, informal sector workers who perform a substantial portion of actual waste collection in developing economies must be formally integrated into EPR systems, both to ensure their economic rights and to harness their existing collection capacity (World Bank, 2025).

3. India's EPR Framework: Structure and Targets

3.1 Legislative Architecture

India's EPR framework for plastic packaging is embedded in the Plastic Waste Management Rules, 2016, enacted under the Environment (Protection) Act, 1986, and substantially operationalised through the Plastic Waste Management (Amendment) Rules, 2022, notified by MoEFCC on February 16, 2022 (MoEFCC, 2022). These were further amended four times in July 2022, April 2023, October 2023, and March 2024 reflecting the regulatory complexity of operationalising a novel market mechanism in a large, structurally fragmented economy (FICCI, 2024). The Plastic Waste Management (Amendment) Rules, 2024, notified on March 14, 2024, introduced additional refinements to target structures, compliance timelines, and sector-specific provisions (India Briefing, 2025).

The 2022 Rules identify four categories of plastic packaging for EPR purposes: Category I (rigid plastic packaging); Category II (flexible plastic packaging other than multilayer); Category III (multilayer plastic packaging and other plastics); and Category IV (plastic sheets and covers). The Rules assign category-specific obligations to PIBOs across four dimensions: (i) collection targets for plastic packaging waste; (ii) minimum recycling targets; (iii) end-of-life (EOL) disposal caps; and (iv) recycled content usage requirements (MoEFCC, 2022). Collection targets have been in force since April 2022. Mechanical recycling targets were phased in from FY 2024–25, with PIBOs required to mechanically recycle 35% of total plastic packaging introduced into the Indian market across all categories (Waste Recycling Magazine, 2024). Recycled content requirements mandating 5% recycled content in Category III packaging came into force from April 1, 2025, with reuse targets scheduled from FY 2025–26 onwards (FICCI, 2024; EcoNexa, 2025).

The CPCB's Centralised EPR Portal, operationalised from April 5, 2022, is the primary compliance and monitoring interface. PIBOs, Plastic Waste Processors (PWPs), and Producer Responsibility Organisations (PROs) are required to register on the portal and report activity data, creating the informational architecture for a certificate trading market in which each EPR certificate represents the processing of one tonne of plastic packaging waste (Singh et al., 2024).

3.2 Certificate Trading Mechanism

The EPR certificate trading system is the central compliance mechanism under India's 2022 framework. PWPs registered recyclers and end-of-life processors generate certificates upon processing plastic waste, which are uploaded to the CPCB portal. PIBOs acquire these certificates to demonstrate fulfilment of their EPR obligations, paying PWPs for the certificates at market-determined prices. The system is designed to operate as a market-based instrument: by creating demand for recycling certificates from PIBOs obligated to meet recycling targets, it was intended to generate revenue for recyclers, fund waste collection infrastructure, and incentivise investment in processing capacity.

The financial architecture of this mechanism is, however, fundamentally skewed. PIBOs currently pay only approximately 10% of the total cost of collecting and channelising plastics to a PWP or recycler, particularly for multi-layer plastic packaging the most problematic category leaving the remaining 90% of the actual cost either uncovered or borne by municipal bodies and informal collectors (Waste Recycling Magazine, 2024). The CSE's 2024 assessment characterised the outcome starkly: EPR for plastic packaging has been "reduced to PIBOs simply procuring certificates from PWPs at throwaway prices, thus reducing the liability and accountability of the PIBOs and undermining the polluter pays principle on the basis of which the laws were notified" (CSE, 2024). This dynamic where the certificate market clears at a price well below the actual cost of genuine waste management is structurally identical to the failure modes observed in carbon credit markets when regulatory oversight is inadequate to prevent the supply of low-quality or fraudulent credits.

4. Compliance and Enforcement Gaps

4.1 Non-Registration and Underrepresentation of Major Polluters

The foundational prerequisite for any EPR system is the registration of all obligated entities. As of October 2024, the CPCB portal had received 41,577 registrations from PIBOs of which 83% were importers, 11% were producers/manufacturers, and just 6% were brand owners (Down to Earth, 2024). This distribution is paradoxical and revealing: brand owners, who are typically the largest users of plastic packaging and bear the greatest EPR obligations, represent the smallest proportion of registered entities. The CSE assessment confirmed that "none of the manufacturers of virgin plastics" the primary material input for packaging feature on the portal, representing a fundamental gap in the regulated entity base (Outlook Business, 2025).

PIBOs registered on the portal collectively declared having introduced 23.9 Mt of plastic packaging into the Indian market between April 2022 and October 2024, translating to an annual average of approximately 8 Mt nearly double the CPCB's own official estimate of 4.1 Mt for all plastic waste (not just packaging) (CSE, 2024; Down to Earth, 2024). This discrepancy has significant regulatory implications: if the CPCB's baseline data underestimates actual plastic waste generation by approximately 95%, then the EPR targets assigned to PIBOs which are calibrated against registered data are systematically set below the level needed to achieve meaningful environmental impact. The data integrity problem is thus not merely a compliance issue but a structural deficiency that vitiates the entire target-setting framework.

4.2 The Certificate Fraud Scandal

The most acute manifestation of India's EPR compliance crisis came in October 2023, when CPCB and State Pollution Control Boards (SPCBs) revealed that plastic waste recyclers in three states Karnataka, Maharashtra, and Gujarat had generated approximately 700,000 fake EPR certificates (Down to Earth, 2024; Climate Samurai, 2024). This figure was 38 times more than the certificate generation capacity of the implicated recyclers, indicating systematic and large-scale fabrication rather than incidental over-reporting (CSE, 2024). The four companies directly implicated Enviro Recyclean Pvt. Ltd., Shakti Plastics Industries, Technova Recycling India Pvt. Ltd., and Asha Recyclean Pvt. Ltd. were found on physical inspection to be unable to demonstrate the sale of recycled plastic commensurate with their claimed processing volumes (Climate Samurai, 2024). The CPCB imposed a cumulative fine of ₹355 crore on the violators; as of mid-2025, no update on actual recovery of these penalties had been publicly disclosed (Outlook Business, 2025).

The discovery was made through a random physical audit of just four out of 2,348 registered plastic waste recyclers a sample fraction of approximately 0.17% (Climate Samurai, 2024). Industry observers and regulators themselves noted that the number of fraudulent certificates could be substantially higher, given the limited scope of the audit (Climate Samurai, 2024). CSE's analysis found similar patterns of discrepancy between claimed processing volumes and registered and verified capacities across multiple states Delhi, Bihar, Madhya Pradesh, Andhra Pradesh, and Tamil Nadu with no regulatory action taken against recyclers in these states (Down to Earth, 2024). An independent analysis by ProIndia (2025) confirmed that in 2023, CPCB admitted that over 70% of PROs had not submitted audited recycling data, and that field inspections remained rare with most reviews limited to desk-based assessments.

The certificate fraud problem is compounded by a structural design flaw: the supply of fraudulent certificates drives EPR certificate prices down to artificially low levels, making genuine recycling operations economically unviable at market prices. When PIBOs can purchase certificates of compliance at prices far below the actual cost of genuine waste management, the financial incentive to invest in real collection infrastructure, support legitimate recyclers, or reduce plastic use at source is eliminated. The certificate market thus perversely selects for fraud.

4.3 Infrastructural Deficits and the Flexible Plastic Problem

India's recycling infrastructure is structurally inadequate to meet the EPR targets set under the 2022 Rules, particularly for the most environmentally problematic categories of plastic waste. Approximately 66% of plastic packaging introduced into the Indian market by volume is flexible in nature films, pouches, sachets, and multi-layer packaging which requires specialised collection, pre-treatment, and processing infrastructure that India's formal recycling sector does not possess at the required scale (CSE, 2024). The CSE assessment found 29% under-capacity in the formal registered recycling sector for flexible plastics. For compostable plastic recycling a category the government has promoted as an alternative to conventional plastics the situation was even more extreme: a capacity deficit of over 700%, with just one registered processing plant in the entire country (Down to Earth, 2024).

End-of-life co-processing units cement plants and waste-to-energy facilities authorised to earn EOL disposal certificates claimed to have collectively processed 335.4 Mt per annum of plastic packaging waste against a verified physical capacity of just 11.4 Mt a claimed-to-capacity ratio of approximately 29:1, pointing to systemic data manipulation on a scale that dwarfs even the packaging certificate fraud (Down to Earth, 2024). The absence of mandatory geographic tagging and physical linkage of EPR certificates to material recovery facilities means that the CPCB cannot, in real time, verify whether claimed processing has occurred or where processed material has gone.

4.4 Exclusion of Informal Waste Collectors and Urban Local Bodies

A structural deficiency of India's EPR framework that the CSE assessment highlighted as requiring urgent redress is the formal exclusion of informal waste collectors ragpickers, kabadiwalas, waste collection cooperatives and Urban Local Bodies (ULBs) from the EPR certificate value chain. Informal waste collectors perform the primary function of post-consumer plastic waste collection in most Indian cities, yet the EPR framework assigns no formal role, revenue stream, or compliance credit to their activities. The CSE noted that "urban local bodies and informal waste collectors lack representation in the EPR framework" and that "this absence deprives them of incentives and support to manage plastic waste effectively, placing an undue burden on local governments" (Down to Earth, 2024).

This exclusion is simultaneously an equity problem and an efficiency problem. Informal collectors estimated at approximately 1.5 to 4 million workers across India contribute disproportionately to the actual diversion of plastic waste from landfills and open dumpsites, yet receive none of the financial flows that EPR is designed to generate. Their exclusion also means that the data their collection activities generate is invisible to the CPCB, further undermining the accuracy of waste flow estimates. In the Philippines, integrating informal waste collectors into the EPR scheme through diversion certificate mechanisms was explicitly designed to address this equity gap; India's framework has not yet adopted an equivalent approach (World Bank, 2025).

Rural India presents an additional structural challenge. Nature's 2025 analysis estimated that rural plastic waste generation is substantially higher than official estimates, but rural areas remain almost entirely outside formal EPR collection systems, with Gram Panchayats the constitutionally mandated local governance institutions for rural areas lacking both the mandate and the resources to participate in the EPR framework (Insights on India, 2025).

4.5 Regulatory Capacity and the Enforcement Gap

The CPCB and SPCBs are structurally ill-equipped to enforce the EPR framework across the scale of India's plastic economy. The regulatory workforce available for physical verification, field inspection, and audit of plastic waste processors is a fraction of what is required to meaningfully oversee 2,348 registered recyclers, 41,577 registered PIBOs, and hundreds of end-of-life processors all generating compliance data on a portal that the CPCB is expected to monitor and verify (Climate Samurai, 2024; ProIndia, 2025). In the absence of automated verification tools GPS-enabled waste tracking, barcode or QR-linked material flow documentation, or blockchain-based certificate registries the CPCB's monitoring capacity is limited to desk-based review of self-reported data and occasional random physical inspections of a tiny fraction of the regulated population (ProIndia, 2025).

The penalty framework under Section 15 of the Environment (Protection) Act, 1986, provides for penalties ranging from ₹10,000 to ₹1.5 million for non-compliance, with an additional ₹10,000 per day for continuing violations (India Briefing, 2025). For large companies handling millions of tonnes of plastic annually, these penalties are economically trivial relative to the compliance costs they are intended to incentivise. The ₹355 crore fine imposed in the certificate fraud cases while the largest enforcement action

under the EPR framework to date had not been substantially recovered as of mid-2025, raising questions about the practical enforceability of even large penalty determinations (Outlook Business, 2025).

5. Conclusion and Recommendations

India's EPR framework for plastic waste management represents a normatively sound and administratively ambitious attempt to operationalise the polluter pays principle at scale in a complex, structurally fragmented economy. The 2022 Rules and their subsequent amendments have created the foundational architecture registration obligations, phased targets, certificate mechanisms, and a centralised digital portal required for a functional EPR system. The identification, within three years of operationalisation, of systemic certificate fraud, pervasive under-registration, massive infrastructure deficits, and the distortion of the certificate market provides, paradoxically, a valuable empirical basis for targeted reform. The government's implementation timeline extends to FY 2027–28, leaving a meaningful window for corrective action if the political and regulatory will is mobilised urgently.

Based on the preceding analysis, the following reform recommendations are proposed.
First, the certificate trading mechanism requires fundamental structural reform to restore the integrity of the polluter pays principle. The current model in which PIBOs satisfy EPR obligations by purchasing certificates at below-cost prices without any physical connection to the waste management activities those certificates purport to represent must be replaced or supplemented by a direct financial contribution obligation. PIBOs should be required to contribute a minimum per-tonne fee set at a level reflecting the actual baseline cost of plastic waste management to a dedicated EPR fund administered by the CPCB, with fund disbursements directed to registered collectors, recyclers, and ULBs based on verified performance data. This would decouple compliance from market certificate prices and ensure that EPR generates real, traceable revenue for the waste management system.

Second, anti-fraud infrastructure must be built into the certificate system as a non-negotiable technological prerequisite. A centralised EPR certificate registry, linked with GPS-enabled waste tracking and physical weighbridge data from recycling facilities, should be implemented to provide real-time verification of processing claims. Blockchain-based digital verification analogous to the GST e-invoicing system should be explored to create immutable audit trails for certificate generation, trading, and retirement. Independent third-party audit firms, empanelled by the CPCB and subject to mandatory annual rotation, must replace the current system of self-reporting and desk-based review. Physical capacity verification of all registered PWPs and EOL processors must be completed and publicly disclosed before any further certificates are issued by unverified entities.

Third, baseline data integrity must be treated as a regulatory emergency. The CPCB's official estimate of 4.1 Mt of annual plastic waste generation is contradicted by the portal's own registered data showing approximately 8 Mt of annual packaging alone, by Nature's per capita analysis suggesting national waste generation may be nearly five times official estimates, and by the implausible processing volumes claimed by EOL units (CSE, 2024; Insights on India, 2025). A rigorous national plastic waste audit, conducted in collaboration with independent academic institutions, CSE, and the World Bank, should be commissioned to establish credible baseline figures against which EPR targets can be realistically calibrated.

Fourth, informal waste collectors and ULBs must be formally integrated into the EPR value chain. A dedicated category of EPR certificates collection diversion certificates should be created for verified post-consumer plastic collection activities undertaken by registered informal collectors, cooperatives, and ULBs. PIBOs should be permitted to fulfil a defined percentage of their EPR obligations through the purchase of collection diversion certificates, creating a direct financial flow from industry to the informal waste sector. This would simultaneously formalise a significant existing collection capacity, improve data

coverage, and address the equity deficit in the current framework's exclusion of the workers who do the most work.

Fifth, the penalty structure must be substantially upgraded to create meaningful deterrence for large corporate actors. Penalties for EPR non-compliance should be restructured as a percentage of the obligated entity's annual turnover in plastic packaging consistent with global regulatory best practice in competition law and data protection with a minimum floor of ₹1 crore per year of non-compliance. Recovered penalties should be ring-fenced within the EPR fund for waste management infrastructure investment, creating a remedial connection between the financial consequences of non-compliance and the environmental problem that compliance is intended to address.

Sixth, eco-design incentives must be integrated into the certificate pricing system through eco-modulation. Fees and certificate prices should be differentiated based on the recyclability, mono-material composition, and recycled content of packaging, following the EU Packaging and Packaging Waste Regulation model. Packaging designed for recyclability should attract lower EPR obligations; packaging that uses non-recyclable materials, including most multi-layer formats, should attract significantly higher obligations that incentivise reformulation.

Seventh, judicial oversight through the National Green Tribunal (NGT) should be systematically engaged to ensure time-bound compliance by government actors. Consistent with the "continuing mandamus" approach used in environmental enforcement by the Supreme Court and NGT in cases such as the Vellore tanneries litigation, the Tribunal should be petitioned to direct periodic compliance reporting by MoEFCC, CPCB, and SPCBs ensuring that the political imperatives of short-term economic management do not consistently override the legally mandated EPR enforcement obligations.

India's commitment to reducing plastic pollution reflected in its endorsements of the UNEP International Legally Binding Instrument on Plastic Pollution (currently under negotiation), the Swachh Bharat Mission, and Sustainable Development Goal 12 on responsible consumption and production demands that its domestic EPR framework be not merely formally enacted but genuinely enforced. As CSE Director General Sunita Narain observed at the release of the 2024 assessment: the EPR guidelines are "an important tool, but the operational loopholes and other concerns that have emerged can lead to questions about its integrity we must ensure that all this effort does not end up being a waste of time" (CSE, 2024). Translating formal legal obligation into substantive environmental outcome is the central regulatory challenge before India's plastic waste governance institutions, and the reforms proposed here represent the minimum necessary to meet that challenge with the seriousness the crisis demands.

REFERENCES:

1. Banyan Nation. (2025, October 30). *Plastic waste management rules in India: Key laws and EPR*. https://www.banyannation.com/blog/plastic-waste-management-rules/
2. Centre for Science and Environment. (2024, October 29). *Is the polluter really paying in India's plastic packaging waste management ecosystem?* https://www.cseindia.org/is-the-polluter-really-paying-in-india-s-plastic-packaging-waste-management-ecosystem--12445
3. Climate Samurai. (2024, July 15). *CPCB uncovers massive fraud: Over 600,000 fake pollution-trading certificates found in plastic recycling audit*. https://climatesamurai.com/2024/07/15/cpcb-uncovers-massive-fraud-over-600000-fake-pollution-trading-certificates-found-in-plastic-recycling-audit/
4. Down to Earth. (2024, October 30). *700k fake certificates, major polluters missing: Misuse of EPR legislation worsening India's plastic problem, shows CSE report*.

https://www.downtoearth.org.in/waste/70k-fake-certificates-major-polluters-missing-misuse-of-epr-legislation-worsening-indias-plastic-problem-shows-cse-report
5. EcoNexa. (2025, September 16). *Extended Producer Responsibility (EPR) market in India*. https://www.econexa.co/blog/environment-knowledge-news-1/extended-producer-responsibility-epr-market-in-india-19
6. Environment (Protection) Act, 1986. Ministry of Environment, Forest and Climate Change, Government of India.
7. European Commission. (2019). *Directive (EU) 2019/904 on the reduction of the impact of certain plastic products on the environment (Single Use Plastics Directive)*. Official Journal of the European Union.
8. FICCI. (2024). *Plastic waste management rules and regulatory compliance challenges in India*. Federation of Indian Chambers of Commerce and Industry. https://ficci.in/public/storage/SEDocument/20708/wvJXfJlTEGj1Mrh6nMNN0RNyY1gf1ZPXOSfOBify.pdf
9. Grant Thornton India. (2022). *Extended producer responsibility for plastic waste*. https://www.grantthornton.in/globalassets/1.-member-firms/india/assets/pdfs/extended_producer_responsibility_for_plastic_waste.pdf
10. India Briefing. (2025, September 30). *Extended producer responsibility in India: Notes for investors*. https://www.india-briefing.com/news/extended-producer-responsibility-in-india-notes-for-foreign-manufacturers-40094.html/
11. Insights on India. (2025, April 30). *India's waste management crisis: Plastic pollution, EPR, and judicial oversight*. https://www.insightsonindia.com/2025/04/30/indias-waste-management-crisis/
12. Ministry of Environment, Forest and Climate Change. (2016). *Plastic Waste Management Rules, 2016*. Gazette of India Extraordinary.
13. Ministry of Environment, Forest and Climate Change. (2022, February 16). *Plastic Waste Management (Amendment) Rules, 2022*. Gazette of India Extraordinary.
14. Ministry of Environment, Forest and Climate Change. (2024, March 14). *Plastic Waste Management (Amendment) Rules, 2024*. Gazette of India Extraordinary.
15. OECD. (2022a). *Global plastics outlook: Economic drivers, environmental impacts and policy options*. OECD Publishing. https://doi.org/10.1787/de747aef-en
16. OECD. (2022b). *Extended producer responsibility: Updated guidance for efficient waste management*. OECD Publishing. https://doi.org/10.1787/9789264307094-en
17. OECD. (2023). *New aspects of EPR: Extending producer responsibility to miscellaneous plastics and other products* (OECD Environment Working Papers No. 253). OECD Publishing. https://one.oecd.org/document/ENV/WKP(2023)17/en/pdf
18. OECD. (2024). *Extended producer responsibility in the garments sector* (OECD Environment Working Papers No. 253). OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/12/extended-producer-responsibility-in-the-garments-sector_3a2dec33/8ee5adb2-en.pdf
19. Outlook Business. (2025, June 11). *How India's plastic waste rules are hollowed out by loopholes and lax enforcement*. https://www.outlookbusiness.com/planet/how-indias-plastic-waste-rules-are-hollowed-out-by-loopholes-and-lax-enforcement
20. Pani, S. K., & Pathak, A. A. (2021). Managing plastic packaging waste in emerging economies: The case of EPR in India. *Journal of Environmental Management*, *288*, Article 112405. https://doi.org/10.1016/j.jenvman.2021.112405
21. Press Information Bureau. (2022). *Extended Producer Responsibility guidelines mandate sustainable plastic packaging to reduce plastic footprint*. Government of India. https://www.pib.gov.in/PressReleasePage.aspx?PRID=1909909

22. ProIndia. (2025, May 6). *The truth behind India's EPR credit system*. https://proindia.net/the-truth-behind-indias-epr-credit-system/
23. Ramasubramanian, B., Tan, J., Chellappan, V., & Ramakrishna, S. (2023). Recent advances in Extended Producer Responsibility initiatives for plastic waste management in Germany and UK. *Materials Circular Economy*, *5*, Article 6. https://doi.org/10.1007/s42824-023-00076-8
24. Recykal. (2025, November 28). *A complete guide to EPR compliance in India (2025 update)*. https://recykal.com/blog/a-guide-to-epr-compliance-in-india/
25. Republic Act No. 11898, Extended Producer Responsibility Act, 2022 (Philippines).
26. Rio Declaration on Environment and Development. (1992). *Principle 16: Polluter pays principle*. United Nations Conference on Environment and Development.
27. ScienceDirect. (2024). *Designing and operationalising extended producer responsibility under the EU Green Deal*. https://doi.org/10.1016/j.sciaf.2024.001434
28. Singh, S. G., Chandra, A., & Biswas, A. (2024). *Unpacking EPR for plastic packaging in India: Navigating challenges and unlocking opportunities*. Centre for Science and Environment. https://www.breakfreefromplastic.org/wp-content/uploads/2024/11/http___cdn.cseindia.org_attachments_0.31282200_1730173267_unpacking-epr-for-plastic-packaging-in-india.pdf
29. Waste Recycling Magazine. (2024). *How successful is the EPR implementation in India?* https://www.wasterecyclingmag.com/news/plastic-recycling/how-successful-is-the-epr-implementation-in-india
30. World Bank. (2025). *Standards and the regulation of plastic wastes in developing countries*. https://thedocs.worldbank.org/en/doc/767e327ea700ed363674ddc7b94d9a2e-0050062025/original/Kate-ONiell-Standards-and-the-Regulation-of-Plastic.pdf