REGULATION OF E-WASTE IN INDIA: STUDY OF THE EXISTING ENVIRONMENTAL LEGAL REGIME

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ABSTRACT

India has built an ostensibly comprehensive legal architecture to govern electronic waste, anchored in the "Environment (Protection) Act, 1986 and the E-Waste (Management) Rules, 2022" as amended in 2024. This article argues that the regime exhibits a structural implementation deficit in which formal regulatory sophistication exceeds enforcement capacity, and it situates that argument within the scholarship on extended producer responsibility, environmental governance, and the informal economies of the Global South. Three problems are examined. First, the conversion of "Extended Producer Responsibility" (EPR) into a market in tradable certificates risks decoupling legal compliance from actual recycling, a risk now concretised in fraud allegations before the National Green Tribunal and in litigation by major producers over the 2024 floor-price regime. Second, the informal sector, which processes the bulk of national e-waste in clusters such as Delhi's Seelampur, remains formally unintegrated and unprotected, reproducing the "informal paradox" documented across the Global South. Third, the regulators charged with oversight lack the resources for credible verification. Engaging both the strongest defence of the certificate model and the doctrinal foundations of Indian environmental law, the article argues that, unless reoriented toward verification, integration, and eco-design, the framework risks operating as symbolic law.

Keywords: E-waste; environmental law; Extended Producer Responsibility; informal sector; environmental justice; circular economy; India.

I. Introduction

Electronic waste is now among the fastest-growing waste streams in India and the world.[1] E-waste differs from other waste in its composition: it carries lead, mercury, cadmium, and brominated flame retardants, whose improper handling injures both health and environment, and it occupies a paradoxical status as simultaneously a valuable secondary resource and a toxic hazard.[2] In India those risks are magnified by informal recycling, open burning and acid leaching in dense urban clusters, which contaminates air, soil, and water and exposes workers and their neighbours to toxic substances.[3]

India has responded with a regulatory framework anchored in the Environment (Protection) Act, 1986[4] and the "E-Waste (Management) Rules, 2022", in force since 1 April 2023 and covering 106 categories of equipment.[5] The framework's organising principle is "Extended Producer Responsibility" (EPR), "the policy idea, first theorised by Lindhqvist" that "the producer should bear responsibility for the entire life cycle of a product, including its end of life".[6] This article asks whether that framework actually reduces environmental harm or functions largely as symbolic law. Its thesis is that India's e-waste regime exhibits a structural implementation deficit, in which formal regulatory sophistication outruns enforcement capacity, and it distinguishes three things the regime conflates: symbolic compliance, documentary compliance, and substantive environmental protection. The argument is

[1]"On e-waste as the world's fastest-growing waste stream, see U.N. Inst. for Training & Rsch. & Int'l Telecomm. Union, The Global E-Waste Monitor 2024, at 20 (2024), https://www.globalewaste.org [hereinafter GEM 2024]. For Indian figures, see Press Info. Bureau, Gov't of India, E-waste Processing Management (July 24, 2025), https://www.pib.gov.in/PressReleasePage.aspx?PRID=2147876 (CPCB estimate of 13.97 lakh tonnes in FY 2024-25, up from 12.54 lakh tonnes the previous year)".

[2]World Health Org., "Electronic Waste (E-Waste): Fact Sheet (Oct. 1, 2024), https://www.who.int/news-room/fact-sheets/detail/electronic-waste-(e-waste)"; see also "Kun Wang, Junxi Qian & Lixiong Liu, Understanding Environmental Pollutions of Informal E-Waste Clustering in the Global South, 17 Int'l J. Env't Rsch. & Pub. Health 2802 (2020) (noting the paradoxical status of e-waste as simultaneously resource and pollutant)".

[3]Zafar Hassan & D.K. Dhusia, "Exploring the Problems Faced by Informal E-Waste Workers in Seelampur, Delhi, Env't Conservation J. (2025), https://journal.environcj.in/index.php/ecj/article/view/3230; see also Nate Millington & Mary Lawhon, Geographies of Waste: Conceptual Vectors from the Global South, 43 Progress Hum. Geography 1044 (2019) (theorising informal waste economies in the Global South)".

[4]Environment (Protection) Act, §§ 3, 5, No. 29 of 1986, India Code (1986) ("conferring on the Central Government power to take measures and issue directions to protect and improve the environment"). "The Act is itself a response to the Bhopal disaster; see M.C. Mehta v. Union of India, (1987) 1 S.C.C. 395 (India)".

[5]E-Waste (Management) Rules, 2022, Gazette of India, pt. II, sec. 3(i), G.S.R. 824(E) (Nov. 2, 2022) (in force Apr. 1, 2023; regulating 106 categories of equipment).

[6]The conceptual origin is Thomas Lindhqvist, "Extended Producer Responsibility in Cleaner Production: Policy Principle to Promote Environmental Improvements of Product Systems (IIIEE Dissertation 2000:2, Lund Univ. 2000), defining EPR as a principle to promote total life-cycle environmental improvement by extending producer responsibility to the post-consumer stage. See also Org. for Econ. Co-operation & Dev., Extended Producer Responsibility: Updated Guidance for Efficient Waste Management (2016)".

developed in dialogue with the EPR literature, environmental-justice scholarship on Global-South informal economies, and recent Indian enforcement evidence. Part II sets out the scale of the problem; Part III the legal architecture; Part IV the critique; Part V the reforms; and Part VI concludes. The method is doctrinal-evaluative, reading the text of the Rules against verified enforcement evidence rather than against government data alone.[7]

II. The Scale of the Problem

National generation almost doubled in eight years, from 7.08 lakh tonnes in 2017-18 to roughly 13.97 lakh tonnes in 2024-25.[8] Two features of these figures matter for the legal analysis. First, they are estimates derived from sales data and assumed product lifespans, not direct measurements; because the schedule of notified equipment expanded from 21 categories to 106, year-on-year figures are not strictly comparable, and the very definition of what counts as "e-waste" is contested in the scholarship.[9] Second, a substantial collection gap persists: even as formal processing has risen, much of what is generated is never formally collected, mirroring the global pattern in which only 22.3% of the world's 62 million tonnes was documented as properly recycled in 2022.[10] The regulatory question follows directly: are the instruments in force capable of closing the distance between waste generated and waste responsibly managed, given that global e-waste is rising five times faster than documented recycling?[11]

III. The Legal and Normative Architecture

"The regime is subordinate legislation under the Environment (Protection) Act, 1986, which empowers the Central Government to take measures and issue directions to protect environmental quality". Successive rules, framed in 2011, expanded in 2016, and recast in 2022, have progressively broadened coverage and tightened obligations. The 2022 Rules

[7]"The methodological posture of this article is doctrinal-evaluative: it reads the text of the Rules against verified enforcement evidence and the peer-reviewed literature, and it treats government data as a supplementary rather than a primary evidentiary source, given the documented reliability concerns canvassed at notes 16-17.

[8]Press Info. Bureau, supra note 1 (FY 2017-18 generation of 7.08 lakh tonnes rising to 13.97 lakh tonnes in FY 2024-25)".

[9]Cent. Pollution Control Bd., "e-Waste Management, https://cpcb.nic.in (FY 2021-22 generation estimated at 16,01,155 tonnes from 21 then-notified categories; the apparent divergence from the FY 2024-25 figure reflects a change in estimation methodology and the expansion of notified categories from 21 to 106, rather than an actual decline in generation)". "On the methodological difficulty of e-waste measurement and the indeterminacy of the category itself, see Wang, Qian & Liu, supra note 2".

[10]GEM 2024, supra note 1, at 20 ("62 million tonnes generated globally in 2022; only 22.3% documented as formally collected and recycled").

[11]Id. ("global e-waste rising five times faster than documented recycling; generation projected to reach 82 million tonnes by 2030").

operationalise EPR through a registration regime: producers, recyclers, and refurbishers must register on a CPCB portal, and producers must meet annually escalating recycling targets fixed by reference to past sales.[12]

The Rules also provide for environmental compensation on default and for verification and audit, and they articulate a circular-economy rationale.[13] The 2024 Amendment formalised an electronic trading platform for EPR certificates and relaxed certain compliance timelines.[14] Conceptually, EPR is the statutory embodiment of the polluter-pays principle: it internalises end-of-life cost in the producer rather than the municipality or the public.[15] Under the certificate mechanism an obligated producer discharges its duty by purchasing tradable certificates generated by registered recyclers. The design is meant to channel informal activity into formal business and to create a transparent market in compliance. It is also, as the next Part argues, the regime's principal vulnerability.

IV. A Critical Appraisal

A. The Certificate Market and the Decoupling of Compliance from Outcome

A certificate is only as good as the audited recycling that generates it. Where verification is weak, the certificate market can clear briskly while the physical waste it nominally accounts for is handled, if at all, by the very informal operators the regime was meant to displace; the certificate then ceases to evidence environmental performance and becomes a tradable permission to appear compliant.[16] This is not a merely theoretical hazard. An investigation drawing on affidavits before the National Green Tribunal alleges that recycling plants collectively authorised to generate EPR credits worth more than Rs 1,800 crore have overstated

[12]E-Waste (Management) Rules, 2022, supra note 5, rr. 5, 16 "(EPR obligations; registration of producers, recyclers, and refurbishers on the CPCB portal). The 2022 Rules supersede the E-Waste (Management) Rules, 2016, which in turn replaced the 2011 Rules. On the evolution of EPR across these instruments, see Daniel Faibil et al., Extended Producer Responsibility in Developing Economies, 41 Waste Mgmt. & Rsch. 297 (2023)".

[13]E-Waste (Management) Rules, 2022, supra note 5, "Schs. III-IV (recycling targets fixed by reference to past sales); id. rr. 21-22 (verification, audit, and environmental compensation). See Cent. Pollution Control Bd., FAQs under E-Waste (Management) Rules, 2022 (Jan. 23, 2024), https://cpcb.nic.in/uploads/Projects/E-Waste/FAQ_ewaste_23012024.pdf."

[14]E-Waste (Management) Amendment Rules, 2024, "Gazette of India, G.S.R. 163(E) (Mar. 8, 2024) (formalising the electronic-trading-platform framework for EPR certificates and relaxing return-filing timelines)".

[15]"On EPR as the statutory embodiment of the polluter-pays principle, see Lindhqvist, supra note 6, at 38-40; the point is foundational and distinguishes EPR from mere take-back obligations".

[16]Soumi Mukherjee, Decoding the Amended E-Waste Management Rules, The Week (Mar. 11, 2024), https://www.theweek.in/news/india/2024/03/11/decoding-the-amended-e-waste-management-rules (reporting expert concern that, absent enforcement, certificate trading may weaken accountability, and that the Central Government empowered itself to fix certificate prices).

their actual processing, even as the relevant State Pollution Control Board certified them compliant, precisely the gap between documentary and substantive compliance this article identifies.[17] The reliability of the regulator's own attestations is thus directly in question.[18]

The critique must, however, engage the strongest case for the model it questions. The tradable-certificate system was adopted for real reasons: administrative feasibility at national scale, lower transaction costs than individual take-back, and incentives to formalise. Major producers, among them Samsung, LG, Daikin, Carrier, Hitachi, and Havells, have in fact challenged the 2024 regime in court, arguing that an 80% recycling target and a fixed floor price are infeasible given the limited number of licensed recyclers.[19] That litigation cuts both ways: it shows the regime tightening rather than relaxing, yet it also reveals a capacity constraint, too few credible recyclers, that a certificate market cannot itself cure. The objection to the model, properly framed, is therefore not that markets are inapt for waste governance, but that a market uncoupled from verification inverts the very principle it implements.[20]

B. The Informal Sector: Ground Reality at Seelampur

The framework's blind spot is the informal economy that actually processes most of India's e-waste. The point is concrete. In Seelampur in north-east Delhi, one of the country's largest e-waste clusters, an estimated 50,000 informal workers strip, burn, and leach discarded electronics in narrow lanes and home workshops.[21] A cross-sectional study of 220 workers across Seelampur, Mustafabad, and Mandoli found that only 12% used any personal protective

[17]On the certificate market's decoupling of legal compliance from physical recycling, "compare the diagnosis in Faibil et al., supra note 11, at 305-08 (compliance-orientation in developing-economy EPR), with the empirical allegations in Anand Mishra, Exclusive: India's E-Waste Mirage, Newslaundry (July 30, 2025), https://www.newslaundry.com/2025/07/30/exclusive-indias-e-waste-mirage-crores-in-corporate-fraud-amid-govt-lapses-public-suffering (reporting that 31 plants authorised to generate EPR credits worth over Rs 1,800 crore are alleged, in NGT proceedings, to have overstated recycling)".

[18]Mishra, supra note 17 (Haryana State Pollution Control Board affidavit before the National Green Tribunal asserting full compliance of inspected plants, against allegations of documentary overstatement).

[19]The producer challenge is documented in "Why Are Electronics Giants Taking India's E-Waste Rules to Court?, Eco-Bus. (Nov. 4, 2025), https://www.eco-business.com/news/why-are-electronics-giants-taking-indias-e-waste-rules-to-court (Samsung, LG, Daikin, Carrier, Hitachi, and Havells challenging the 80% target and fixed floor price as infeasible given limited licensed-recycler capacity). This is the strongest defence of the prior flexible-trading model and must be confronted rather than ignored".

[20]The strongest case for the tradable-certificate model rests on administrative feasibility, transaction-cost efficiency, and formalisation incentives at scale; see Faibil et al., supra note 11, and the producers' own arguments in Eco-Bus., supra note 19. The critique offered here is not that markets are inapt but that, uncoupled from verification, they invert the principle they implement.

[21]Citizen Matters, In Photos: "Bleak Reality of the E-Waste Industry in Delhi's Seelampur (May 26, 2024), https://citizenmatters.in/e-waste-market-seelampur-delhi-hazards (estimating roughly 50,000 informal workers in the Seelampur cluster)".

equipment, and measured elevated lead concentrations in their hair samples.[22] These workers fall entirely outside the registration-and-certificate system; the law neither protects them nor captures the waste they handle. As recycling formalises and licensed plants absorb the valuable fractions, Seelampur workers report losing even this hazardous livelihood.[23]

This is the "informal paradox" that environmental-justice scholarship documents across the Global South, from Guiyu in China to Agbogbloshie in Ghana: informal recycling is at once a source of livelihood and a source of grave toxic exposure, and formalisation that ignores it tends to displace the burden rather than resolve it.[24] The Global E-Waste Monitor frames the lesson plainly: whatever material value the informal sector recovers is largely offset by health and environmental costs, and durable gains in collection depend on integrating, not bypassing, informal labour.[25] A regime that measures success by certificates traded, rather than by exposure reduced among those who handle the waste, can improve its own metrics while leaving the underlying harm, and the injustice of its distribution, untouched.

C. Institutional Capacity and Enforcement

The certificate and informal-sector problems share a root: enforcement capacity. "The CPCB and the State Pollution Control Boards" must register entities, verify processing, audit certificates, and impose environmental compensation, a technically demanding mandate.[26] The portal generates data, but its integrity depends on verification and audit functions that remain under-resourced; self-reported figures cannot substitute for inspection, as the NGT's recurring dissatisfaction with waste-rule compliance and the EPR-fraud allegations both suggest.[27]

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[22]Rachna Arora et al., Knowledge, Attitude and Practice Study of Health Risks Among E-Waste Recyclers in Delhi, 11 J. Health & Pollution art. 210306 (2021), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8009644 ("cross-sectional study of 220 workers in Seelampur, Mustafabad, and Mandoli; only 12% used personal protective equipment; elevated lead in hair samples)".

[23]Bhasker Tripathi, "In Delhi's E-Waste Hub, India's Informal Workers Lose Business, Context (Thomson Reuters Found.) (Nov. 26, 2025), https://www.context.news/just-transition/in-delhis-e-waste-hub-indias-informal-workers-lose-business (formalisation displacing Seelampur workers). On formalisation that marginalises rather than protects, see Millington & Lawhon, supra note 3".

[24]On the structural injustice of displacing environmental burdens onto the informal sector and the Global South, see Millington & Lawhon, supra note 3; and, on the Basel Convention origins of "toxic colonialism," the comparative discussion in Wang, Qian & Liu, supra note 2. The Agbogbloshie (Accra) literature describes the same "informal paradox" of livelihood and toxic exposure.

[25]GEM 2024, supra note 1 (material value recovered by the informal sector is largely offset by health and environmental costs; durable gains depend on formal-informal collaboration).

[26]E-Waste (Management) Rules, 2022, supra note 5, rr. 21-22; on the gap between paper systems and inspection capacity, see Faibil et al., supra note 11.

[27]The National Green Tribunal has repeatedly recorded dissatisfaction with authorities' compliance with waste rules even in the national capital; for the comparable plastic-waste EPR context, see News Item Published in "The Hindu" (NGT directions to finalise the EPR regime), and the discussion in Mishra, supra note 17.

Without credible verification, the entire edifice, targets, certificates, compensation, rests on representations the regulator cannot reliably test. This single deficiency, more than any drafting flaw, is what converts an ambitious regime into a symbolic one.

D. The Doctrinal Backdrop: Principles Without Purchase

The deficit is striking because Indian environmental jurisprudence already supplies the principles the regime needs. "The Supreme Court has read the precautionary principle and the polluter-pays principle into domestic environmental law,[28] and has held hazardous enterprise to a standard of absolute liability".[29] EPR is, in effect, a statutory expression of polluter-pays.[30] The gap is therefore not doctrinal but operational: the courts have furnished the normative foundation, and the Rules the administrative machinery, yet neither reaches the open fires of Seelampur. The deeper question this raises, whether a principle judicially declared but administratively unrealised retains any constitutional purchase, is one the e-waste regime poses with unusual sharpness, and one a faithful application of polluter-pays would answer by measuring compliance through environmental outcome rather than documentary discharge.

V. Pathways Toward Substantive Reform

Four reforms follow, and they stand or fall together. First, tie certificate generation to audited, environmentally sound processing, and insulate certificate pricing from discretionary intervention, so that a certificate again means recycling rather than permission; the fraud allegations make this the most urgent reform.[31] Second, integrate the informal sector through cooperatives, training, protective infrastructure, and recognised channels for handing material to authorised recyclers, so that formalisation protects livelihoods instead of erasing them. Third, resource the regulators: verification and audit require expertise and personnel if portal data is to support oversight rather than simulate it. Fourth, shift the regulatory centre of gravity upstream toward eco-design, repairability, and the reduction of hazardous inputs, aligning the regime with the circular-economy purpose it proclaims, and recognising that investment in

[28]Vellore Citizens Welfare Forum v. Union of India, (1996) 5 S.C.C. 647 (India) (reading the precautionary principle and the polluter-pays principle into Indian environmental law).
[29]M.C. Mehta v. Union of India, (1987) 1 S.C.C. 395 (India) (absolute liability for hazardous enterprise).
[30]On the alignment between EPR and polluter-pays, see Lindhqvist, supra note 6; for the Indian doctrinal articulation, see Vellore Citizens, supra note 28.
[31]On integrating informal recyclers into EPR systems rather than displacing them, see Millington & Lawhon, supra note 3; for a comparative integration model, see Faibil et al., supra note 11, at 309-11.

collection and recycling infrastructure tends to pay for itself.[32]

These are not independent options. Verification without integration formalises a fraction of the stream and leaves the rest in unsafe hands; integration without capacity creates duties no agency can police; and neither arrests the upstream generation of hazardous product. The point is sharpened by India's own strategic interest: the formalisation drive is now bound up with the National Critical Minerals Mission, which seeks to recover critical minerals through formal recycling, so that environmental integrity and resource security pull in the same direction.[33]

VI. Conclusion

India's e-waste law is well drafted and unevenly enforced, though that formulation should not be mistaken for a complete explanation: the regime's shortfall reflects not merely administrative will but the structural difficulty of governing an informal economy, a fragmented supply chain, and a globalised electronics market at once. Its EPR architecture, environmental-compensation provisions, and circular-economy language are sound in form; what is missing is the institutional capacity to make them bite. The certificate market risks substituting paper for processing, a risk no longer hypothetical; the informal sector that handles most of the waste remains outside the law's protection and reach; and the regulators cannot reliably verify what they require. The corrective is not more rules but verification, integration, capacity, and an upstream turn toward design. Until then, the measure of this regime is not the sophistication of its drafting but the tonnage it keeps out of open fires and the exposure it spares the workers of places like Seelampur.

[32]GEM 2024, supra note 1 (investment in collection and recycling infrastructure pays for itself through recovered materials and avoided costs).
[33]India's formalisation drive is bound up with the National Critical Minerals Mission (2023), which seeks to recover critical minerals through formal recycling; see Eco-Bus., supra note 19.

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