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E-waste regulation in India: A critical legal analysis of the E-waste management rules, 2022 and subsequent amendments

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Abstract
The increasing generation of electronic waste (e-waste) has emerged as a significant environmental and regulatory challenge in India. To address this issue, the Government of India introduced the E-Waste (Management) Rules, 2022, replacing the earlier 2016 framework. This study critically examines the provisions of the 2022 Rules and subsequent amendments introduced in 2023 and 2024, focusing on Extended Producer Responsibility, recycling targets, stakeholder accountability, hazardous substance management and regulatory compliance. It also explores the implications of these regulatory changes for sustainable waste management, resource recovery and environmental protection, while identifying challenges in their effective implementation.

Keywords: E-Waste management, E-Waste Rules 2022, extended producer responsibility, environmental sustainability

Introduction

The discarded and end-of-life electronics products ranging from computers, equipment used in Information and Communication Technology (ICT), home appliances, audio and video products and all of their peripherals are popularly known as Electronic waste (E-waste). E-waste is not hazardous if it is stocked in safe storage or recycled by scientific methods or transported from one place to the other in parts or in totality in the formal sector. The e-waste can, however, be considered hazardous if recycled by primitive methods. E-waste contains several substances such as heavy metals, plastics, glass etc., which can be potentially toxic and hazardous to the environment and human health, if not handled in an environmentally sound manner. E-waste recycling in the nonformal sector by primitive methods can damage the environment (Chatterjee) [1].

Electronic devices contain over 60 elements, including precious metals (Gold, Silver, Platinum, and Palladium), critical materials (Lithium and Cobalt), rare earth elements (Indium, Gallium, and Tantalum), and multiple hazardous substances and heavy metals (Lead, Mercury, Cadmium, and Chromium) (ITU & UNITAR, 2024) [2]. The concentration and combination of these materials vary across devices, requiring specialised processing. E-waste constitutes about 33% metals, 30% plastics, and 37% glass and other materials. Iron (52%) dominates the metal composition, followed by Copper (18%), Aluminium (12%), Zinc (3%), and Lead (3%). Other metals account for the remaining 12%. Also, E-waste contains a higher concentration of precious metals compared to traditional ores, creating substantial economic opportunities for formal E-waste processing.

India's transition towards a sustainable future is anchored in the Hon'ble Prime Minister's vision for Atmanirbhar Bharat (Self-Reliant India), which is centered on expanding clean technologies such as renewable energy, promoting electric vehicles (EVs), and digital infrastructure. India has taken preliminary steps toward establishing a circular economy framework under the E-Waste (Management) Rules, 2022.

The rapid expansion of India's electronics industry, coupled with technological advancements, increasing consumer demand and shorter product life cycles, has contributed to the growing generation of electronic waste (e-waste). E-waste comprises discarded electrical and electronic equipment and contains both valuable recoverable materials and hazardous substances that may pose serious risks to human health and the environment if improperly managed. Recognising these challenges, the Government of India introduced the E-Waste (Management) Rules, 2022, which came into force on 1 April 2023, replacing the earlier 2016 framework. The Rules establish an Extended Producer Responsibility (EPR) mechanism, placing greater accountability on producers for ensuring the environmentally sound management and recycling of electronic waste.

At the global level, e-waste generation continues to increase, while formal collection and recycling systems remain inadequate, highlighting the need for stronger regulatory and institutional mechanisms (Baldé *et al*., 2024) [3]. The 2022 Rules establish an EPR-based framework through mandatory registration, recycling targets and EPR certificates. Subsequent amendments in 2023 and 2024 have further modified selected compliance and enforcement provisions (Ministry of Environment, Forest and Climate Change [MoEFCC], 2022, 2024) [4, 5]. Nevertheless, challenges relating to collection mechanisms, recycling infrastructure, regulatory enforcement and stakeholder coordination continue to require attention (NITI Aayog, 2026) [6]. Therefore, this study critically examines the legal framework and its practical effectiveness in promoting environmentally sound e-waste management in India.

Objectives of The Study

The present study is guided by the following two objectives:

1. To critically examine the provisions of the E-Waste (Management) Rules, 2022, and subsequent amendments introduced in 2023 and 2024, with particular reference to Extended Producer Responsibility, stakeholder responsibilities and regulatory compliance.
2. To analyse the effectiveness and implementation challenges of India's e-waste regulatory framework in promoting environmentally sound recycling, resource recovery and sustainable e-waste management.

Research Design

The present study adopted a descriptive research design.

Analysis

The Ministry of Environment, Forests, and Climate Change (MoEFCC) established an E-waste management framework through the E-waste (Management) Rules, 2022, which superseded the E-waste (Management) Rules, 2016. The framework was subsequently amended in 2023 and 2024 to address gaps and evolving technological challenges.

Table1: Key highlights of E-Waste Management Rules, 2022, and its amendments

Title	Gazette Notification	Policy Description
E-waste (Management) Rules, 2022	G.S.R. 801(E) (02.11.2022)	Established an E-waste management framework with provisions of producer responsibility, collection and recycling targets, mandatory stakeholder registration and authorization, environmental safeguards for processing activities, and strengthened monitoring and compliance systems.
		Apply to manufacturers, refurbishers, dismantlers, recyclers, and importers of electrical and electronic equipment and its components.
		Standardized reporting of material flow and processing outcomes, environmental clearances for facilities, and penalty enforcement by the CPCB and SPCBs.
E-waste (Management) Amendment Rules, 2023	G.S.R. 61(E) (30.01.2023)	Strengthened producer accountability by tightening reporting requirements.
		Expanded exemptions from hazardous substance restrictions for specified solar and medical equipment.
		Enhanced disclosure of hazardous substances in electrical and electronic equipment.
E-waste (Management) Second Amendment Rules, 2023	G.S.R.534(E) (24.07.2023)	Assigned responsibility for refrigerant destruction to manufacturers and recyclers.
		Introduced conversion factors for EPR certificates to standardize compliance estimates.
		Updated exemptions under Schedule II.
E-waste (Management) Amendment Rules, 2024	G.S.R. 164(E) (08.03.2024)	Clarified definitions of dismantlers and extended reporting timelines in specified circumstances
		Empowered the Central Government to establish EPR certificate trading platforms under CPCB to strengthen market-based compliance and traceability mechanisms.

Table 1 presents the major provisions and regulatory developments introduced under the E-Waste (Management) Rules, 2022, along with their subsequent amendments in 2023 and 2024. The original Rules, notified through G.S.R. 801(E) on 2 November 2022, established a comprehensive framework for e-waste management by introducing Extended Producer Responsibility (EPR), recycling targets, mandatory registration of stakeholders, environmental safeguards and enhanced monitoring mechanisms. The first amendment, notified through G.S.R. 61(E) on 30 January 2023, focused on strengthening producer accountability, modifying certain exemptions relating to hazardous substances and improving disclosure requirements. Subsequently, the Second Amendment Rules, notified through G.S.R. 534(E) on 24 July 2023, addressed refrigerant destruction responsibilities, introduced conversion factors for EPR certificates and revised certain exemptions under Schedule II. Further, the 2024 Amendment, notified through G.S.R. 164(E) on 8 March 2024, introduced additional clarifications concerning stakeholder definitions and reporting requirements, along with provisions relating to EPR certificate trading mechanisms. Collectively, these regulatory developments reflect the evolving approach of the Indian government towards strengthening producer responsibility, improving recycling practices, enhancing regulatory compliance and promoting environmentally sustainable e-waste management.

Key Challenges in Implementation and Enforcement

E-Waste management has become a global concern with the huge rise of technology, shortened product life cycles, and increasing consumption of electronic devices. It is the serious growing concern stream around worldwide.

- **Dominance of the Informal Sector**

1. The (Yadav *et al*. 2025) [7] study finds out that the informal sector dominates the e-waste collection and recycles process in India which is highly irregulated.

- **Weak Regulatory Enforcement & Compliance Gaps**

1. State Pollution Control Boards (SPCBs) and central authorities often lack the manpower, technical tools, and resources to audit and monitor thousands of producers, recyclers, and dismantlers.
2. Paperwork manipulation remains rampant; for instance, investigations have uncovered hundreds of thousands of fake or fraudulent EPR recycling/pollution certificates.

- **Flaws in EPR Pricing and Economics**

1. The market cost for collecting and responsibly recycling electronics is often higher than what

manufacturers or PROs (Producer Responsibility Organizations) budget for.
2. This creates unfair competition where compliant firms struggle against uncompliant actors who bypass green norms to cut costs.

- **Resistance from Large Manufacturers**

1. Major consumer electronics and tech brands frequently push back against strict compliance timelines, data-reporting burdens, and escalating EPR recovery targets, citing logistical and cost hurdles.

- Infrastructure Gaps and Regional Disparities (Verma 2025) [8]:

1. India lacks a widespread network of authorized, high-tech e-waste dismantling and recycling plants.
2. Smaller cities and rural areas suffer from a complete absence of safe collection channels, forcing households to throw electronics into regular municipal landfills or burn them.

- **Low Public Awareness**

1. Most consumers do not know the toxic risks of improper e-waste disposal or the location of authorized drop-off points, treating old gadgets like regular municipal trash.

Conclusion

The E-Waste (Management) Rules, 2022, along with subsequent amendments, represent an important regulatory framework for addressing India's growing electronic waste management challenges. The introduction of Extended Producer Responsibility, mandatory registration, recycling targets and improved monitoring mechanisms provides a structured approach to managing e-waste. However, effective implementation requires stronger regulatory enforcement, adequate recycling infrastructure, technological advancement and greater stakeholder participation. Strengthening compliance mechanisms and promoting formal recycling practices are essential for improving resource recovery, reducing environmental pollution and achieving sustainable e-waste management in India.

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