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An Introduction to the E-Waste Management System in India

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ABSTRACT

Electronic waste (e-waste) has emerged as one of the fastest-growing waste streams globally, owing to rapid technological advancement, increased consumption of electronic devices, and shorter product life cycles. India, as one of the world's largest consumers of electrical and electronic equipment, faces significant challenges in managing the growing volume of e-waste. In response, the Government of India introduced the E-Waste (Management) Rules, 2022, replacing the earlier E-Waste (Management) Rules, 2016. The 2022 Rules seek to strengthen the regulatory framework through an improved Extended Producer Responsibility (EPR) regime, mandatory registration of stakeholders, digital monitoring systems, and enhanced recycling targets. This paper examines the evolution of the e-waste management system in India and critically analyses the E-Waste (Management) Rules, 2022 in the context of sustainable development.

Keywords: *E-Waste, Extended Producer Responsibility, Sustainable Development Goals, Environmental Governance, India, E-Waste (Management) Rules, 2022.*

I. INTRODUCTION

The rapid advancement of science and technology has transformed modern society by improving communication, healthcare, education, transportation, and industrial productivity. However, the increasing dependence on electrical and electronic equipment has also generated a significant environmental challenge in the form of electronic waste, commonly known as e-waste. Electronic waste consists of discarded electrical and electronic devices that have reached the end of their useful life through obsolescence, replacement, damage, or technological advancement. Computers, laptops, mobile phones, televisions, refrigerators, printers, air conditioners, and other electronic appliances constitute major sources of e-waste, which has emerged as one of the fastest-growing waste streams worldwide.

E-waste is a broad category of hazardous pollutants that, if not handled properly, can have lasting effects on human health and the environment. These pollutants include flame retardants,

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lead, mercury, arsenic, cadmium, selenium, and hexavalent chromium.¹ Because most of India's e-waste is disposed of in the unorganised sector, this is a serious concern. The volume of e-waste generated poses a major threat to the environment and to public health, especially in major cities such as Bangalore, Mumbai, and Delhi. Harmful methods used in the informal sector include open-air burning of e-waste to recover copper and other materials; metal stripping in outdoor acid baths to recover precious metals; dismantling with hammers, chisels, screwdrivers, and bare hands to separate materials; disposal of toxic substances in fields and along rivers; and landfilling in non-designated sites where large amounts of e-waste are dumped. Improper handling of e-waste can have several detrimental effects on both the environment and public health: hazardous substances such as lead, arsenic, mercury, and polychlorinated biphenyls (PCBs) are found in e-waste, and considerable harm is caused when it is not properly treated.² When e-waste is improperly disposed of (that is, when it is disassembled, shredded, or melted), dust and airborne contaminants such as dioxins are released, which can aggravate respiratory conditions. Burning e-waste releases tiny particles into the air that can travel thousands of miles, increasing the risk of cancer and chronic illness in both humans and animals. Because air pollution degrades soil, water, and plant life, it harms ecosystems. E-waste improperly disposed of in conventional landfills or unapproved locations can leak flame retardants and heavy metals into the environment; these pollutants are dangerous to soil, plants, and microorganisms and can linger in the ground for a long time.³

II. IMPORTANCE AND NEED FOR THE E-WASTE MANAGEMENT RULES IN INDIA

Toxins from e-waste, including lead, mercury, lithium, and barium, penetrate the earth and, after contaminating the soil, reach groundwater. These pollutants eventually find their way into ponds, streams, rivers, and lakes. Regardless of distance from the source, animals, plants, and human populations are placed at risk by the acidity and toxicity that these channels carry into the water.⁴ Humans and other species can be adversely affected by e-waste, which contains toxic materials capable of damaging the central nervous system and causing birth deformities, cancer, neurological conditions, and respiratory ailments. This effect is especially pronounced in developing countries such as India, where the majority of e-waste recyclers work in the unorganised sector. The informal sector is often more attractive than the formal sector owing to

¹ Mark Anderson, *What an E-Waste*, IEEE SPECTRUM, Sept. 2010, at 72.

² Anwesha Borthakur & Madhav Govind, *Public Understandings of E-Waste and Its Disposal in Urban India: From a Review Towards a Conceptual Framework*, 172 J. CLEANER PROD. 1053 (2018).

³ Ahmad-Faisal Alias et al., *E-Waste Management: An Emerging Global Crisis and the Malaysian Scenario*, 4 INT'L J. ENVTL. SCI. 444 (2014).

⁴ Federico Magalini, *Global Challenges for E-Waste Management: The Societal Implications*, 31 REVS. ON ENVTL. HEALTH 137 (2016).

a lack of information and the presence of financial incentives, and e-waste is increasing quickly, reflecting a broader social and moral dilemma.⁵

Waste that presents significant or potential risks to the environment and public health, and that typically meets one or more prescribed criteria, is considered hazardous. Over the past few decades, India's rapid industrialisation has expanded the generation of hazardous waste; the term 'hazardous waste' was earlier known as 'special waste'. Lead, found in old computer monitors and televisions, is a neurotoxin that endangers the nervous system. Hazardous waste, whether solid, liquid, or gaseous, that has no known use and is likely to harm human health or the environment because of its physical, chemical, or reactive nature, or that is flammable, explosive, corrosive, radioactive, or infectious, is dangerous to create, handle, store, transport, treat, or dispose of. The effective implementation of the 2022 Rules can significantly advance environmental protection, resource efficiency, circular-economy practices, and sustainable development. However, challenges such as informal recycling, inadequate infrastructure, low public awareness, and enforcement gaps continue to hinder effective e-waste management.

III. MEANING AND DEFINITION OF E-WASTE

The term 'e-waste' is commonly used to describe any outdated, end-of-life electrical appliances that have been discarded by their owners. Thus, anything electrical or electronic that has been discarded after reaching the end of its useful life, such as outdated computers, television sets, refrigerators, radios, telecommunication equipment, laboratory and health-related equipment, and other handheld devices, would be considered e-waste.

IV. IMPORTANCE AND NEED FOR SAFE DISPOSAL OF E-WASTE

E-waste is not a single substance; it is a combination of complex hazardous materials. Radioactive materials, poisonous chemicals, and infectious or biological waste are all considered hazardous. These dangerous substances affect not only the individuals exposed to them at work but also the general public in their homes, communities, and surroundings.

Environmental disasters are those that result from hazardous waste being disposed of carelessly. The Bhopal gas leak of 1984 released Methyl Isocyanate (MIC), resulting in a catastrophic event in India. Hazardous-waste generation has long been a part of modern civilisation, but only after environmental catastrophes in the Love Canal region of Niagara Falls, New York, and elsewhere in the late 1970s did the issues surrounding its safe disposal come to light.

⁵ D. Beula & M. Sureshkumar, *A Review on the Toxic E-Waste Killing Health and Environment: Today's Global Scenario*, 47 MATERIALS TODAY: PROC. 2168 (2021).

Through the manufacture of chemical goods, which have contributed to agricultural productivity, improved health and life expectancy, expanded economic prospects, and greater comfort, rapid industrialisation has improved the quality of life. However, the inevitable creation of chemical residues during the manufacture of these compounds also poses previously unprecedented threats to the environment and public health.

V. CONSTITUTIONAL AND LEGISLATIVE PROVISIONS

The Factories Act, 1948 provides a legal definition of hazardous processes. Under Section 2(cb)⁶, a ‘hazardous process’ is any process or activity in an industry specified in the First Schedule in which, unless special precautions are taken, the raw materials, intermediate or finished products, by-products, wastes, or effluents could (i) cause material impairment to the health of the persons engaged in or connected with the process, or (ii) result in pollution of the general environment. The State Government may modify the First Schedule by adding, removing, or altering any industry listed in it through a notification published in the Official Gazette.

Furthermore, Section 12 of the Act, concerning the disposal of wastes and effluents, mandates that every factory make effective arrangements to treat and dispose of the wastes and effluents arising from its manufacturing process so as to render them innocuous.⁷ The State Government may make rules prescribing these arrangements or requiring that they be approved by the prescribed authority.

This statute remains significant because it addressed wastes and effluents and their hazardous nature in line with Article 21 of the Indian Constitution, which forms the basis for legislation concerning hazardous-waste disposal and environmental protection, even though it was not enacted in the same spirit as the Environment (Protection) Act, 1986.⁸ A ‘hazardous substance’ is any substance or preparation that, because of its chemical or physico-chemical properties or handling, is liable to cause harm to humans, other living creatures, plants, microorganisms, property, or the environment. The Environment (Protection) Act, 1986 used this term, although it did not refer to ‘wastes’.⁹

The Hazardous Wastes (Management and Handling) Rules, 1989 provided, in Rule 3, a definition of hazardous waste by reference to the categories listed in the Schedule.¹⁰ The

⁶ The Factories Act, 1948, No. 63, Acts of Parliament, 1948, § 2(cb) (India).

⁷ *Id.* § 12.

⁸ The Environment (Protection) Act, 1986, No. 29, Acts of Parliament, 1986 (India).

⁹ *Id.* § 2(e).

¹⁰ The Hazardous Wastes (Management and Handling) Rules, 1989, r. 3 (India), *amended by* The Hazardous Wastes (Management and Handling) Amendment Rules, 2003.

Schedule includes numerous chemicals, compounds, and other wastes to be regarded as hazardous; radioactive waste, ship and marine wastes, and wastewater and exhaust gases are excluded. The term was further defined in 2003 by the Hazardous Wastes (Management and Handling) Amendment Rules. Under these provisions, the wastes listed in column (3) of Schedule 1 are hazardous; wastes containing substances listed in Schedule 2 are hazardous where the concentration equals or exceeds the specified threshold; and the wastes in Lists 'A' and 'B' of Schedule 3 (Part A) may be imported or exported only in compliance with Rules 12, 13, and 14, and only if they possess any of the hazardous characteristics specified in Schedule 3 (Part B). By way of explanation, all wastes listed in column (3) of Schedule 1 are hazardous regardless of the concentration limits in Schedule 2 (which applies only to wastes or waste constituents not covered by column (3) of Schedule 1), and Schedule 3 is relevant only in the event of import or export.

VI. SALIENT FEATURES OF THE E-WASTE (MANAGEMENT) RULES, 2022

The E-Waste (Management) Rules, 2022 mandate Extended Producer Responsibility (EPR), legally requiring stakeholders in waste management to safely channel, process, and recycle electronic waste through formally registered recyclers rather than through physical collection targets.¹¹

Solar-panel coverage. Solar photovoltaic (PV) modules, panels, and cells are now formally classified as e-waste, subject to specialised disposal procedures and inventory reporting under the latest Rules.

Reduction of Hazardous Substances (RoHS). Producers of electrical and electronic equipment (EEE) must ensure that their products do not contain heavy metals or hazardous components, such as lead, mercury, or cadmium, beyond the prescribed concentration levels.

Penalties and audits. The Rules introduce strict environmental compensation for non-compliance, data fabrication, and crude disposal methods.

VII. JUDICIAL MILESTONES IN INDIA'S E-WASTE MANAGEMENT

In 1999, the Supreme Court of India constituted a committee to evaluate waste management in Class-I cities, paving the way for India's first Municipal Solid Wastes (Management and Handling) Rules, 2000¹².

¹¹ The E-Waste (Management) Rules, 2022 (India) (notified Nov. 2, 2022; in force Apr. 1, 2023; superseding The E-Waste (Management) Rules, 2016).

¹² *Almitra H. Patel v. Union of India*, Writ Petition (Civil) No. 888 of 1996 (India) (order dated Feb. 15, 2000).

India formally introduced Extended Producer Responsibility (EPR) for electronic waste under the E-Waste (Management and Handling) Rules, 2011,¹³ and in 2016 the Central Pollution Control Board strengthened the mandate, binding bulk consumers, dismantlers, and recyclers more closely to scientific disposal methods. The National Green Tribunal, in *Shree Nath Sharma v. Union of India* (decided 17 January 2023),¹⁴ held that it is the constitutional obligation of the States and Union Territories to ensure compliance with the mandate under Articles 243G, 243W, and 243ZD read with the Eleventh and Twelfth Schedules. A clean environment is part of the right to life under Article 21 of the Constitution and is also fundamental to governance under Article 37 read with Articles 47 and 48A. The environment is likewise covered by the definition of ‘disaster’ under Section 2(d) of the Disaster Management Act, 2005.¹⁵ Effective administrative machinery to address these matters is therefore required at all levels, and the existing machinery should be revamped from time to time to meet the challenge.

VIII. CONCLUSION

The evolution of India’s e-waste management framework reflects the country’s growing commitment to environmental sustainability and resource efficiency. The E-Waste (Management) Rules, 2022 represent a significant advance in regulatory governance, introducing an improved Extended Producer Responsibility regime, digital compliance mechanisms, and enhanced accountability measures. Although rules on waste management already existed in India, the 2022 Rules are more comprehensive in regulating the handling and management of e-waste. They were notified by the Ministry of Environment, Forest and Climate Change and came into force with effect from 1 April 2023. Under these Rules, all manufacturers, producers, refurbishers, and recyclers must register on the centralised CPCB e-waste management portal.

¹³ The E-Waste (Management and Handling) Rules, 2011 (India).

¹⁴ *Shree Nath Sharma v. Union of India*, O.A. No. 360 of 2018 (NGT, Jan. 17, 2023) (India).

¹⁵ The Disaster Management Act, 2005, No. 53, Acts of Parliament, 2005, § 2(d) (India).