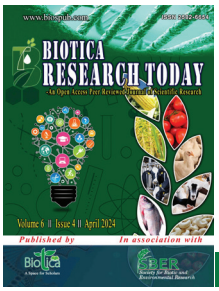
Bio. Res. Today 2024, 6(4):188-191



Biotica Research Today

e-ISSN: 2582-6654

April, 2024

Article ID: RT1580 **Popular Article**

Transforming E-Waste: Circular Economy and Resource Efficiency in India

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Open Access

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Conflict of interests: The author has declared that no conflict of interest exists.

How to cite this article?

Devi, R.U., Sarkar, P., Kumar, S., 2024. Transforming E-Waste: Circular Economy and Resource Efficiency in India. *Biotica Research Today* 6(4), 188-191.

Abstract

In today's world of rising purchasing power and technological improvement, electronic waste poses a significant global pollution issue besides others leading to economic, environmental and health consequences. Developed nations often dump their e-waste into developing nations where informal recycling practices prevail and stakeholders are not bound by any regulations. Therefore, proper management and treatment of e-waste is important to reduce its hazardous impacts, reflecting the zero-waste management concept, a comprehensive approach recognizing waste together a resource and also a measure of modern society's inefficiency. India stands third next to China and the USA producing 13 and 16 lakh tonnes in 2020-21 & 2021-22 respectively, according to CPCB. This article offers insights into India's strategy for resource efficiency to address the e-waste sector challenges with transition from traditional waste management to a circular and resource-efficient system. This shift promotes sustainable practices fostering a circular economy approach to e-waste management.

Keywords: E-Waste management, Resource efficiency, EPR, Circular economy

Introduction

Technological advancements, characterized by rapid digitalization and innovation, have significantly improved lives worldwide by making them easier and better. The utilization of electrical and electronic devices is experiencing a rapid and substantial expansion. So, the result is the e-waste. The United Nations termed it a 'Tsunami' of e-waste as it is the world's fastest-growing stream and turning out into a significant global environmental issue. E-waste, encompassing both functional and broken items, refers to any discarded and rejected electric and electronic equipment. The discarded electronic equipment, specified as "e-waste" or "Waste of Electronic and Electrical Equipment (WEEE)," is defined as "electrical and electronic equipment which is waste - including all components, subassemblies and consumables, which are part of the product at the time of discarding" (EU WEEE Directive 2012/19/EU Article 3e, 2012). E-waste refers to electrical-powered appliances of various sizes and functions that are no further wanted by the consumer. The expression 'no further wanted' encompasses the idea that e-waste not only may result from products losing their service function or reaching the end of their lifespan but also from consumer behaviour or antiquated technology that reduces the lifespan of Electrical and Electronic Equipment (EEEs).

E-Waste in India is defined as the electrical and electronic equipment (EEE), being discarded/disposed as waste, either entire or partially, by consumers (individual and bulk) including the rejected ones from manufacturing, refurbishment and disposal, under the 2016 E-waste (Management) Rules. In this, Schedule I has divided different electrical and electronic equipments (EEE) into two broad categories. Of which one includes the Information, technology and communication (ITEW) and the other includes Consumer electrical and electronics (CEEW) (Figure 1).

E-Waste Growth in India - Management Crisis

The global challenge of electronic waste is impacting India, primarily due to the swift and unsafe disposal of electronic devices. With the Indian middle-class population rise and the surged technology penetration into the country, India

Article History

RECEIVED on 04th March 2024 RECEIVED in revised form 20th April 2024 ACCEPTED in final form 21st April 2024

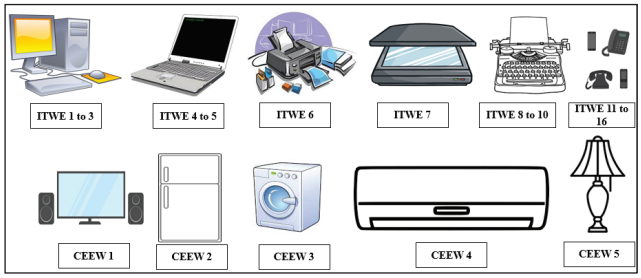

Figure 1: Various categories of EEE

is becoming one of the largest electronics markets in the world. Also, the country is among the top generators of e-waste globally, coupled with a poor record in tracking the disposal of both unwanted as well as used electronics. Massive challenges are being faced with an increased push for high sustainability. Key factors contributing to this situation include inadequate awareness, limited organized recycling efforts, the influx of waste equipment across borders into India, insufficient outreach and awareness regarding proper disposal and a lack of coordination among various authorities. These factors collectively account for the limited involvement of municipalities in e-waste management.

As per the Global E-Waste Monitor report 2020, the world witnessed the production of a striking rate of 53.6 Metric Tonnes (MT) of e-waste, contributing 7.3 kg per capita average in 2019 (Pandey and Singh, 2023). Asia stood in 1st position in e-waste generation, producing 24.9 MT, subsequently America with 13.1 MT, Europe with 12 MT and Africa and Oceanica with 2.9 MT and 0.7 MT, respectively. India retrieved almost 3.2 MT of e-waste, securing the third position next to China (10.1 MT) and the USA (6.9 MT) in 2019. A recent report from the CPCB (Central Pollution Control Board) revealed that India managed to collect just 10% of the estimated e-waste generated in the country during 2018-19 and 3.5% of which was produced in 2017-18. An assessment for the proper implementation of effective resource efficiency in India is needed to be made by studying the existing significant gap in between e-waste generation and its collection for further recycling. The pie chart (Figure 2) reveals a significant coordination gap among Indian states in managing e-waste. Among the top ten states engaged in these activities, Haryana stands out by securing the first rank, single-handedly contributing 47% to the overall collection

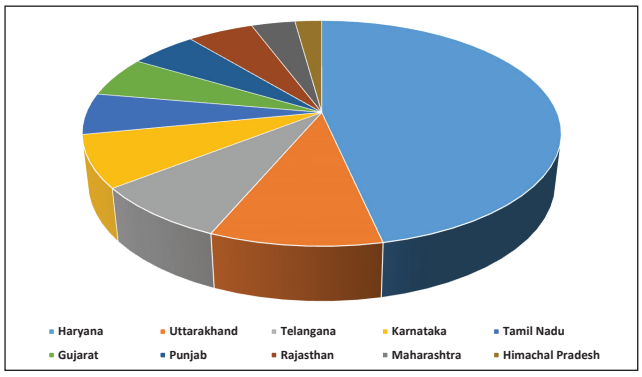

Figure 2: Top ten e-waste collection and processing states in India (in Tonnes) during FY 2021-22

and processing. In contrast, the 10th ranked state, Himachal Pradesh, only contributes a mere 2% to the total collection. This stark contrast highlights that states outside these top ten categories make minimal contributions to e-waste collection. In light of this, it is evident that other states should consider adopting the Haryana model for the e-waste management strategy to improve their contributions in this crucial aspect.

India's Domestic E-Waste Production

The production of electronic goods within the domestic market has experienced a remarkable upsurge, escalating from Rs. 3,17,331 crores (equivalent to 49 billion USD) in the fiscal year 2016-17 to Rs. 6,40,810 crores (approximately 87.1 billion USD) in the fiscal year 2021-22, showcasing a notable Compound Annual Growth Rate (CAGR) of 15%. According to the latest annual report released by the MeiTY (Ministry of Electronics and Information Technology), Government of India, it is projected that India's electronic manufacturing sector will soar to a staggering 300 billion USD by the year 2026. There was 43% rise in India's e-waste generation between FY 2018-20. An ASSOCHAM (Associated Chambers of Commerce & Industry of India) study says that computer equipment owes to almost 72% of e-waste in India, subsequently telecom/ phones (13%), electrical equipment (8%) and medical equipment (7%) (Figure 3) (Garg and Adhana, 2019). The manufacturing rate has rised significantly for mobile handsets, Liquid Crystal Display (LCD) and Light-Emitting Diode (LED) products like TVs in the country in recent years as a result of rising demand for these electronic products.

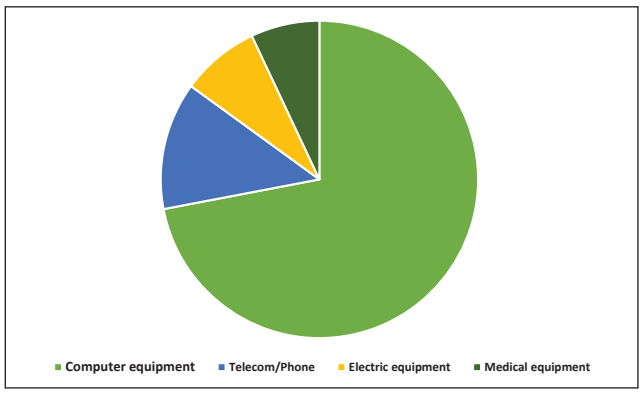

Figure 3: E-waste production profile in India

India - World's Dumping Ground for E-Waste

India is one of the world's largest electronic markets owing to its growing middle-class population and exclusive technology penetration. As per the 2015 United Nations Environment Programme (UNEP) report, around 90% of the world-wide produced electronic waste is unlawfully disposed of in India, placing the country at the forefront of the estimated 1.8 MMT (million metric tonnes) of domestic e-waste produced annually. It was reported that almost 90% of the produced e-waste is dispatched to the developing nations across the globe with only the remaining 10% being recycled in developed countries (Abalansa *et al.*, 2021). US is the major contributor of e-waste in India shipping around 42% of its generated e-waste into the country, and then

China (30%), the EU (18%) and Taiwan, South Korea & Japan (each 10%) into Delhi (Figure 4).

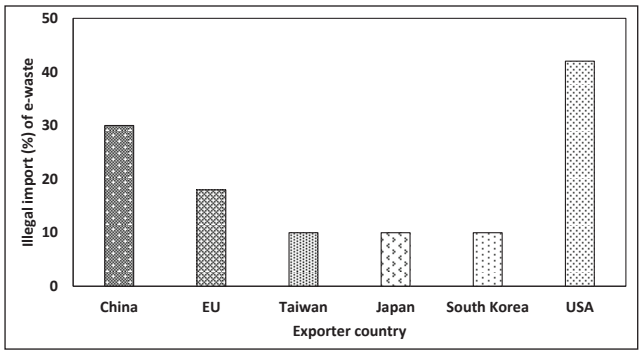

Figure 4: Contribution (%) of illegal import of e-waste into India

India - National Action Plan

In the 2018 released Environmental Performance Index by the World Economic Forum, India is positioned in the lower 10 out of 180 countries. The regulations to manage e-waste in India were introduced for the first time in 2011 and enforced from 2012 having been amended twice, once in 2016 and again in 2018. Under mandated 2012 regulations, take-backs came into action but no specific targets and incentives. Whereas, pertaining to collection more regulatory certainty was provided by the 2016 amendment. However, changes made in 2018 said to be the latest with yearly revised collection targets by 10% until 2023 under EPR. Thereafter, this has been made 70% of the quantity of e-waste generated by 2023, according to CPCB.

The Government implemented the Hazardous and Other Wastes Rules 2016 for a ban on e-waste imports into the country. The government has established a monitoring system for Extended Producer Responsibility (EPR) obligations concerning Producers along with Producer Responsibility Organizations (PROs) under the regulations of E-Waste (Management) Rules, 2016. During the 2021-22 financial year, EPR targets were adjusted from 50% to 40% based on industry representations and considering the pandemic-posed challenges (PIB, 2023).

EPR involves the execution of a take-back system, the establishment of collection centres, or a combination of both. Furthermore, this involves establishing mutually agreed-upon arrangements by producers with dismantlers and recyclers being authorized, whether done independently or collaboratively employing Producer Responsibility Organization (PROs) acknowledged in their Extended Producer Responsibility (EPR) authorization. The major role in the EEE sector is ruled by EPR. EPR's principle mandates producers in ensuring the end-of-life equipment collection and reconsideration of the product's design. In a circular economy approach, the crucial stage in eliminating the odds is considered as product design, thus enhancing the accessibility of disassembly and material recovery. Consequently, this helps in closing the loops across various stages of the product's life-cycle.

Circular Economy in the Electronics Sector

Manufacturing of EEE is particularly dependent on higher material consumption and this utilizes the metals namely iron, aluminium, copper, gold, silver, manganese, chromium and zinc including other rare earth elements. Ultimately this will result in a higher extraction rate of such abiotic resources rather than their formation rate, making them exhaustive. Therefore, considering e-waste as a valuable source of secondary raw materials to ensure resource security and environmental sustainability and addressing the challenge of its collection and management is vital. Hence a circular way of approach is a must necessary shift for the sector. To expedite the focus on CE and assure the modulation of electronic products in the country to sustainable models, an action plan has formulated by the MeiTY (Ministry of Electronics and Information Technology) for the implementation of CE as per the directions of NITI Aayog.

Despite the abundance existence of minerals like iron ore and bauxite in India, it is still largely dependent on many essential products that include copper, nickel, cobalt and many rarer earth metals. Enhanced resource scarcity results in increased manufacturing costs, environmental damages, and associated human health risks, thus increasing import dependency (Ali and Shirazi, 2023). Therefore, transition towards the circular economy and reusage of materials obtained through urban mining helps India to meet its resource demands. Initiatives introduced by the government such as Make in India mission, Digital India mission, Self-reliant India and also Swachh Bharat together enhancing the utilization of digital technology and end-of-life resources management, aims in establishing India as a 'manufacturing hub'. A Circular Economy action plan aspires in postulating the 'Make in India' and 'Atma Nirbhar Bharat' principles and this emphasizes self-reliance through resource efficiency maximisation altogether with minimized/ reduced consumption of finite resources.

India's 2030 Vision

The GOI's flagship missions envision a potential path to make India, a resource-efficient together with circular economy driven country. The Make in India mission fulfils the demand agitated through the Digital India initiative consequently drawing resources from the Swachh Bharat Mission in order to manage such end-of-life/ retired materials. This, as a whole, will guarantee the reliable raw material availability and creative approaches helping India to transform into a self-sustained circular economy (Figure 5). The Indian culture of reusing and repairing has prolonged or extended the lifespan of materials and resources. The transition of a traditional and linear model of "produce, use and dispose"

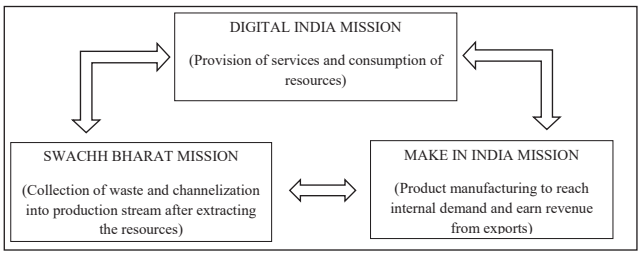

Figure 5: Transformation into a RE and Circular Economy with GOI missions

to a circular and resource-efficient system helps close the cycles of many material flows. Most of the WEEE materials include metals that consistently maintain productivity but will deplete if not managed properly.

Conclusion

The effective e-waste handling is considered to be a substantial challenge for governments in numerous developing nations and this challenge is growing exponentially. Collecting the e-waste separately, with both effective treatment and careful disposal stands as the prime criterion. In a country like India with such huge waste production, the integration of informal recycling sector with the formal sector is necessary. The competent authorities should come up with some new safe and sustainable handling mechanisms for e-waste along with their treatment. In India, the informal sector handles around 90-95% of the collected e-waste. The resource deficiency and low recycling efficiency along with environmental and health-related risks are resulted due to insufficient and inefficient technologies for dismantling and proper recycling of the e-waste. Also, the informal recycling sector mainly focuses on recycling operations and remains on the 3-4 precious metals recovery. Therefore, strategic interventions are needed to realize a resource and circular-efficient economy in this sector which can be accomplished through diligent monitoring and implementation of the e-waste regulations. The key to achieve RE & CE relies on thorough supervision and effective implementation of the rules. Furthermore, an efficient listing of e-waste is also essential in addressing the gap existing between the generated e-waste volume and the current national recycling infrastructure present in the formal sector.

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