



Recent Trends in E-waste Generation and Management a Review

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Abstract

There has been a significant increase in e-waste generation in India during the last five years, as it has increased from 1.01 million metric tonnes in 2019-20 to 1.75 million metric tonnes in 2023-24. Since 2019-20, e-waste has increased in our nation at an alarming rate of 72.54 percent. E-waste or electronic waste are discarded electronic devices, used electronic materials destined for reuse, resale, refurbishment, recycling, or disposal are also included in e-waste. Rapid changes in technology, decreasing prices of electronic goods, the digital revolution, increasing consumerism, and frequent releases of new electrical goods models have contributed to an exponential increase of e-waste in the modern era. There is a huge gap between e-waste produced and e-waste processed in the economy. Informal processing of e-waste leads to adverse effects on ecology and the environment. Electronic goods contain materials like lead, mercury, cadmium, etc which are hazardous to the health of our society. There is an urgent need to improve the existing system of e-waste management in our country which requires an efficient collection system and proper treatment of hazardous material present in these electronic items. This research paper is based on secondary data. The paper attempts to analyse the recent trends of increasing e-waste generation in our country and the existing practices of e-waste management.

Keywords: E-waste, refurbish, recycle, e-waste management, health hazards.

1. Introduction

Rapid technological changes and the obsolescence of existing technical devices have resulted in the growth of e-waste at an alarming rate worldwide. United Nations refers to this increasing e-waste phenomenon as a "tsunami of e-waste" [1]. As per the data of 2022, 62 billion kilograms of e-waste was generated out of which only 22.3% were recycled [2]. At times this millennium is referred to as the era of e-waste.[3] The worst thing is that in most developing countries there is informal processing of e-waste leading to various hazardous effects on the health of human beings, other creatures and ecology at large. Electric waste or e-waste is the discarded electrical and electronic devices. Consumed electronic devices meant for reuse, resale, recycling, refurbishment, or disposal are regarded as e-waste. It is also called waste electrical and electronic equipment WEEE or end-of-life electronics. There are several factors responsible for this upsurge in e-waste in recent of the

years. Continuous technical upgradation in various sectors like electronics, marketing, designing, etc. has reduced the life span of electronic devices.[4] Besides, the introduction of new and advanced models of electronic gadgets, low recycling rates, and unnecessary purchases due to increasing consumerism trends, there is a significant increase in e-waste.[5] E-waste contains hazardous materials such as heavy metals and substances like arsenic, cadmium, lead and mercury, etc. lead and cadmium is used in circuit boards; lead oxide and cadmium are used in cathode ray tubes, mercury is used in flat screen monitors and switches, cadmium is used in making computer batteries. After the end of life of the electronic products then if not disposed of properly and systematically it may lead to harmful effects on the health of people involved in dismantling and recycling of e-waste. E-waste leads to hazardous emissions in case it is incinerated. It also leads to

water contamination and a damaging impact on environment and the health of human beings and other creatures in the surroundings. Rapid technological changes and the obsolescence of existing technical devices have resulted in the growth of e-waste at an alarming rate worldwide. United Nations refers to this increasing e-waste phenomenon as a “tsunami of e-waste” [1]. As per the data of 2022, 62 billion kilograms of e-waste was generated out of which only 22.3% were recycled [2]. At times this millennium is referred to as the era of e-waste.[3] The worst thing is that in most developing countries there is informal processing of e-waste leading to various hazardous effects on the health of human beings, other creatures and ecology at large. Electric waste or e-waste is the discarded electrical and electronic devices. Consumed electronic devices meant for reuse, resale, recycling, refurbishment, or disposal are regarded as e-waste. It is also called waste electrical and electronic equipment WEEE or end-of-life electronics. There are several factors responsible for this upsurge in e-waste in recent years. Continuous technical upgradation in various sectors like electronics, marketing, designing, etc. has reduced the life span of electronic devices.[4] Besides, the introduction of new and advanced models of electronic gadgets, low recycling rates, and unnecessary purchases due to increasing consumerism trends, there is a significant increase in e-waste.[5] E-waste contains hazardous materials such as heavy metals and substances like arsenic, cadmium, lead mercury, etc. lead and cadmium is used in circuit boards; lead oxide and cadmium are used in cathode ray tubes, mercury is used in flat screen monitors and switches, cadmium is used in making computer batteries. After the end of life of the electronic products then if not disposed of properly and systematically it may lead to harmful effects on the health of people involved in dismantling and recycling of e-waste. E-waste leads to hazardous emissions in case it is incinerated. It also leads to water contamination and a damaging impact on environment and the health of human beings and other creatures in the surroundings. Classification of E-waste As per the Global E-waste Report, 2020

electrical and electronic waste is divided into six broad categories as follows: Large Equipment – It includes washing machines, dishwashers, large copying machines, Xerox machines, cloth drying machines, etc. Temperature Exchange Equipment -- Includes machines like air conditioners, refrigerators coolers, heat pumps, etc. Screens and Monitors include electronic equipment, like televisions, computers, laptops, notebooks, tablets, etc. Lamps include items like filament lamps, fluorescent lamps, LED lamps, compact fluorescent lights Small Equipment – in this category items like kitchen appliances such as microwave ovens, electric cookers, toasters, electric kettles; electric weighing machines. radio sets, video cameras, electrical and electronic tools, and small medical devices are included. Small Information Technology and Telecommunication Equipment—This category includes personal computers, small printers, routers, modems, mini calculators, smartwatches, and smartphones.[6]

2. Research Methodology

This research paper is based on secondary data. Data is collected from various government reports and information from various websites is collected and collated to analyse the facts related to e-waste generation and management in World and India.

3. Literature Review

Vijayan et al. has analysed the role of households' behaviour towards e-waste recycling intentions in India. They have examined the impact of attitude, and subjective norms on households' intention to recycle e-waste. [7] Wasim Ayub, has discussed the importance of circular economy in e-waste management in India. The author has examined the E-waste processing capacity forecast using ARIMA model for Maharashtra. [8] Ministry of Environment, Forest and Climate Change has revised the E-waste Management Rules, 2016 and the terms of E-waste Management Rules, 2022. The new rule prescribes to management e-waste in an eco-friendly manner and emphasizes the role of Extended Producer Responsibility towards e-waste management in India.[9] Pandey Kiran has highlighted the increasing burden of e-waste in India in the last five years as a

burning issue. She has mentioned that the India's e-waste surges by 73% since 2019-20 to 2022-23. [10]d mercury, etc. lead and cadmium is used in circuit boards; lead oxide and cadmium are used in cathode ray tubes, mercury is used in flat screen monitors and switches, cadmium is used in making computer batteries. After the end of life of the electronic products then if not disposed of properly and systematically it may lead to harmful effects on the health of people involved in dismantling and recycling of e-waste. E-waste leads to hazardous emissions in case it is incinerated. It also leads to water contamination and a damaging impact on environment and the health of human beings and other creatures in the surroundings.

4. Discussion

4.1 Status of E-Waste Generation in India

India ranks third in the world's e-waste generating nation, followed by the USA and China. According to the data provided by Shri Tokan Sahu, Minister of State for Union Minister of Housing and Urban Affairs in India, e-waste generation has significantly increased during the last five years, reaching 1.75 million metric tonnes in 2023-24 from 1.01 million metric tonnes in 2019-20. [11] Due to rising trends in the use of electronic and electrical devices, e-waste has increased by an alarming rate of 72.54 percent since 2019-20. Around 30 percent of e-waste comprises computers and related accessories; the telecom sector, medical equipment and electronic equipment are the major contributors to e-waste generation. Table 1 E-Waste Generation in India, Figure 1 E-Waste Generation in India

Table 1 E-Waste Generation in India

Year	E-Waste Generation (Metric Ton)
2019-20	1,014,961
2020-21	1,346,496
2021-22	1,601,155
2022-23	1,609,117
2023-24	1,751,236

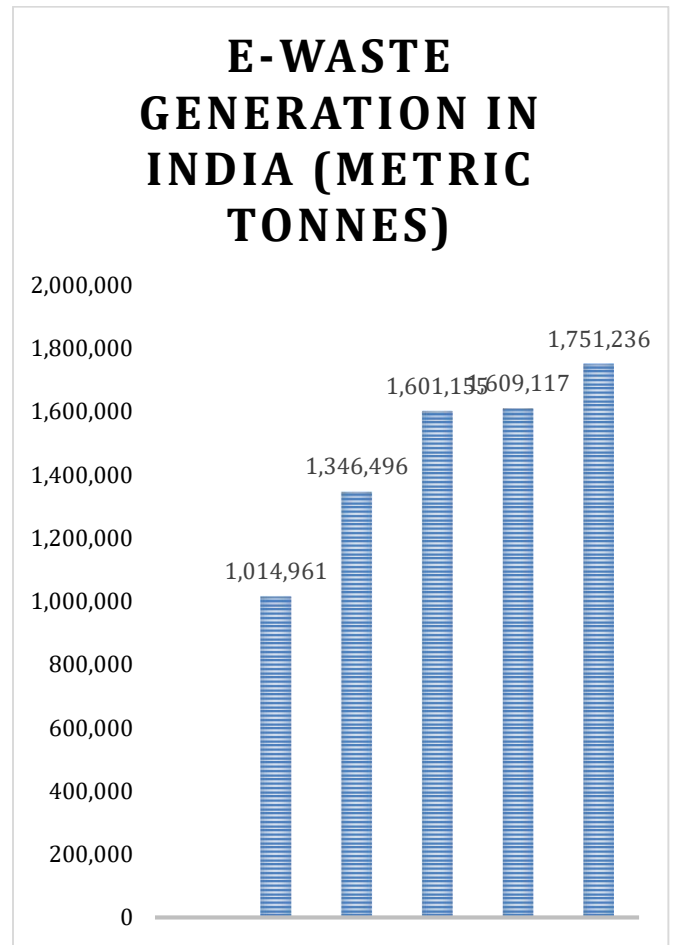


Figure 1 E-Waste Generation in India

Distribution of E-waste generation in India varies across the States. Maharashtra is the largest contributor of e-waste, followed by Andhra Pradesh and Tamil Nadu. A significant level of e-waste contribution comes from the State of Delhi. Punjab, Gujarat, Madhya Pradesh, Uttar Pradesh, West Bengal and Karnataka. In the list of e-waste-generating Indian Cities Mumbai is the largest contributor, followed by the capital city Delhi, Kolkata, Bengaluru and Chennai. Table 2 shows State/UT Wise Details of E-Waste Collected and Processed During FY 2021-2022 hazardous effects on the health of human beings, other creatures and ecology at large. Electric waste or e-waste is the discarded electrical and electronic devices. Consumed electronic devices meant for reuse, resale, recycling, refurbishment, or disposal are regarded as e-waste

Table 2 State/UT Wise Details of E-Waste Collected and Processed During FY 2021-2022

S. No.	Name of the State	E-Waste collected and processed (In Tonnes)
1.	Andhra Pradesh	2021.19
2.	Assam	67
3.	Andaman & Nicobar Island	0.78
4.	Bihar	41.07
5.	Chhattisgarh	4167.9
6.	Chandigarh	67.92
7.	Delhi	2130.79
8.	Dadra and Nagar Haveli & Daman Diu	12.34
9.	Gujarat	30569.32
10.	Haryana	245015.82
11.	Himachal Pradesh	373.2
12.	Jammu & Kashmir	561.61
13.	Jharkhand	366.71
14.	Karnataka	39150.63
15.	Kerala	1249.61
16.	Madhya Pradesh	553.59
17.	Maharashtra	18559.3
18.	Mizoram	14.85
19.	Odisha	477.54
20.	Punjab	28375.27
21.	Puducherry	31.77
22.	Rajasthan	27998.77
23.	Sikkim	8.47
24.	Tamil Nadu	31143.21
25.	Telangana	42297.68
26.	Tripura	13.67
27.	Uttarakhand	51541.12
28.	West Bengal	320.44
	Total	5,27,131.57

In India in recent years, the e-waste is increasing significantly which is a matter of great concern. After the COVID-19 pandemic electronic consumption increased due to new ways of working, work-from-home and remote learning and teaching systems for students and educators respectively. It has further led to increased trends in the use of electronic devices like computers, laptops, mobile phones, game consoles, electric ovens, etc [14]. Financial inclusion digitization, and direct benefit transfers in the account of the general people have almost made it necessary to own a mobile for every person. The evolution of mobile phones to smartphones has aggravated the generation of e-waste in the country. As per a study report around 75% of e-waste is generated from industrial sectors while households contribute around 16% of the e-waste in India. Associated Chambers of Commerce and Industry of India reported that only 1.5% of the electronic waste generated is recycled systematically in India.

4.2 Management of E-Waste

India has a system of e-waste management consisting of collection of e-waste, dismantling and recycling but it is largely operated in the unorganised sector of the economy. These unorganised sectors collect e-waste from rag-pickers and kabadiwallas and dismantle and extract the reusable components from electronic goods for resale. They are not attentive to the detrimental effects of this e-waste on the health of the people involved in the recycling of e-waste materials and its implications on the neighbouring areas. As per a study in India every day, the generation of municipal solid waste is around 1.6 million metric tonnes. As per the size of population cities of our country generate around 0.2 to 0.6 kilogram of waste per person every day. It is estimated that by the year 2047 annual production of waste will increase up to 260 million tonnes. In that case, the country will require about equivalent to the area of our state capital Delhi to dump the waste if we fail to dispose of the e-waste systematically and scientifically. As mentioned by Garg and Adhana 2019 "India produces more than 8 million tonnes of hazardous garbage annually, of which 4.8 million tonnes (or 60%) are recyclable, and the remaining 3.2

million tonnes (or 40%) are not recyclable". In India, the e-waste management system is poor. A portion of e-waste is recycled whereas a major portion of it is deposited in the landfills. These landfills become a conglomeration of plastic and steel casing, wires, capacitors, resistors, glass tubes, and other assorted parts. It is reported that 70 percent of heavy metals present in landfills are generated from discarded electronic goods.

4.3 Government Initiatives

India has developed legal enforcement for e-waste management since 2011. It prescribes that only approved dismantlers and recyclers will be assigned for handling e-waste. India passed the E-waste (Management) Rules in 2016, and Bhopal, Madhya Pradesh, the nation's first facility for managing e-waste gathered from residential and commercial units, has been established. The Ministry of Environment, Forest and Climate Change, Government of India, revised its existing E-Waste (Management) Rules, 2016, in 2022, as the "E-Waste (Management) Rules, 2022 came into force on 1st April 2023 to manage e-waste in an environmentally sound manner. The new rule prescribes an improved Extended Producer Responsibility (EPR) regime in place of e-waste recycling." As per this new E-waste Management Rule 2022 all producers, manufacturers, recyclers and refurbishers have to register on the portal of the Central Pollution Control Board. This new rule helps develop a Circular Economy with the help of Extended Producer responsibility and more systematic and scientific recycling of disposal of e-waste.

[15]

4.4 Way Forward

As there is a significant upsurge in the e-waste generation in India in recent years it becomes pertinent to devise a strategy for e-waste management. The first and foremost matter is to identify various stakeholders in the generation and management of e-waste. [15] The traditional practices of e-waste management need to be upgraded or substituted with alternative cost-effective, eco-friendly healthy sustainable methods. Circular economy- provides a sustainable solution for

e-waste management as it discards the “use and throw” practices. The circular economy promotes the practices of using repaired and refurbished electronics which can reduce the heaps of electronic garbage in our landfills. The existing legislation and government policies for dismantling and recycling e-waste should be strictly implemented so that the people involved in it may have reduced harmful effects on their health. There is a need to spread awareness in society and educate people regarding the harmful effects of e-waste on their health and environment. Lessons can be learned from other countries. For example, the European Union is restricting use of hazardous components in personal computers. These countries are finding alternative solutions for producing eco-friendly electronic products. India needs to learn lessons from the computer manufacturer giant Hewlett and Packard Computer which has made arrangements for its end-of-life electronic waste. HP collects all discarded parts of its computers like cartridges, printers, UPS, monitors, etc. of its computers from various points of the HP centers and deposits them to the recyclers. They have arranged with a recycling company to do the process in an eco-friendly and cost-effective manner. [16]

Conclusion

As the issue of e-waste continues to grow significantly, the need to evolve sustainable methods of disposing the e-waste becomes more pertinent. Rapid technological advancement and increasing trends of using upgraded and new models of electronic gadgets by people have aggravated the problem of e-waste. Conventional management strategies are not suitable for the security and safety of the environment and the health of human beings. Therefore, there is a dire need to evolve a cost-effective, eco-friendly and sustainable e-waste management strategy.

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