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E-WASTE AND ITS IMPACT ON ENVIRONMENT POLLUTION IN INDIA

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ABSTRACT:

Electronic waste is an indirect and unimaginable waste which make adverse effects on the human, animals and environment by polluting the natural resources like air, soil and water. Accumulation and contamination of e-waste for a longer period may harshly affect the environmental resources. India and China are the largest consumers of electronic gadgets at the same time they are responsible for an increase in the waste electrical and electronic equipment. Therefore, this review article mainly focuses on the detailed explanation of the e-waste management system includes the recycling process and its effects in India. The uniqueness of this review article lies in the discussion of legal instruments and awareness programs in India at various periods of time. Also, it provides sufficient knowledge to the readers in various aspects of increasing e-waste and its controlling methods. As a result, it gives adequate information for reducing the utilization of e-product in consumer-side and control measures on the manufacturer-side. In addition to that, it will be helpful to the policymakers who are involving in framing the future policy of e-waste in India.

KEY WORDS: *Pollution, E-Waste, Recycling, human Health, Environment, Policy, E-waste Management.*

A. INTRODUCTION

In the 18th century, advances in science and technology ushered in the industrial revolution, ushering in a new age in human civilization. The information and communication revolution in the twentieth century revolutionised the way we organise our lives, economies, industries, and organisations. These remarkable advancements in modern times have unquestionably improved the quality of our lives. Simultaneously, this has resulted in a slew of issues, including the large volume of hazardous garbage and other waste generated by electric products. These and other hazardous pollutants constitute a serious threat to human health and the environment. As a result, appropriate waste management is vital for the protection of livelihood, health, and the environment. It is a severe difficulty for modern society, and it necessitates concerted efforts to solve it in order to achieve long-term growth.[1]

[1] Text of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, UNEP, Geneva, Switzerland, p.6, http://www.basel.int/text/

Wastes are substances or items that are disposed of, intended to be disposed of, or are required to be disposed of by national legislation, according to the Basel Convention. 1 Furthermore, wastes are materials that individuals are obligated to dispose of, for example, due to their harmful nature. Our regular activities generate a significant number of diverse wastes from various sources. Municipal waste, on the other hand, is garbage generated by households and consists of paper, organic waste, metals, and other materials. Hazardous waste is generated by manufacturing operations, residences, and commercial activities. Discarded medications, waste sharps, microbiology and biotechnology waste, human anatomical waste, animal waste, and other biomedical waste are examples of biomedical waste generated by hospitals and other health care providers. Any material containing a concentration of radionuclides higher than that judged safe by national authorities and for which no application is anticipated is classified as radioactive waste. End-of-life cars, packaging waste, tyres, agricultural waste, and other kinds of waste are among the others. 2 Because they are flammable, corrosive, reactive, toxic, explosive, poisonous, or contagious, these waste compounds are harmful in the long run. As a result, they constitute a serious or potentially dangerous hazard to public health and the environment.[2]

B. WHAT IS E- WASTE

Mercury, lead, and brominated flame-retardants are just a handful of the dangerous compounds found in e-waste. These compounds cause damage to practically all major bodily systems after continuous exposure during dangerous e-waste recycling activities, including neural systems, blood systems, brain development, skin problems, lung cancer, heart, liver, and spleen damage. This is especially important in the informal sector, since a large majority of e-waste workers do not take any health-prevention precautions. According to a research by the Associated Chambers of Commerce and Industry of India (ASSOCHAM),[3] due to inadequate safeguards, around 80% of e-waste workers in India suffer from respiratory diseases such as breathing difficulties, irritation, coughing, and choking. Workers and children are typically among the most exposed to harmful vapours on a regular basis, with bare hands and no protective facemasks. Open flames are used to burn tube lights, motherboards, and toner cartridges, releasing lead, mercury, and cadmium into the air. Every day, the country generates around 160,000 metric tonnes (MT) of municipal solid trash. In cities, per capita trash generation ranges from 0.2 kilogramme to 0.6 kg per day, depending on population size. This is expected to rise at a rate of 1.33 percent per year. By 2047, the overall amount of garbage created is expected to reach around 260 million tonnes per year. If the garbage is not disposed of in a more systematic and scientific manner, it is anticipated that more than 1,400 km2 of land, roughly similar to the size of the city of Delhi, will be required in the country by 2047. Non-hazardous solid wastes are generated at a rate of 100 million tonnes per year in India's industrial sector, with coal ash from thermal power plants alone accounting for more than 70 million tonnes per year. In India, around 8 million tonnes of hazardous waste are generated each year, with roughly 60% of these wastes, or 4.8 million tones per year, being recyclable and the remaining 3.2 million tonnes per year being non-recyclable. Approximately 1.5 percent of all e-waste created in India is recycled by formal recyclers or institutional processing and recycling, while the other 8% is made unusable and ends up in landfills.[4]

According to the 'Global e-waste monitor 2020,' 53.6 million tonnes of electronic garbage were produced globally in 2019, with just 17.4 percent being recycled. After China and the United States, India is the world's third largest contributor, with 3.2 million tonnes of e-waste produced each year. As

[2] Sandeep Joshi, 'Growing e-waste is causing concern', The Hindu, 28 February 2009.
Moushumi Basu, 'New e-waste management plan lucrative for states', The Pioneer, New Delhi, 18 May 2010.
'Disposal of e-waste', Rajya Sabha Unstarred Question no. 1887, dt. 07.12. 2009.
Sanjay Jog, 'Ten states contribute 70% of e-waste generated in India', The Financial Express, 13 March 2008
[3] The *Global E-Waste Monitor, 2017* published by the United Nations University, USA
[4] Dr. Neha Garg & Deepak Kumar Adhana , E-waste management in India: a study of current scenario, International Journal of Management, Technology And Engineering, June 2020.

a result, planning and stronger legislative enforcement will be accelerators in India's transformation from a linear to a circular economy in terms of electronics.

Prime Minister Narendra Modi spoke in December 2020 on the importance of maximising the use of electronic devices while properly eliminating obsolete ones, as well as the need to better manage electronic waste. He just announced a 'Garbage to Wealth' programme in August 2021, concentrating on putting waste to greater use.[5]

C. IMPACT ON ENVIRONMENT

Their constituents are extremely harmful to the environment. They're just dumped in landfills and let to leak into the ground, especially during the warmer months. When e-waste is heated, harmful compounds are discharged into the air, harming the ecosystem; this is one of the most serious environmental consequences of e-waste. These poisonous compounds can then leak into groundwater, causing harm to both land and sea species.

Electronic trash can potentially pollute the environment. These are items that should not be thrown out because they contain lead, mercury, cadmium, and other potentially hazardous compounds.[6]

There have also been studies that suggest a link between e-waste in landfills and potential health risks, such as major respiratory problems. Researchers analysed air samples from a big e-waste dismantling location in China and found that these goods had a harmful influence on human lung cells, according to the journal Environmental Research Letters.

Furthermore, various contaminants are generated by e-waste, and these pollutants can build in the human body as a result of inhaling contaminated air. The findings of a United Nations Environmental Programme study of 300 kids near Dandora were announced at the National E-Waste Conference and Exhibition in Nairobi. Half of the youngsters tested positive for respiratory difficulties, and 30% had blood abnormalities, both of which are signs of heavy-metal poisoning from electronics, according to the study.

1. Effects on the Air

When e-waste is disposed of informally by dismantling, shredding, or melting the components, dust particles or chemicals, such as dioxins, are released into the environment, causing air pollution and harming respiratory health. Burning is commonly used to dispose of low-value e-waste, but it can also be used to extract valuable metals from electronics, such as copper. Burning e-waste increases the risk of chronic diseases and malignancies because it releases small particles that can travel thousands of miles, posing severe health concerns to humans and animals. Higher-value components, such as gold and silver, are frequently extracted from highly integrated circuits using acids, desoldering, and other chemicals, all of which emit fumes in locations where recycling is not properly regulated. The dangers of informal e-waste recycling on the environment are greatest for individuals who handle the material, but pollution can spread thousands of miles distant from recycling locations.[7]

The air pollution created by e-waste has a greater impact on particular animal species than others, putting these species and the biodiversity of certain contaminated areas in jeopardy. Air pollution can harm water quality, soil, and plant species over time, causing lasting ecosystem damage. For example, in Guiyu, China, an informal recycling hub was developed by parties interested in

[5] E-Waste: India Must Take a Closer Look at Extended Producer Responsibility, https://science.thewire.in/environment/e-waste-india-must-take-a-closer-look-at-extended-producer-responsibility/

[6] How Does Recycling Electronics Help the Environment, https://www.ewaste1.com/how-does-recycling-electronics-help-theenvironment/#:~:text=When%20e%2Dwaste%20is%20exposed,also%20contribute%20to%20air%20pollution.

[7] Dinesh Raj Bandela, E-Waste Day: 82% of India's e-waste is personal devices, a special report published on E-waste Day, Published on Saturday 13 October 2018

extracting valuable metals from e-waste, resulting in exceptionally high lead levels in the air, which are inhaled and later swallowed when the waste is returned to water and soil. Larger animals, wildlife, and humans in the region may suffer disproportionate brain damage as a result of this.

2. The Effects on the Soil

Both heavy metals and flame retardants can leak straight from e-waste into the soil when it is placed improperly at ordinary landfills or in places where it is discarded illegally, contaminating underlying groundwater or crops that may be planted nearby or in the area in the future. When heavy metals are present in the soil, crops are more susceptible to absorbing these toxins, which can cause a variety of ailments and make agriculture less productive.[8]

Because of their size and weight, big particles produced after burning, shredding, or disassembling e-waste quickly re-deposit on the ground and contaminate the soil. Temperature, soil type, pH levels, and soil composition all have an impact on how much soil is contaminated. These pollutants can persist in the soil for a long time, posing a threat to soil microbes and plants. Animals and creatures that rely on nature for survival will eventually consume the afflicted plants, resulting in internal health issues.[9]

3. Effects on the water

Heavy elements from e-waste, such as mercury, lithium, lead, and barium, leach through the earth even deeper after soil pollution, eventually reaching groundwater. These heavy metals eventually find their way into ponds, streams, rivers, and lakes after reaching groundwater. Even if they are miles distant from a recycling site, these channels cause acidification and toxification in the water, which is harmful to animals, plants, and communities. It becomes difficult to find safe drinking water.

Acidification has the potential to kill marine and freshwater creatures, as well as disrupt biodiversity and destroy ecosystems. If there is acidity in water, it can harm ecosystems to the point where recovery is difficult, if not impossible.[10]

4. Human Consequences

As previously stated, electronic trash contains hazardous materials such as mercury, lead, cadmium, polybrominated flame retardants, barium, and lithium, all of which are harmful to human health. The chemicals' harmful health consequences on humans include damage to the brain, heart, liver, kidneys, and skeletal system. It can also have a significant impact on the nervous and reproductive systems of humans, resulting in sickness and birth abnormalities. Improper e-waste disposal is extremely hazardous to the global ecosystem, which is why it is critical to raise awareness about this rising problem and its potentially disastrous consequences. It is critical to correctly e-cycle goods so that they can be recycled, refurbished, resold, or repurposed in order to reduce the hazardous impacts of e-waste. If people aren't taught on how to properly dispose of e-waste, the problem will simply get worse.

D. E-WASTE PROBLEM IN INDIA

According to a report issued at the World Economic Forum 2018, India ranks 177 out of 180 countries and is among the worst five countries on the Environmental Performance Index 2018. This

[8] Ms Akanksha Manish & Dr Paromita Chakraborty, Waste Management in India: Challenges and Opportunities, 06 Nov 2019

[9] Sejal Mehta, The why and how of disposing electronic waste by on 25 August 2020, https://india.mongabay.com/2020/08/explainer-the-why-and-how-of-disposing-electronic-waste/#:~:text=India%20generates%20about%203%20million,5%20million%20tonnes%20by%202021.

[10] Ms Akanksha Manish & Dr Paromita Chakraborty, Waste Management in India: Challenges and Opportunities, 06 Nov 2019

was connected to low environmental health policy performance and mortality from air pollution categories. In addition, after the United States, China, Japan, and Germany, India is rated fifth in the world among major e-waste producing countries, recycling less than 2% of the entire e-waste it creates annually. Since 2018, India has produced over two million tonnes of e-waste per year and imports massive volumes of e-waste from other countries. Dumping at open dumpsites is a typical sight, resulting in groundwater damage, bad health, and other problems. According to the study Electronic Waste Management in India by the Associated Chambers of Commerce and Industry of India (ASSOCHAM) and KPMG, computer equipment accounts for nearly 70% of e-waste, followed by telecommunication equipment phones (12%), electrical equipment (8%), and medical equipment (7%), with the remainder coming from household e-waste.[11]

The informal sector dominates e-waste collection, transportation, processing, and recycling. The industry is well-connected and uncontrolled. Frequently, all of the materials and value that may be retrieved are not. Furthermore, there are severe concerns about pollutants leaking into the environment, as well as worker safety and health.[12]

The largest e-waste dismantling centre in India is at Seelampur, Delhi. Adults and children spend 8–10 hours every day collecting reusable components and valuable metals such as copper and gold, as well as numerous functioning parts, from electronic equipment. Processes including open incineration and acid-leeching are used by e-waste recyclers. This issue could be rectified by raising awareness and strengthening recycling unit infrastructure, as well as existing policies. An unorganised sector manages the majority of the e-waste collected in India.

In addition, informal electronics recycling/reuse channels such as repair shops, used goods dealers, and e-commerce portal merchants acquire a considerable share of abandoned electronics for reuse and component cannibalism.

Table-1 Contribution of e-waste in the year 2019

Category	Examples	Contribution of e-waste in the year 2019 (million metric tons)
Small equipment	Irons, Toasters, Luminaires, Radio sets, Microwave oven, Ventilation equipment, Vacuum cleaners, Clocks and Watches, Digital cameras, Electric kettles, Video cameras	17.4
Large equipment	Large medical devices, Large monitoring and control instruments, Photovoltaic panels, Cookers, Electric stoves, Large computer mainframes, Large printing machines, Washing machines, Clothes dryers, Dish washing machines	13.1
Monitors and screen	Televisions, LED/LCD, Monitors, Tablets, E-Book readers, Laptops	6.7

[11] *Akanksha Manish and Dr Paromita, Leading Environmental Science & Technology Research Group, Department of Civil Engineering, SRM Research Institute, SRM Institute of Science and Technology, Chennai, India, Research paper published.*

[12] Sejal Mehta, The why and how of disposing electronic waste by on 25 August 2020, https://india.mongabay.com/2020/08/explainer-the-why-and-how-of-disposing-electronic-waste/#:~:text=India%20generates%20about%203%20million,5%20million%20tonnes%20by%202021.

Category	Examples	Contribution of e-waste in the year 2019 (million metric tons)
Temperature exchange equipment	Heat pumps, Freezers, Air-conditioners, Refrigerators	10.8
Lamps	CFL, Fluorescent lamps, Pressure sodium lamps, Metal halide lamps, LED lamps	0.9
Small IT and telecom equipment	Mobile phones, Printers, Routers, Personal computers, Telephones, GPS and navigation equipment	4.7

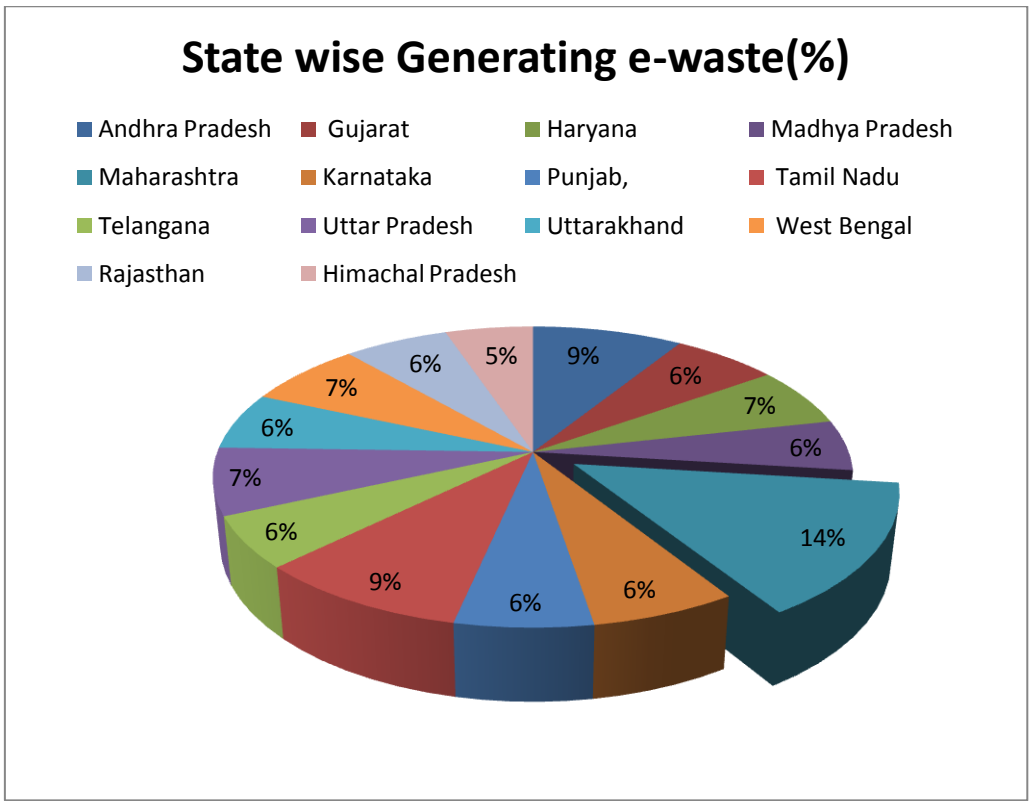

Fig-1

India is one of the top five e-waste producing countries in the world. Maharashtra produces the most e-waste (19.8%), but only recycles roughly 47,810 tonnes per year (TPA). According to the joint research, Tamil Nadu recycled about 52,427 TPA with an e-waste contribution of 13%; Uttar Pradesh (10.1%) recycles about 86,130 TPA; West Bengal (9.8%), Delhi (9.5%), Karnataka (8.9%), Gujarat (8.8%), and Madhya Pradesh 7.6%. Aside from China, the United States, Japan, and Germany, India is

one of the top five e-waste producing countries in the world. Maharashtra produces the most e-waste (19.8%), but only recycles roughly 47,810 tonnes per year (TPA).[13]

E. E-WASTE RECYCLING MANAGEMENT

Almost all e-waste contains recyclable components such as plastic, glass, and metals; however, these materials cannot be recovered for other purposes due to inappropriate disposal procedures and techniques. The hazardous elements of e-waste can wreak havoc on the human body if it is deconstructed and handled in a crude manner. To dispose of the garbage, processes such dismantling components, wet chemical processing, and incineration are used, resulting in direct exposure and inhalation of dangerous chemicals. Gloves and face masks aren't commonly worn, and workers typically lack the expertise and experience needed to do their duties effectively. Furthermore, hand extraction of toxic metals results in deadly materials entering the bloodstream of the person doing so. Kidney and liver damage, as well as neurological issues, are among the health risks. Recycling e-waste junk pollutes water, soil, and the atmosphere. Burning wires and cables to recover metal has resulted in the release of brominated and chlorinated dioxins, as well as other carcinogens, which pollute the air and cause cancer in humans and animals. During the recycling process, toxic compounds with no economic value are simply dumped. These harmful compounds leak into the subterranean aquifer, lowering the quality of local groundwater and making it unfit for human consumption and agricultural use. When e-waste is disposed of in landfills, lead, mercury, cadmium, arsenic, and PCBs contaminate the soil, rendering it unfit for agricultural use. Recent studies on e-waste recycling have found rising levels of PCBs, dioxins and furans, plasticizers, bisphenol-A (BPA), polycyclic aromatic hydrocarbons (PAH), and heavy metals in the surface soil of India's four metro cities: New Delhi, Kolkata, Mumbai, and Chennai, where e-waste is processed by the informal sector (Chakraborty et al., 2018 and 2019). In those research, it was discovered that the places where metal recovery activities are carried out are the most likely to have such persistent hazardous compounds. According to the same group's research, the semi-volatile nature of the persistent organic pollutants created or released during the recycling process allows them to escape into the ambient air.[14]

F. CONCLUSION

E-waste management is a significant concern for many developing countries, including India. This is rapidly becoming a major public health concern that is only getting worse. It is critical to link the informal and formal sectors in order to collect, adequately handle, and dispose of e-waste, as well as divert it from traditional landfills and open burning. In order to handle and dispose e-waste in a safe and sustainable manner, competent authorities in developing and transition nations must build processes.

To encourage environmentally friendly e-waste management programmes, increasing information campaigns, capacity building, and awareness is vital. To prevent the illegal trade of e-waste, increased efforts are urgently needed to improve present methods such as collection systems and management practises. Reducing the number of dangerous compounds in electronic items can also help with certain e-waste streams because it will aid in the preventative process.

Nokia, a mobile phone maker, appears to be one of the few firms that has made a significant effort in this direction since 2008. According to an EPR Authorization plan issued by the Central

[13] India's e-waste to touch 5.2 MMT by 2020: ASSOCHAM-EY study Read more at: http://timesofindia.indiatimes.com/articleshow/68240340.cms?utm_source=contentofinterest&utmmedium=text&utm_campaign=cppst
https://timesofindia.indiatimes.com/business/india-business/indias-e-waste-to-touch-5-2-mmt-by-2020-assocham-ey-study/articleshow/68240340.cms

[14] Sejal Mehta, The why and how of disposing electronic waste by on 25 August 2020, https://india.mongabay.com/2020/08/explainer-the-why-and-how-of-disposing-electronic-waste/#:~:text=India%20generates%20about%203%20million,5%20million%20tonnes%20by%202021.

Pollution Control Board (CPCB) in India, the enterprises are accountable for building routes for proper collection and disposal of e-waste. Some major corporations' import licences were recently revoked due to violations of E-waste regulations. Such policies have a significant impact on India's ability to effectively conduct e-waste management. Any activity that is done must include a set of incentives that will entice stakeholders to participate. To ensure compliance across the electronics industry, the government must announce incentives in the realm of e-waste management, which might take the shape of tax concessions or refunds. In addition, e-waste collection targets must be evaluated and extended on a regular basis to ensure e-waste collection compliance across India.