INDIAN E-WASTE: MANAGEMENT, ISSUES AND SOLUTIONS

Dr. Pranita Das
Assistant Professor
Department of Chemistry,
Barama College, Barama, India

Abstract - Waste always conjures up images of rubbish or solid/semi-solid waste, nothing more. Over the past decade, e-waste has emerged as a worldwide concern. India also produces a significant amount of electronic garbage, or "e-waste," annually. People's knowledge of e-waste is rather low since, regrettably, it does not receive much media coverage. In India, e-waste recycling is a relatively new idea. Because of this, e-waste is frequently disposed of improperly, either by being recycled or treated, and deposited in rivers or landfills. There are several risks associated with this, both to one's health and the environment. The paper presents an overview of the e-waste situation in India and other global locations. It also illustrates the e-waste trends in India. According to the survey, the main sources of e-waste in India are mobile phones and computer equipment. Telecommunications equipment made up 12% of the total e-waste produced in India, with computers making up 70% of the total. Mumbai was the most productive city on the list, producing an estimated 20,000 tonnes of e-waste yearly. Delhi and Bangalore came in second and third place, respectively, with 98,000 and 92,000 tonnes of generated e-waste. State-wise Maharashtra is ranked first in generation of electronic waste, followed by Tamil Nadu and Uttar Pradesh. Approximately 70 percent of heavy metals found in landfills are accounted for by E-waste. The paper, in the end also offers suggestions to deal with the challenges and problems of e-waste.
Keywords: E-Waste , Awareness, Health, Management, Challenges.

I. INTRODUCTION

Electronic trash, or e-waste, is produced when any electrical or electronic equipment is no longer fit for its original use or has passed its expiration date. Outdated gadgets may be easily replaced thanks to the rapid evolution of technology and the manufacture of newer electronic equipment. As a result, e-waste has increased dramatically, especially in India. Over time, product life spans also tend to shrink, and people regularly switch to more modern models and popular technologies. The current issue is India's handling of e-waste and associated challenges. When any electrical or electronic equipment has reached its expiry date or is no longer fit for its original purpose, it produces electronic trash, often known as e-waste. It is easy to replace obsolete models with newer versions due to the rapid growth of technology and the creation of newer electronic equipment. It has led to an exponential increase of e-waste, especially in India. Consumers prefer to switch to more recent models and widely used technologies, and product lifetimes become shorter with time. However, the issue of managing e-waste in India and associated challenges still exists. Customers are the key to improving e-waste management in India. Initiatives include the 3Rs (Reduce, Reuse, and Recycle) technical platform for linking the market, Extended Producer Responsibility, and Design for the Environment. The handling of electronic trash is highly prioritised in many affluent nations. On the other hand, it is made worse in developing nations by fully absorbing or imitating the e-waste management practises of wealthy nations as well as a number of other issues, such as a dearth of funding and highly qualified people resources. Furthermore, inadequate infrastructure and a dearth of relevant regulations, particularly pertaining to e-waste, are present. Furthermore, the roles and obligations of institutions and stakeholders in the management of e-waste are not well described.

II. ASSISTANCE WITH E-WASTE MANAGEMENT

E-waste poses a serious threat to the environment, wildlife, and people. Plastics, metals, cathode ray tubes (CRTs), printed wires, circuit boards, and other materials are frequently found in e-waste. . Once the e-waste is scientifically handled, valuable metals including copper, silver, gold, and platinum can be recycled. It is extremely dangerous if e-waste is disassembled and processed in an imprecise manner using rudimentary techniques because it contains toxic materials like liquid crystal, lithium, mercury, nickel, selenium, polychlorinated biphenyls (PCBs), arsenic, barium, brominates flame retardants, cadmium, chrome, cobalt, copper, and lead. When they are no longer suitable for use, electronic devices such as computers, mainframes, servers, monitors, printers, scanners, compact discs (CDs), copiers, calculators, batteries, cellular phones, fax machines, transceivers, TVs, medical equipment, iPods, refrigerators, washing machines, and air conditioners become e-waste. Heavy metals and highly poisonous chemicals like mercury, lead, beryllium, and cadmium present a serious threat to an organism In India, the informal sector accounts for the majority of e-waste recycling. The scavenging of materials from rubbish dumps provides a meager subsistence for thousands of low-income households. The collection, sorting, repair, refurbishment, and dismantling of outdated electrical and electronic products is done by thousands of urban households that work in the informal e-waste recycling industry. The situation is different in developed nations, and there is no idea of people willingly giving outdated electrical and electronic equipment at official e-waste recycling facilities in India. Additionally, the idea of consumers paying for the disposal of the electronic garbage they produce does not exist.

The following are some of the main problems caused by the e-waste recycling industry's strong reliance on the unorganised sector:

• Initially, attempting to financially penalise individuals for violating regulations on the management and processing of e-waste is futile.
• Secondly, the public's awareness of market pricing and health and safety costs related to recycling e-waste is lower since fewer well-paid individuals who carry out this activity lack the proper abilities.
• Third, even though the volume of produced e-waste has significantly increased, recycling has dropped as a result of improper training for those who conduct this labour for lesser compensation. insufficient e-waste recycling facilities.

India lacks the infrastructure necessary to manage e-waste on a large scale. Of the relatively few facilities that do exist, just around one-fifth of the country's yearly e-waste production is recycled at facilities that have received official approval. The Indian government offers a co-funded grant initiative that pays for e-waste disposal facilities and company capacity development. The programme covers 25–50% of project expenses. Almost none of this idea has been implemented, though. Not only is it difficult to find officially approved e-waste recycling facilities, but the ones that do exist are currently operating considerably below capacity because of poorly managed supply networks connecting them to most informal sector collectors. In order to recover base and precious metals on a large scale, there are currently not enough industrial e-waste managers equipped with the necessary environmental controls. A number of nascent Indian businesses extract metals from electronic trash; nevertheless, their processing capacity is limited. Most of the e-waste that is officially managed comes from other countries that have the extensive infrastructure needed to recover metals. On the other hand, the unofficial sector gathers metals by hazardous methods including open-air burning and acid leaching, which exacerbate environmental degradation and health issues

III. E-WASTE MANAGEMENT: CHALLENGES IN INDIA

E-waste recycling in India is mostly done by the unorganised sector. Many low-income households rely on items salvaged from landfills to make ends meet. When it comes to recycling waste paper, plastic, clothes, or metal, middle-class urban homes usually sell it to "kabadiwalas," small-scale, unregulated purchasers who sort it and utilise it as a raw material for industrial or artisanal processors. Electronic devices like computers, mainframes, servers, monitors, printers, scanners, CDs, copiers, batteries, cell phones, fax machines, transceivers, TVs, medical equipment, iPods, refrigerators, washing machines, and air conditioners become e-waste when they are no longer functional. Heavy metals and very toxic substances like mercury, lead, beryllium, and cadmium pose a significant risk to the environment even in tiny concentrations. An analogous tendency may be seen in India's management of e-waste. Numerous metropolitan households are employed by an unregulated e-waste recycling industry to gather, sift, repair, refurbish, and disassemble outdated electrical and electronic products.

The public's awareness of the dangers of e-waste is lacking in India, which has led to comparatively low recycling rates. Most people are either ignorant of the risks connected to e-waste components or just have a vague grasp of them, as well as the repercussions of incorrect disposal. They don't know that e-waste is managed by state or municipal governments in India. In certain places, there aren't many formal recycling facilities or specialised collection terminals where consumers may willingly drop off their electronic garbage. Most people and urban house buyers used to sell their old gadgets or get a discount in exchange for purchasing any new electrical or electronic items from small-scale retail outlets. Due to the introduction of new electronic gadgets onto the market, e-waste is continuously changing in composition.

The current e-waste laws oblige the manufacturers to provide information on their websites about e-waste's consequences, appropriate disposal techniques, and other matters. Periodic awareness campaigns are also necessary. Research shows that bulk customers' overall levels of knowledge are still low, even though many manufacturers have previously placed information on the websites. Tighter policies governing the frequency and format of these awareness campaigns for the creators might perhaps alleviate the issue. Alternatively, it should be mandatory for the makers to carry out these activities via regional e-waste associations. On its part, the government has to consider merging e-waste awareness programmes with those concerning other waste streams, such batteries and municipal solid trash.

IV. INDIA'S PUBLIC POLICY FOR THE MANAGEMENT OF E-WASTE

India's e-waste laws were developed using the Extended Producer Responsibility (EPR) approach. They were updated in 2016 and came into effect in May 2012. After seven years of deployment, there has been no discernible influence on the broader national e-waste management system. Positively, hundreds of brand-new recycling and deconstruction facilities that have been formally registered with regulatory organisations may have been born out of the constraints. The 2016 amendments seem to have strengthened the producers' dedication to adhering to the regulations, since they established collection rate targets for makers of electronic items. More generally, it may be claimed that the limitations are to blame for the numerous stakeholders' increased awareness of the e-waste problem.

V. COMMON E-WASTE DISPOSAL METHODS

- **Landfilling**

This refers to the process of successfully digging a large hole in the ground, filling it with rubbish, and then covering it with dirt. Some toxins, including cadmium, lead, and mercury, always manage to escape into the soil and groundwater, even when the pits are lined with clay or plastic and have a leachate basin to prevent hazardous waste from leaking into the environment.

- **Bath in Acid**

Electronic circuits containing metal can be cleaned up by immersing the metal in powerful concentrations of sulfuric, hydrochloric, or nitric acid. The metals may then be recycled and utilised to create new products. Disposing of the extremely hazardous acid waste properly is necessary to avoid contaminating adjacent water sources and posing a new waste disposal problem.

- **Incineration**

It is a highly archaic method of disposing of electrical waste, which involves burning the waste at extremely high temperatures. This has the two benefits of providing energy that may be utilised for other things and drastically reducing the amount of garbage produced. Unfortunately, when the components of electronic trash are burned, a considerable amount of hazardous chemicals, such as mercury and cadmium, are released into the atmosphere.

- **Recycling**

Many e-waste objects may be disassembled, and the individual pieces can then be used to make new products. Using e-waste recycling procedures, valuable metals from circuit boards can be recovered and melted down to create new products like jewellery or new technologies.

- **Reuse**

Customer behaviour in India is key to improving e-waste management. programmes such as 3Rs, Extended Producer Responsibility, and Design for the Environment. It is made worse in developing countries by completely imitating or adopting their e-waste management strategy in addition to a host of other problems, such a lack of finance and human resources with the necessary technical skills. In addition, there are problems with the infrastructure and the absence of relevant laws, especially with regard to e-waste. Furthermore, not enough is spoken about the responsibilities and tasks that institutions and other stakeholders have in the management of e-waste.

VI. SUGGESTIONS

Significant investment is required in research and development for innovative recycling techniques and technologies in order to set up India's e-waste policy and management for the future. For example, the use of smartphones has grown dramatically in India over the last five years, yet there are currently no laws governing the recycling of e-waste from the lithium-ion batteries that power these devices.Many new battery and material technologies will be used in the production of the next generation of electronic gadgets. Therefore, the Indian government has to promote and fund research that develops cutting-edge, future technologies for recycling and turning new streams of e-waste into valuable materials. In order to optimise the recycling efficiency of India's enormous e-waste management volumes, sophisticated recycling technologies must be integrated with the nation's existing manual methods. India has a sizable and well-developed plastics processing sector that is capable of recycling plastic from e-waste. In order to create large-scale industrial e-waste recovery operations, the Indian government must promote collaborative partnerships between international and domestic enterprises. Funding for these projects may come from both governmental and private sources. In India, most e-waste is recycled in unorganised facilities, which means a large workforce is needed. The most dangerous course of action is to extract metals from PCBs using conventional procedures. Better tools, adequate education, awareness, and—most importantly—access to alternative, reasonably priced technology must be provided to individuals who rely on these forms of income.

Transitioning to economic instruments such as an ADF might alleviate the regulatory load by doing away with the necessity to control producers. Because the ADF has been collecting taxes for a long time, it should be easy to transfer it from one electronic device to another. The State and Central Pollution Control Boards will still need to monitor and enforce compliance with the guidelines established for collection facilities, recyclers, dismantlers, and PROs. Transparency in all e-waste rules is required from the MoEFCC. Information on inspections of registered facilities, authorizations and the requirements attached to them, and the compliance status of facilities under examination should all be accessible to the public. Programmes for the environmentally responsible handling of e-waste need to be pushed with more educational campaigns, capacity building, and awareness raising. It is critically necessary to step up efforts to fortify present protocols, such as collection plans and management practises, in order to reduce any illicit e-waste trafficking. Reducing the number of hazardous chemicals in e-products can help the particular e-waste streams as well, since it will aid in prevention. In India, most e-waste is recycled in unorganised facilities, which means a large workforce is needed. The most dangerous course of action is to extract metals from PCBs using conventional procedures. Better tools, adequate education, awareness, and—most importantly—access to alternative, reasonably priced technology must be provided to individuals who rely on these forms of income.

VII. CONCLUSION

Over the past ten years, e-waste has become a more prominent global issue. India, a significant participant in the electronics sector, has not been an exception to this trend. There are serious risks to the environment and public health as a result of improper e-waste disposal procedures and a lack of general knowledge. This study has examined several facets of the e-waste situation in India, highlighting its expansion, difficulties, and potential solutions.

One of the main conclusions of this study is that the main sources of e-waste in India are electronic devices, especially computers and mobile phones. The lifespan of electronic equipment has decreased due to the rapid improvements in technology and the continuous release of new items, which has made the issue of e-waste worse. India's largest cities—Mumbai, Delhi, Bangalore, and other places—produce a significant amount of e-waste, with Maharashtra leading the nation in this regard.

India faces major issues in managing its e-waste due to inadequate infrastructure, limited recycling capacity, and a lack of official e-waste recycling facilities. Although there are some recycling facilities with official approval, their efficiency is limited by mismanaged supply networks. As a result, a significant amount of e-waste is treated improperly, which can cause harm to the environment and health issues.

The study report emphasises how little the general population knows about the dangers of e-waste. The possible risks associated with e-waste components and the right disposal techniques are not well known to many customers. The efficient handling of e-waste is further hampered by this ignorance.

In conclusion, India's e-waste problem presents a range of challenges, from a lack of infrastructure and recycling capacity to limited public awareness. However, with comprehensive research, innovative recycling technologies, improved infrastructure, and increased public awareness, India can develop a more sustainable and effective approach to managing e-waste, protecting both the environment and public health while promoting responsible consumer behavior.

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