



# Analysis of the impact of electronic waste on the natural environment and its interference with the sustainable development

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## Abstract

Technological revolution the way that we live our lives. Our lives were impacted by technological evolution in so many different ways that it is hard to quantify or enumerate some of the most impacted areas. We are surrounded by electronic equipment and we don't usually think about the consequences of its production and use or our model of consumption. And when we do, we are often unaware of the full complexity of the reality. It contains numerous toxic chemicals including metals such as lead, cadmium, mercury and nickel and organic compounds such as flame retardants, chlorofluorocarbons, polycyclic aromatic hydrocarbons, poly chlorinated dibenzo-p-dioxins and furans etc. E-waste recycling recovers valuable materials including iron, aluminium, copper, silver, and rare earth metals but excessive exposure can be noxious. There are so many reasons that why E-waste is becoming a immense health threat, firstly, a major lack of knowledge and understanding about the proper management and handling techniques of E-waste. This paper we have gone through various exploratory instances of technology that shows a negative impact on sustainability and explains how ignoring negative consequences may be harmful to human beings.

**Key words:** Electronic waste, E-waste recycling, brown goods, white goods, Extended Producers Responsibility ,Producer Responsibility Organization.

**1.0 Introduction-** Electronic gadgets are constructed of the most common reserves available in our planet earth as sand and some of the rare metal like, rhodium, platinum, gold etc. Furthermore, highly dangerous and harmful elements such as cadmium, nickel, lead and mercury are used in the process. Our society and environment both are highly impacted by technological advancement in so many different ways that is very hard to quantify. Electronic waste, or e- waste can be considered as "volcano" in the present globalised world. Electronic waste products have exhausted their utility value through either replacement or breakage.

As per present scenario, it became almost impossible to imagine life without technology. Mobile phones , televisions, computers, washing machine , dishwasher, car, internet etc all are the part of technology. If observe, we get up and flip a switch to turn on lights , the light is the technology and if we talk about switch, this is also a result of polymer technology. If we observe the power plant that generated the light is also a technology. We use coffee maker for preparation of coffee or use kettle to boil water for tea or coffee , this is technology.

We are surrounded by electronic equipment and we don't usually think about the consequences of its production and use or our model of consumption. And when we go through, we are generally unaware of the full complexity of the actual state. It is classified as (Dahl R ., 2002)-

- White goods- These constitute refrigerators, washing machines, and microwaves etc.
- Brown goods- These constitute television, radio, computers, and cell phones etc.

The information and technology revolution has exponentially increased the use of new electronic equipment has also produced growing volumes of superannuated products; e-waste is one of the fastest -growing waste streams. It contains complex combinations of highly toxic substances that pose a danger to health and the environment,

Electronic waste is define as any electronic devices that has reached the end of its usable life cycle. It contains numerous toxic chemicals including metals such as lead, cadmium, mercury and nickel and organic compounds such as flame retardents, chlorofluorocarbons, polycyclic aromatic hydrocarbons, poly chlorinated dibenzo-p-dioxins and furans (Arya and Kumar2020).

Exponential growth in electrical and electronic industries to meet consumers demand has correspondingly created a large waste flow.

While the technology overall is causing optimistic impact on our societal environment and giving lots of choices. Life expectations are longer and the people have more choices and more time to make use of these choices. There are lot many issues also we cannot deny with them. The everyday use of technologies taxing the environment and society. All of these and other modern electronic devices raise concerns about resource consumption, energy consumption, carbon footprint and waste. We become habitual of electronic equipment and we can not imagine our life without it. Usually we don't think about the consequences of its manufacturing and our model of utilization.

## 2.0 Statement of the Problems-

Economical growth and widespread access to technology are considered to expand global E-waste generation, as we move to higher GDP, it leads to more procurement of electronic devices and in turn more electronic waste generation (Gaidajis et al., 2010). Global survey says electronic waste in just five years, give an hike of 21% of generated waste, which is a serious ultimatum. United Nations University in 2015 had published a report and claimed that globally electronics waste has reached around 41.8 million metric tones. With the radical change in modern technologies and demand for the new trendsetting, eventualize the more electronic waste. E-waste generation is presumed to reach 20–50 Mt each and every year, scribal of 1–3 percent of worldwide refuse production.

Globally, e-waste add up to more than 5 percent of all municipal solid waste and is extending with the rise of commerce of electronic products in developing countries. The majority of the world's e-waste is reprocess in developing countries, where informal and hazardous setups for the extraction and sale of metals are common.

## 3.0 Literature Review-

Waste Electrical and Electronic Equipment (WEEE) or e-Waste are loosely discarded, obsolete, broken, electrical or electronic devices. In India most of the waste electronic items are stored at households as people do not know how to discard them (CPCB, MoeF, 2008). These electronic wastes items is very discursive in nature but rich source of metals such as silver, gold, lead copper, which could be obtain back and can reenter into the fabrication cycle. The Global E-waste monitoring estimated that around 53.6 million metric tons (Mt) of e-waste were produced globally in 2019. This figure is projected to grow to 74.7 Mt by 2030. Asian countries has generated largest quantity of electronic waste 24.9 Mt, in 2019 which has been followed by Americans (13.1 Mt), Europeans (12 Mt) Africans (2.9 Mt) and Oceania (0.7 Mt)

An average estimated 80% of electronic waste from developed nations are illegally exported to low

income or middle income countries including Pakistan, Nigeria, Brazil, Ghana where laws are less stringent and cost of labor and disposal are cheap. E-waste recycling also recovers valuable materials including iron, aluminium, copper, silver, and rare earth metals but excessive exposure can be noxious. These environmental contaminants pose severe threats to both the health of human beings and the environment (Baud I. et al., 2001).

Facts has been found almost 16 kg of water ,7kg of chemicals and 1.6 kg of fuel is required to prepare a microchip of computer.

According to a survey, around seven billion people lives on this planet, out of which only 5 billion of them have access of their basic requirements and are capable of getting it. More than 6 billion people uses mobile phones which becomes a basic need and necessity now days.(Ceballos and Dong, 2016) Since, E-waste composition is very complicated as it is composed of around more than 1000 types of substances. These substances are classified as the precarious and non- precarious (Wath et al.,2011). E-waste constitutes a broad range of materials, such as plastics, metals and glass, few of them can be extensively recovered, thus making this waste stream as a source of raw materials (Ari 2016).

#### **4.0 Classification of Electronic waste Resources-**

Demands of electronic such as computers, mobile phones, , solar cells, and laptops, the economical upsurge of IT divisions resulted in a good economic rate of the country but exponentially enhances the electronic waste. To launch new gadgets into the market, the private sectors are substituting the obsolete electronic products with the newer ones, as a consequence increase in E-waste garbage.It overlay a wide range of electronic devices, line up from large household appliances, telecommunications equipment, industrial and office devices, monitoring and controlling instruments, home electronic as electrical and electronic implements , sports equipment (Debnath et al., 2021)

The main constituents of electrical and electronic tools (EEE), such as batteries, electric cables from a bitter end vehicles ,plastic casings, printed circuit boards (PCBs),cathode-ray tubes (CRTs), activated glass, and lead capacitors are also classified as electronic-waste ( Debnath et al., 2021).

*Home Appliances:* Fans, Electronic Cookers, Heater, Home Entertainment devices.

*Communication and Information Technology Devices:* Computer Monitor, Cell phones, Laptops, Circuit boards, smart phones, Hard Drives etc

*Electronic utilities:* Television remotes, Lamps, smart lights, smart watches, heart monitors, heating pads, massage chairs etc.

*Industrial and office equipments:* Wi-fi dongles, cords and cables, phone and PBX system, audio & video equipments, power strips and power supplies, uninterrupted power supplies (UPS systems), network hardware (server, switches and hubs etc.)

#### **5.0 Threatening remark to E-waste-**

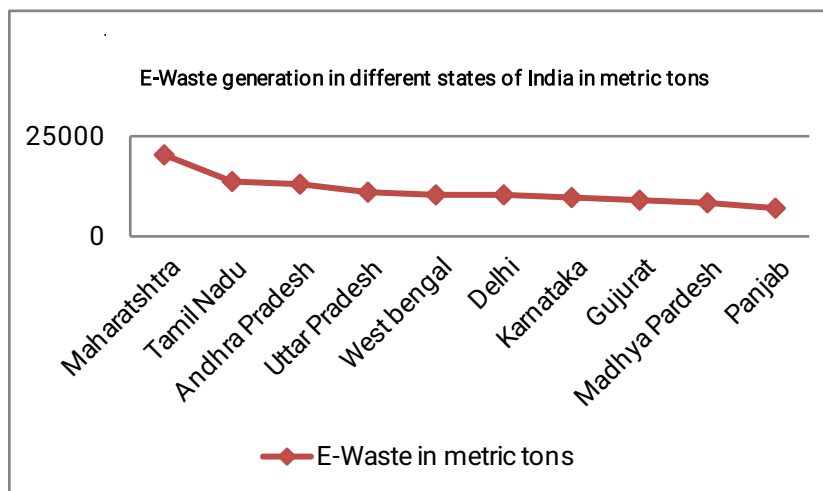
The threatening remarks of E-waste generation and about waste management strategies has been started in the late 1980's and then strict environmental laws and acts regulations were announced and enforced to all to follow that. Later on it was found by virtue of considering to tremendous blooming in the price of handling hazardous waste, the illegal trading practices of e-waste began at the lower costs in developing countries to cut off the expenses towards handling the hazardous waste (Rao, 2014). Regardless of forbidding the of trans-boundary movement of hazardous waste, almost 75–80% of generated electronic waste of developed countries are transported to Asian nations (India, China, Bhutan , Pakistan, Bangladesh, Nepal & Srilanka,) and African nations (Ghana, Nigeria, Kenya) countries,

respectively (Abalansa et al., 2021).

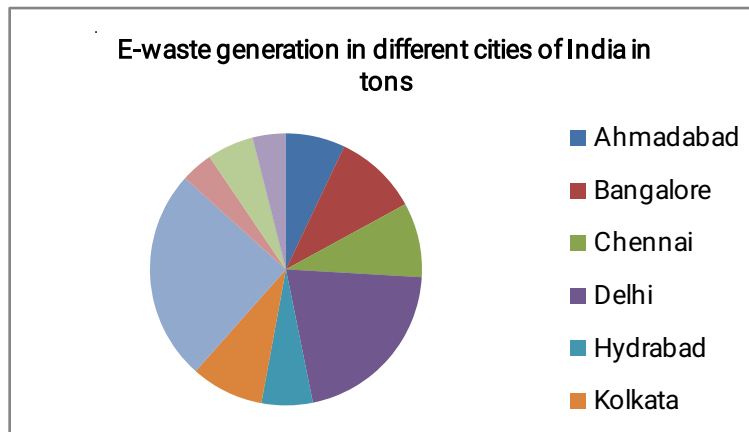
Number of urban places like Delhi, Mumbai, Hyderabad, Madras & Ahmedabad (India), Karachi (Pakistan), Guiyu (China), were the notable cities, which had been obtained bulk of E-waste as a charity (Widmer et al., 2005). The E-waste from most of the economically developing countries land up in the backyard of the poverty stricken categories and traded informally by the shareholders. These procedures are overpriced to separate the metals from E-waste (Guerrero et al., 2013).

The Dumping ground in the US has been announced to have approximately 70% of Hg & Cd and 40% of Pb from purchaser electronics. The mixtures of the compounded dioxin-related compounds (DRCs) were dispenses to the environment when the E-waste is subjected to unmethodical recycling process (Decharat,2018). Presently, India is in the top of 4 countries in E-waste bringing forth and second biggest populated country in the world (Bandyopadhyay,2008).

Econometrics cardinal shows that India is one of the potential growing financial (International Labor Office, 2012), higher aspirations for luxurious lifestyle, international business trade and tremendous development in the field of electronic waste. Under the wake of rising demands, Prime Minister of India has introduce a Digital India Flagship program in 2015. This was a great initiative and has bring about a number of new and upgrade appliances which lead a enhanced gross value approximately 388 Billion USD (Assochem, 2018). The act as an initiative to control the pollution was passed as Environment Protection Act 1986 and to extend the producer's responsibility, E-waste Management & Handling Rules, 2011 has passed as per that producers has to take responsibility of end life of the product. E-waste (Management) Rules in 2016 have been passed and set a criteria for the proper collection, transportation and disposal of E-waste. The Ministry of Environment, forest and climate change has broadcast the Plastic waste Management (Amendment)Rules in 2018. Despite of many initiatives, India is still struggling with lot many challenges and there is quite enough research gaps in current E-waste management practices because of poor awareness, lack of execution of rules, reluctance in the corporate sector, unavailability of infrastructure, lack of supply chain concepts, meager distribution of finance & dearth in administrative enactment.



**Top E-waste generating cities in India-**



## 6. Challenges with E-waste Management-

There are so many reasons that why E-waste is becoming a immense health threat, firstly, a major lack of knowledge and understanding about the proper management and handling techniques of E-waste .As the volume of electronic waste produced increases, it becomes a threat and a bigger risk to human health and the environment. All types garbage and rubbish have a significant influence on both physical and mental health, whether direct or indirect (R. Heeks.,2015). Rapid advancements in automation have resulted in a reduction in the number of legislations governing E-waste recycling.

Global waste trade agreement policies which are having various rules and regulations enforced to the import and exports of generated waste. The most vital aspect of proper of electronic and electrical waste management is the introduction of an EPR (Extended Producers Responsibility) certificate. As per EPR, it would be a responsibility of EEE producers to arrange the take back system. The EPR authorization is provided to the producers by the CPCB ( Central Pollution Control Board).

One reason of not taking action to such wastes which are increasing steeply worldwide, that since it is believed, electronic industry is the future of communications and because of that , economic growth is expanding day by day.These products are hardly new just for the time period of six months or one year and after that its monetary value gets reduced significantly, which resulted in the form of e- trash (Awasthi et al.,2019). So, for all these things, there must be an organization which gives the regular recommendation on the improvement of these issues (Bhutta et al., 2011).

The most significant challenge is with e-waste recycling is the lack of awareness among the producers ,consumers, policymakers etc. Limited access and kind of notifications related to the disposal and very few people used to think about that. There is also challenge with the separation of electronic waste because it is complex in nature, having both valuable and hazardous materials. It needs advanced technology to recover from that so most of companies are not willing to take waste projects and invest more due to high risk .

During study we have also found that worldwide and even in our country , we have poor and having limited infrastructure for the electronic waste recycling. Very less numbers of government approved recycling centre's are present that can recycle only 1/5 of the total produced electronic waste every year. Indian government is offering the co-funded grants but it also covers only 25% to 50 % of waste management projects cost.

## 7.0 Legislative perspective of electronic waste management –

Indian Legislation and Central Pollution Control Board Now has taken the initiatives buyback waste and taking it back for the better e-waste management. Producer Responsibility Organization (PRO) in 2016 has been established to help with electronic trash collection and recycling. (Cleaning Up Electronic Waste.,2022).It was recorded 34 registered producers responsibility organizations (PRO) at the end of May 2020.The are private , non-profit, state run organizations.They are given with the primary duty to attain the set goals by the SPCB( state pollution control board)to achieve Extended Producers

## Responsibility.

The Hazardous Waste Import and Export Rules of 2008 and the Central Pollution Control Board were largely employed to monitor and advise on E-waste management. The ministry of Forest and Climate Change plays a significant role in import and export of hazardous waste. The sector that constituting small businesses need to get licensed as the government has issued its E-waste collection and its processing guidelines in May 2012 (UNU,2022).

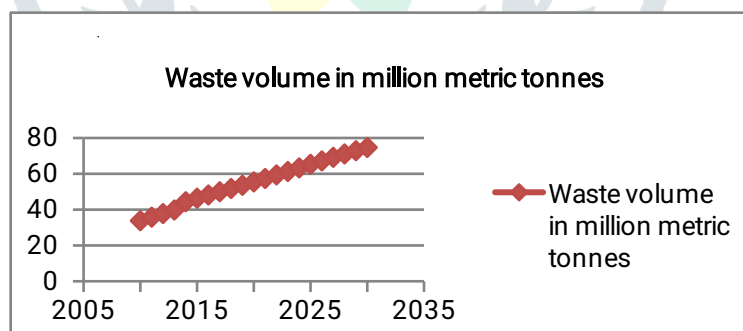
During data collection it has been noticed that 65 cities are responsible for more than 60% of total E-waste generation, whereas ten states are responsible for 70% of total E-waste production.

An International E-waste monitor research found that just 20% of the total world's waste is properly handled. In comparison towards the profits that may be generated from recycled electronic components, efficient E-waste disposal and recycling is quite time consuming and expensive (Awasthi et., 2016).

Another endeavor to control hazardous waste mobility is the Basel Convention on the limiting of transboundary movements and disposal of hazardous wastes. Since, 1992 in has been established treaty has been ratified by 179 nations (Aston et al., 2010). The Basel convention has started implementing its terms and regulations since 2002, after the acceptance of Mobile Phone Partnership Initiatives( MPPI) in Conference of Parties (COP6) 6<sup>th</sup> meeting. The Basal Convention's , 14<sup>th</sup> meeting of conference of parties (COP14) has adopted the amendments with the primary objectives of encouraging the control of trans boundary movement of plastic waste (www.basel.int, highlights 2023)

The World Health Organization (WHO) has passed e-waste and child health risk research report to watch over its impact on children's health. The purpose of this project was to bring together specialists from all around the world to look at long term effects of children being exposed to hazardous E-waste. Research scholars from multidisciplinary field and non-governmental organizations has participated in a WHO assessment of E-waste on children's health. (Forti et al., 2020). Many nations have enacted their own legislation to limit and regulate the dangers of E-waste. In China, the Administration of Control of Pollution Caused by Electronic Information Products, which was founded in February 2006, regulates total E-waste (EUR-Lex2022).

The Ministry of Environment and Forests, India's national body, is in charge of waste management and environmental protection laws, which was adopted in March 2008. Worldwide Electronic waste generation since year 2010 to 2030 ( Forti et al., 2020).



## 8.0 Conclusion-

Modern industries witnessed several breakthrough changes due to technological innovation and thrive to employ them for commercial growth. Technology and the environment are closely connected so it looks almost impossible by recognizing these links for seeking sustainability. A large number of associates are

involved in disassembling of the electronic items for their source of income on the cost of health risk. For e-waste management many technical solutions are available, but to be adopted in the management system, preconditions such as legislation, collection system, logistics, and manpower should be needed. In this paper we have gone through various instances of technology that have a negative impact on sustainability and explains how ignoring negative consequences may be harmful to humans beings and paying them out for it. Significant input in research and development department for innovative future oriented recycling technologies may transform e-waste into valuable products. By applying the Extended Producers Responsibility rules and improving the infrastructure for recycling of e-waste, we may enhance the sustainability of environment.

## **9.0 Suggestions for the sustainable management of E-waste-**

Cheaper processing prices, lower labor costs, and a lack of environmental regulatory enforcement are all contributing factors to the surge in illegal e-waste imports. Since no one knows that how much E-waste is produced or how much is imported and exported to other countries. There is one option for addressing the E-waste problem is to improve regulation and implementation. Additionally, the government should set real life, evidence-based objectives. This would help in keeping a record of how much E-waste is generated and how skillfully recycling facilities could manage it. There must be a fundamental change in the policy framework. Most environmental rules in India are under the command and control regulation, where only manufacturers are facing penalties if they fail to fulfill a specified objective, there should also be rules for consumers that they get in to practice of taking their used electronics to an authorized recycling firm ,where they will disassemble them, separating them on the basis of their constituents and then shredding them mechanically for further sorting with advanced separation techniques.

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