A REVIEW ON MANAGEMENT AND IMPLICATIONS OF E-WASTE IN INDIA

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1.0 Introduction

The transition from mechanical to digital electronics, or the Third Industrial Revolution, started in the second part of the 20th century and is more commonly referred to as the Digital Revolution (Byjus, 2021). People started adopting this modern technology and through online publishing platforms, network intelligence and day to day devices, it transformed the way we interact with electronics cand caused a shift in human communication that we face to this day. This came with many positive and negative factors. Positive aspects being greater interconnectedness with one another, easier communication from far off distances, and exposure of information while the negative effects were information overload, on children and adults alike, social isolation, especially among young adults media saturation which hampers development etc. We anticipated a modernized future with technology at its source but what we did not anticipate was the disastrous implications it had on our health and on our beloved environment, from landslides affecting mountain sides to acid rain directly impacting our precious monuments. The amount of electronic waste generated in 2021 alone, which will total 57.4Mt in 2023, is increasing by an average of 2 metric tonnes annually and is being dumped in numerous vacant environmental sites. On top of that there was 347 Mt of unrecycled e-waste on Earth calculated this year which continues to damage our environment and its surrounding flora and fauna as well as the people working and living in and around these areas. The most devastating fact was that China, India and the United States of America produced the most electronic waste in the entire world being 10129Kt, 6918Kt and 3230Kt respectively(The Roundup, 2023). Due to the high population density in these countries, a larger amount of electronic waste is generated and disposed, mainly through the informal sector which also affects everyone involved by causing a myriad of health issues such as respiratory problems, skin irritations etc. Electronic garbage is mostly an informal sector activity in India, with tens of thousands of families making a living by scavenging goods from waste dumps. Computers, printers, mainframes, calculators,

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cell phones, refrigerators, and other electronic devices are examples of e-waste, and when they are no longer usable, they are either recycled or disposed of completely.

2.0 Generation

Using EEE production statistics and estimating the share of EOL (End of Life) recycled and disposed garbage is the simplest way to predict the benefit and harm E-waste is doing to the globe. The statistics of the EOL EEE is primarily influenced by the high population growth over the years, as well as economic development and a shift in electronic consumerism among the general public. According to the Central Pollution Control Board (CPCB), India generated considerably more than 10 lakh tonnes of rubbish in 2020 alone, a 7 lakh tonnes rise over the previous year [5]. This production only continues to increase and unless we improve and implement solid management strategies, India will end up as a dumping ground for all the waste.

2.1 Classification

E-waste, also known as electronic garbage, refers to electronic equipment or components that are no longer in use or have been destroyed. The products or devices which are damaged or have been disposed of comes under the category of e-waste. (J.J, 2021)It can be divided into 10 categories:

1. Small home appliances
2. Lamps
3. Tools
4. IT hardware (includes monitors)
5. Luminaires
6. Toys
7. Electronics for the home (including televisions)
8. Medical equipment
9. Instruments for Monitoring and Control,
10. Automated dispensers

Technology is continually advancing, and as a result, devices that do not have the most recent technology become e-waste. E-waste or end-of-life (EOL) electrical includes discarded appliances such as DVD players, TVs, and MP3 players, as well as their components, sub-parts, and consumables.

Table 1: Projected life cycle of e-wasteReferenced from (Hindrise, 2021)

Item Mass of Item (kg) Estimated life (years)

Item	Mass of Item (kg)	Estimated life (years)
Radio	2	10
Fax machine	3	5
High-fidelity system	10	10
Cell phone	0.1	2
Electronic games	3	5
Photocopier	60	8
Personal Computer (PC)s	25	3
Television (TV)	30	5
Video recorder/DVD Player	5	5
Air-conditioner	55	12
Dish washer	50	10
Electric cooker	60	10
Food mixer	1	5
Freezer	35	10
Hair-dryer	1	10
Vacuum cleaner	10	10
Kettle	1	3
Microwave	15	7
Refrigerator	35	10
Telephone	1	5
Toaster	1	5
Tumble Dryer	35	10
Iron	1	10
Washing machine	65	8

E-waste also includes broken or the items in working condition which are thrown or the items which goes unsold in stores.

2.2 Composition

It is a mixture of hazardous, non-hazardous, and precious materials such as gold and silver (Greene, 2018). These hazardous elements have the potential to harm human health and the environment. E-waste recycling is critical for all countries (developed and developing) because it is directly tied to environmental issues. The increasing volume and lack of

accountability of e-waste provide a significant and serious challenge, and this issue is critical and must be addressed correctly.

Table 2: Composition of E-wasteReferenced from (Hindrise, 2021)

Constituents	Vats and Singh (2014)	Realff et. al. (2004)	Kong et. al. (2012)	Hossain et. al, (2015)
Metals	60.20%	49%	13%	39.50%
- Copper			7%	20.10%
- Iron				8.10%
- Tin				4%
- Nickel				2%
- Lead				2%
- Aluminum				2%
- Zinc				1%
- Silver				0.20%
- Gold				0.10%
- Palladium				0.01%
Plastics	15.20%	33%	21%	30.30%
Metal-plastic mixture	5%			
Cables	2%			
Screens (CRT and LCD)	11.90%	12%		
PCB	1.70%			
Others	1.40%	1%		
Pollutants	2.70%			
Wood		5%		
Refractory Oxides				30.20%

Overall, e-waste disposal can result in the waste and depletion of rare and important materials, while also contributing to a significant and growing volume of e-waste being recycled or disposed of via hazardous or incorrect methods. These informal or incorrect practices include open dumping, burning, and other practices that cause major environmental concerns as well as serious health dangers.

These informal practises are widespread in many poor nations. Given this rapid expansion, e-waste issues are a major concern. Household appliances (42%), communication and information technology (34%), consumer electronics (14%), and others (10%) account for the majority of e-waste.This trash consists primarily of plastics, nonferrous metals (such as copper, aluminium, and precious metals such as gold and platinum), iron, and steel. Now, we will study about the effects of e-waste, its scenario, and how it is controlled in India. [19]

3.0 Scenario in India

Table 3: E-waste Generation

S.No.	Financial Year	Generation (Tonnes)
1.	2017-2018	7,08,445
2.	2018-2019	7,71,215
3.	2019-2020	10.14,961.2

Referenced from (Press Information Bureau, 2022)

After China and the United States, India is the world's third largest e-waste generator, accounting for 38% of the total 53.6 million tonnes Mt of e-waste generated in 2019. India currently has the capacity to treat only one-fourth of its trash. Though no such estimate exists, the country's low recycling capability indicates a significant loss in terms of its incapacity to mine precious and important elements from e-waste. Furthermore, non-collected e-waste poses a major health and environmental risk due to the presence of various hazardous compounds. (RecyKal, 2022) According to CPCB, there are 214 authorized recyclers and dismantlers in India. In 2016 and 2017, only 0.036 million of the total electronic waste generated in this country was treated which is a shockingly low amount for the waste generated.

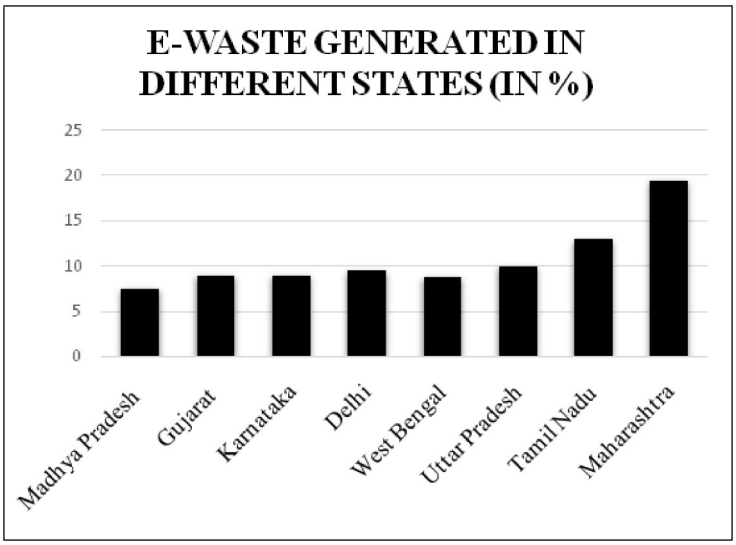

Figure 1: E-waste generated by different states

The key challenges while implementing multiple e-waste projects in states like Jharkhand, Madhya Pradesh and Chhattisgarh was the lack of understanding and awareness within the general public and the government departments, the informal sectors mainly

operate on cash which provides lack of accountability for their actions should they choose to discard their devices and products however they wish; lastly, though the law penalizes the sellers and defaulters, the execution of its punishment falls short and hence, allows them to continue defaulting However, India is the only country in the South Asian region having e-waste legislation. However, in India, e-waste management is primarily focused on informal sector operations for collection and recycling. Because very little e-waste enters the official sector, a considerable amount of e-waste enters the informal sector, where it is handled using crude methods and the leftovers remaining are discarded recklessly. The most serious issue with India's existing e-waste infrastructure is the uncontrolled discharge of particles that pollute the air, water, and land and are not even monitored. Solid waste management, which was always a major challenge in India, has gotten more complicated as a result of e-waste, particularly computer garbage imported from other parts of the world. In India, the leading states in terms of e-waste generation are Maharashtra, Tamil Nadu, Uttar Pradesh, and so on.

4.0 Implications

When an electronic gadget, for example, reaches the end of its "useful life," it is classified as E-waste. It refers to abandoned and old electronic equipment that is destined for reuse, resale, recycling, and so on. Its impact on our society has been profound, and it continues to be so (N, 2017).

4.1 Employment opportunities

Many business owners, recyclers among others believe that e-waste along with its production and maintenance, the disposal and recycling of electronic waste will provide a myriad of employment opportunities from a variety of age groups and will contribute to overall poverty reduction in India and worldwide.

4.2 Provides Alternatives

The material from E-waste and electronics as products can be used in the production of new materials as well as the revamping and the repair of old devices.

4.3 Earth Metals

When E-waste is ground to a fine powder in an industrial plant the several rare metals it is made up of are obtained which is then used to produce other parts etc. which in the end, help us sustain the Earth's surface.

It is no surprise that with all of the pros electronic devices bring to our lives, there is a long list of cons that follow it. From Environmental and health effects, to the overall implications of E-waste on India as a whole, this segment will cover how E-waste has and

is continuing to impact the environment and different aspects of our day to day lives.

4.4 Health effects

The scrap components contained in electronic waste contain elements such as lead, cadmium or beryllium which causes kidney damage and high blood pressure in children and adults alike. (NIEHS, 2014) Even the workers who work in the recycling sector of E-waste are exposed to terrible diseases like lung cancer, a variety of skin diseases and brain damage. This is also common to those living around dumping grounds for this waste.

4.5 Environmental effects

In many countries where the E-waste management is not up to standard, dust is one of the major problems which cause respiratory issues for those employed in and around the dumping site, for their families as well. Heavy metals such as lead, barium etc. leach the soil of its nutrients and contaminate the groundwater channels which leads to degradation of the environment and of the flora and fauna in it.

5.0 Management

E-waste management in a developing country like India has significant limitations. Lack of formal recycling facilities and proper education among the general mass allows the informal sector to thrive without concern for their health and the consequences of their actions(Sushant B. Wath,2010) .Out of all the electronic waste produced, only 17.4% is found to be collected and properly recycled. This figure has greatly fallen over the years and is proving to be an enormous problem for the surrounding landscapes and the people who live near landfills etc. Along with that, most of the waste produced by big corporations is not recycled and undocumented and hence, researchers can not accurately track where it ends up in the world. (EPA, 2022)Using Green Technology and its variants, Estonia, Norway, and Iceland have the highest recycling rate being 76%, 72% and 71% respectively. Actually, managing E-waste is a lucrative market and there are many solutions that researchers have come up with to counter this silent danger to India and the world. Some solutions are as follows.

There are several techniques available for management of e-waste in India, some are given below(Khanna, 2022): -

5.1 Land Filling

This is one of the most utilised e-waste disposal procedures. which includes following steps

1. Burying e-waste in pits

2.Covering such pits by layers of earth

5.2 Recycling

In this approach, e-waste is run through a massive magnet capable of removing ferrous metals such as iron and steel from the trash mix. Additionally, an eddy current may be utilised to separate the non-ferrous metals (Hindrise, 2021). These materials can then be diverted to smelting furnaces for recycling.Many large firms will satisfy the highest standards for how they recycle E-waste so that they can meet the huge demand for recycled metals, which will then be utilised to produce new products in the future. (CEO, SB, 2022)

5.3 Incineration

Although incineration is a non-eco-friendly process because exhaust gases from this process may be toxic, it is one of the safest ways of disposing of hazardous wastes such as e-waste (PIB, 2022).

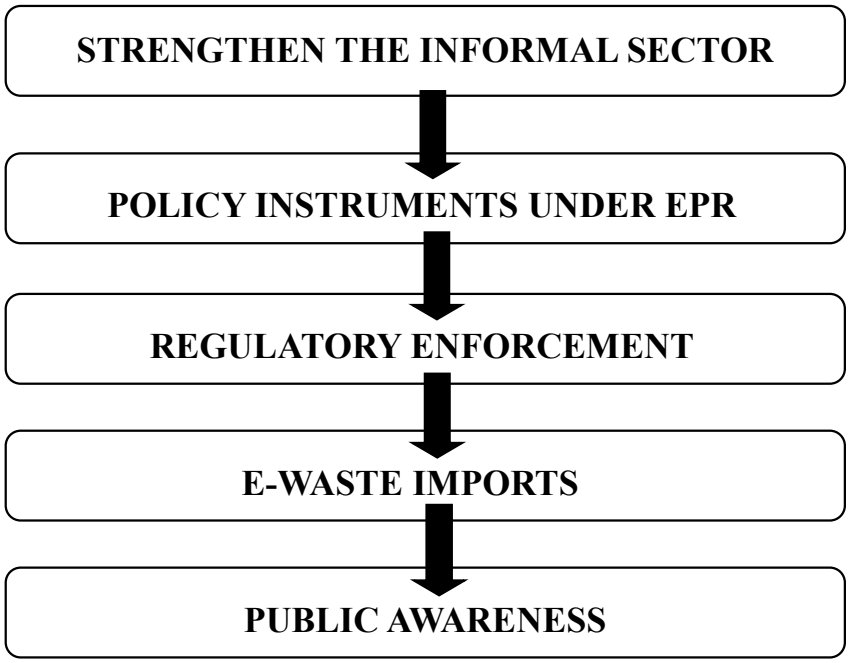

Figure 2: Methods for proper management

Consumers have the key to good e-waste management in India. Many initiatives, such as Extended Producer Responsibility (EPR), the (3R's) Reduce, Reuse, and Recycle technology platform for connecting the market and facilitating the circular economy, aim to encourage consumers to properly dispose of e-waste, with increased reuse and recycling rates, and to adopt sustainable consumer habits.

The Indian e-waste management system may be enhanced by- (Hindrise, 2021)

1. Providing market intelligence on e-waste costs
2. Providing financial incentives for formal e-waste recycling
3. Training and upskilling players in the informal sector
4. Making use of easily available and developed recycling technology
5. Creating novel methods and technology for processing new types of e-waste

Public awareness is also critical for effective e-waste management. There is a demand for ongoing awareness efforts. Many companies have already given information on their websites on the effects of e-waste, proper disposal practises, and other issues, but evidence suggests that general knowledge levels among bulk consumers remain low. Partnerships and collaboration among many stakeholders should underpin public awareness activities. (2018) (Ranganathan)

Figure 3: Disposal of varieties of E-waste

6.0 Conclusion

This article discusses the current state of e-waste handling in India. E-waste is a rapidly rising problem, particularly in developing countries like India, and there is a clear need to focus appropriately on ways of recycling and recovery possibilities for better e-waste management in India. The involvement of public-private partnerships (PPPs) is critical in organising and building an effective e-waste management system in this country. Although India is doing better in terms of e-waste management than in the past, there are still many things to work on, as well as correct norms and regulations to be enacted. The harm and destruction caused by e-waste must be handled very seriously because it is extremely detrimental to human health and the environment. The increase of e-waste has been far

greater than the increase in recycling, recovery, and disposal over the years. We should take some efforts towards our goal of a pollution-free planet by properly disposing of used EEE and switching to more sustainable solutions. Many electronic businesses even offer services to help clients bring in old devices or parts to dispose of them safely and professionally, all so we are healthy and the world around us, is preserved.

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