E-WASTE POLLUTION

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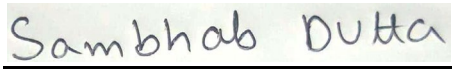

Sambhab Dutta

INTRODUCTION-----

Advances in the field of science and technology brought about industrial revolution in the 18th Century which marked a new era in human civilization. In the 20th Century, the information and communication revolution has brought enormous changes in the way we organize our lives, our economies, industries and institutions. These spectacular developments in modern times have undoubtedly enhanced the quality of our lives. At the same time, these have led to manifold problems including the problem of massive amount of hazardous waste and other wastes generated from electric products. These hazardous and other wastes pose a great threat to the human health and environment. The issue of proper management of wastes, therefore, is critical to the protection of livelihood, health and environment. It constitutes a serious challenge to the modern societies and requires coordinated efforts to address it for achieving sustainable development.

COMPOSITION OF E-WASTE ----

E-waste consists of all waste from electronic and electrical appliances which have reached their end- of- life period or are no longer fit for their original intended use and are destined for recovery, recycling or disposal. It includes computer and its accessories monitors, printers, keyboards, central processing units; typewriters, mobile phones and chargers, remotes, compact discs, headphones, batteries, LCD/Plasma TVs, air conditioners, refrigerators and other household appliances.

The composition of e-waste is diverse and falls under ‘hazardous’ and ‘non-hazardous’ categories. Broadly, it consists of ferrous and non-ferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete, ceramics, rubber and other items. Iron and steel constitute about 50% of the waste followed by plastics (16%), non-ferrous metals (10.20%) and other

constituents. Non-ferrous metals consist of metals like copper, aluminium and precious metals like silver, gold, platinum, palladium and so on, Metal-plastic mixture(5%),screens(11.90%) and others.

The presence of elements like lead, mercury, arsenic, cadmium, selenium, hexavalent chromium, and flame retardants beyond threshold quantities make e-waste hazardous in nature. It contains over 1000 different substances, many of which are toxic, and creates serious pollution upon disposal.7

Obsolete computers pose the most significant environmental and health hazard among the e-wastes

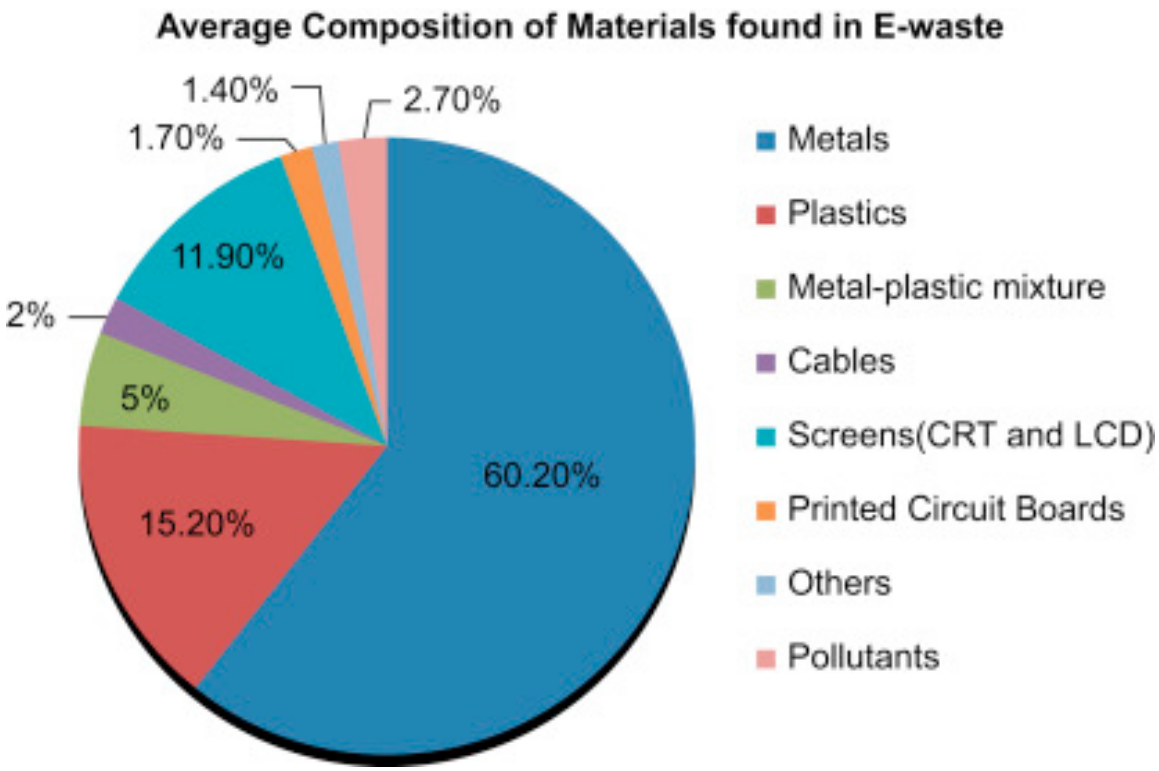

Image 1: Average Composition of Materials found in E-waste

E-WASTE ON GLOBAL CONTEXT-----

As the fastest growing component of municipal waste across the world, it is estimated that more than 50 MT of e-waste is generated globally every year. In other words, these would fill enough containers on a train to go

round the world once. However, since the markets in the West have matured, it is expected to account for only 2 per cent of the total solid waste generated in developed countries by 2010.

Therefore, with increasing consumerism and an anticipated rise in the sales of electronic products in the countries experiencing rapid economic and industrial growth, the higher percentage of e-waste in municipal solid waste is going to be an issue of serious concern.

A report of the United Nations predicted that by 2020, e-waste from old computers would jump by 400 per cent on 2007 levels in China and by 500 per cent in India. Additionally, e-waste from discarded mobile phones would be about seven times higher than 2007 levels and, in India, 18 times higher by 2020.

Such predictions highlight the urgent need to address the problem of e-waste in developing countries like India where the collection and management of e-waste and the recycling process is yet to be properly regulated. According to the UN Under-Secretary General and Executive Director of the United Nations Environment Programme (UNEP), Achim Steiner, China, India, Brazil, Mexico and others would face rising environmental damage and health problems if e-waste recycling is left to the vagaries of the informal sector.

Image 2; Global e-waste generated in 2019

Image 3: A heap of E-waste

E-waste in INDIA------

India collected just 10 per cent of the electronic waste (e-waste) estimated to have been generated in the country 2018-19 and 3.5 per cent of that in the generated in 2017-18, said a recent report by the Central Pollution Control Board. India generated 708,445 tonne e-waste in 2017-18 and 771,215 tonne the following fiscal, the report estimated. In 2019-20, the figure rose 32 per cent to 1,014,961 tonne. The figures have taken into account the 21 types of electrical and electronic equipments listed in the E-Waste Management Rules, 2016. These include discarded computer monitors, mobile phones, chargers, motherboards, headphones, television sets, among other appliances. The report published on December 18, 2020 mentioned that the collection targets for 2017-18 and 2018-19 based on the rules were 35,422 tonnes and 1,54,242 tonnes, respectively. The actual collection, however, was lower in both the years — 25,325 tonnes in 2017-18 and 78,281 tonnes in 2018-19.

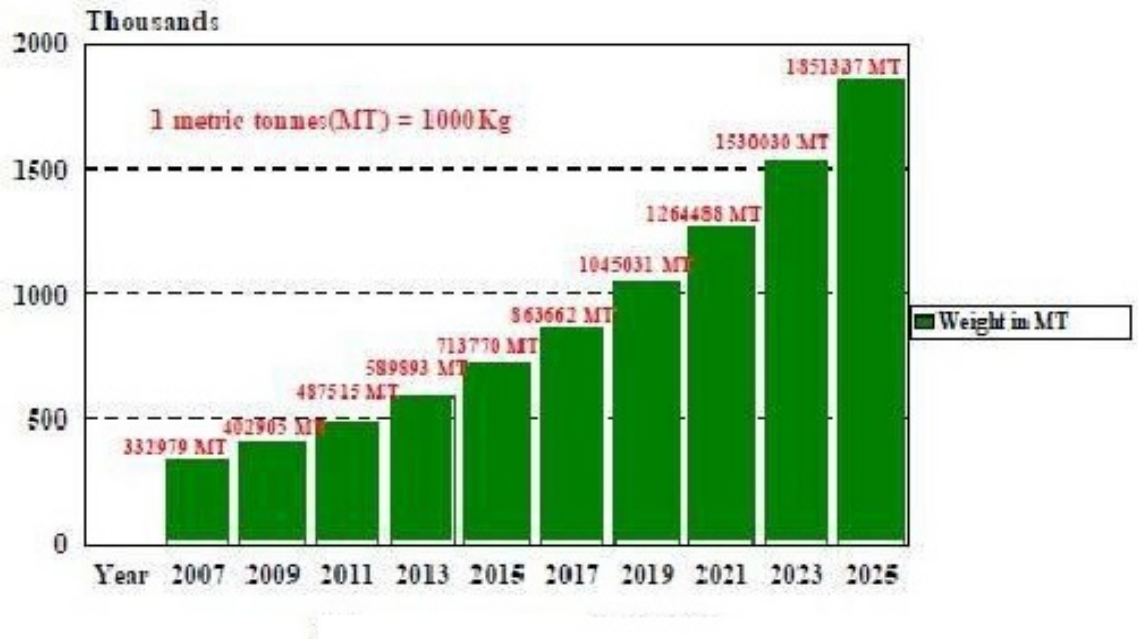

Image4: Growth of E-waste in India

ADVERSE EFFECTS OF E- WASTE------

The consequences of improper e-waste disposal in landfills or other non-dumping sites pose serious threats to current public health and can pollute ecosystems for generations to come. When electronics are improperly disposed and end up in landfills, toxic chemicals are released, impacting the earth's air, soil, water and ultimately, human health.

(1)The Negative Effects on Air--

Contamination in the air occurs when e-waste is informally disposed by dismantling, shredding or melting the materials, releasing dust particles or toxins, such as dioxins, into the environment that cause air pollution and damage respiratory health. E-waste of little value is often burned, but burning also serves a way to get valuable metal from electronics, like copper. Chronic diseases and cancers are at a higher risk to occur when burning e-waste because it also releases fine particles, which can travel thousands of miles, creating numerous negative health risks to humans and animals, which may be endangering these species and the biodiversity of

certain regions that are chronically polluted. Higher value materials, such as gold and silver, are often removed from highly integrated electronics by using acids, soldering, and other chemicals, which also release fumes.

Image 5: Air pollution due to E-waste

(2)The Negative Effects on Soil--

When improper disposal of e-waste in regular landfills or in places where it is dumped illegally, both heavy metals and flame retardants can seep directly from the e-waste into the soil, causing contamination of underlying groundwater or contamination of crops that may be planted nearby or in the area in the future. When the soil is contaminated by heavy metals, the crops become vulnerable to absorbing these toxins, which can cause many illnesses and doesn't allow the farmland to be as productive as possible. These pollutants can remain in the soil for a long period of time and can be harmful to microorganisms in the soil and plants. Ultimately, animals and wildlife relying on nature for survival will end up consuming affected plants, causing internal health problems.

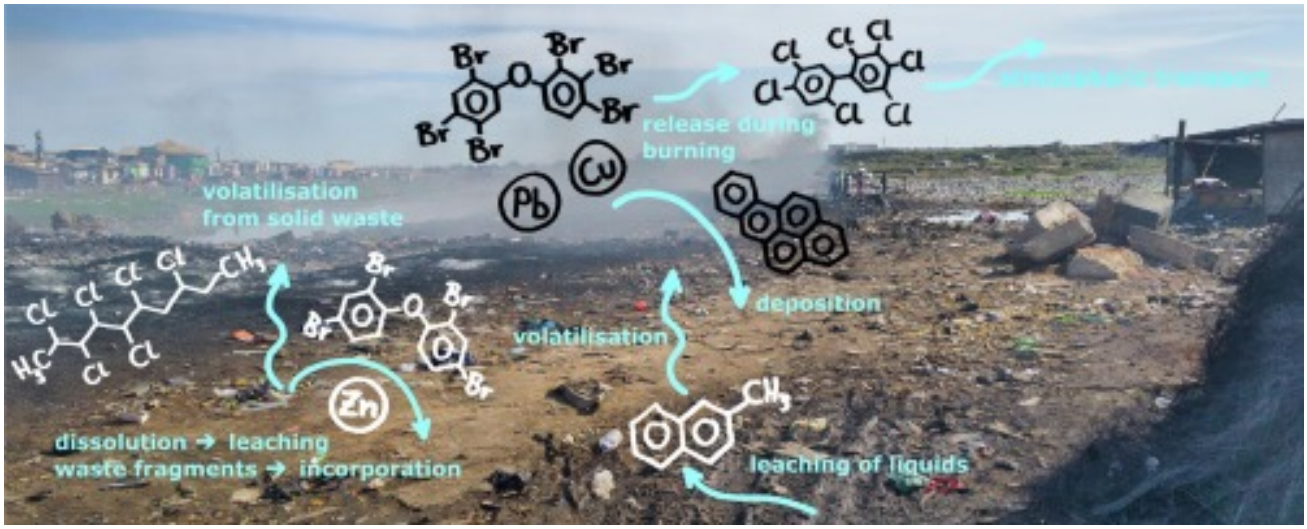

Image 6: Soil pollution due to E-waste

(3)The Negative Effects on Water--

Heavy metals from e-waste, such as mercury, lithium, lead and barium, then leak through the earth even further to reach groundwater, they eventually make their way into ponds, streams, rivers and lakes. Through these pathways, acidification and toxification are created in the water, which is unsafe for animals, plants and communities even if they are miles away from a recycling site. Clean drinking water becomes problematic to find. Acidification can kill marine and freshwater organisms, disturb biodiversity and harm ecosystems. If acidification is present in water supplies, it can damage ecosystems.

Image 7: Water pollution due to E-waste

(4)The Negative Effects on Humans--

As mentioned, electronic waste contains toxic components that are dangerous to human health, such as mercury, lead, cadmium, polybrominated flame retardants, barium and lithium. The negative health effects of these toxins on humans include brain, heart, liver, kidney and skeletal system damage.

Table 1: Sources of E waste, constituents and health effects

Sources of E-waste	Constituents	Health Effects
Solder in printed circuit boards, glass panels ad gasket in computer monitor	Lead (Pb)	Damage to central and peripheral nervous systems, circulatory systems and kidney damage. Affects brain development of children
Chip resistors and semiconductors	Cadmium (Cd)	Accumulates in kidney and liver, causes neural damage, Teratogenic
Relays and switches, printed circuit boards	Mercury (Hg)	Chronic damage to brain, Respiraratory and skin disorders due to bioaccumulation in fishes
Corrosion protection of untreated and galvanized steel plates, decorator or hardener for steel housings	Hexavalent chromium (Cr) VI	Asthmatic bronchitis, DNA damage
Cabling and computer housing	Plastic including PVC	Burning produces dioxin, Causes reproductive problems, Damage Immune system, Interfere with regulatory hormones
Plastic housing of electronic equipments and circuit boards	BFRs	Disrupts endocrine system functions
Front panel of CRTs	Barium (Ba)	Short term exposure causes muscular weakness, Damage to heart, liver and spleen
Mother board	Beryllium (Be)	Lung cancer, Inhalation of fumes causes chronic beryllium disease (berylliocosis), Skin disease such as warts

Source: (www.basel.int/)

Image 8: Health effects

MANAGEMENT OF E-WASTES-----

It is estimated that 75% of electronic items are stored due to uncertainty of how to manage it. These electronic junks lie unattended in houses, offices, warehouses etc. In industries management of e-waste Should begin at the point of generation. This can be done by waste minimization techniques

and by sustainable product design. Waste minimization in industries involves adopting.

1- Inventory management

2- Production process modification

3- Volume reduction

4- Recovery and rescue

1-Inventory management-

Proper control over the materials used in the manufacturing process is an important way to reduce waste generation. By reducing both hazardous material and excess raw material. This can be done in two ways i.e. establishing material- purchased review and control procedure and inventory tracking system. Another inventory procedure to reduce the e-waste is that only the needed quantity of material is ordered.

2-Production-process modification-

This reduction can be accomplished by the changing of materials used to make the product or by more efficient use of input materials. Potential waste minimization technique can be broken into 3 categories (i) improve operating and maintain procedure (ii) material change (iii) process-equipment modification.

3-Volume reduction-

It includes technique that removes hazardous portion of waste from non-hazardous portion. Waste containing different type of metal can be treated differently. Concentration of the waste stream may increase the likelihood that the material can be recycled or reused.

4-Recovery and reuse-

It could eliminate waste disposal cost, reduce raw material cost and provide income from a salable waste. Waste can be recover on site or an off-site recover facility through industrial exchange. Technique involve to reclaim waste is reverse osmosis, condensation, filtration, centrifugation extra.

We can also-

Rethink the product design

Use of renewable material and energy

Use of non renewable material that are safer

CONCLUSION------

E-waste is a serious problem at both local and global scales. E-waste problems appeared initially in developed countries and now extend widely to other countries around the world. The volume of e-waste is growing fast because consumer technology is rapidly changing and the innovation of technology results in rapid obsolescence, thus generating massive amounts of E-waste consists of many different materials, some of which contain a variety of toxic substances that can contaminate the environment and threaten human health, if the end-of-life management is not meticulously managed. Many case study from e-waste recycling plants confirmed that the toxic chemicals such as heavy metals and POPs have and continue to contaminate the surrounding environment. This results in considerable accumulation of hazardous substances into the ecosystem and which can adversely impact human health. In order to mitigate e-waste problems, there are investigations in term of the volume, nature and potential environmental and human health impacts of e-waste and extensive research into e-waste management. Over and above all of these, no matter how well the policies are introduced and implemented benefits will only arise provided end users are prepared to accept introduced policies and adhere to them.