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A Step Towards Sustainable Development Through Effective E-waste Management

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Abstract - One of the buzzwords that we hear everywhere these days is sustainability and how important it is to have sustainable development in every sphere of life so that we can leave a promising future to our coming generations. Looking at the criticality of the situation, the United Nations and all its member countries have framed the Sustainable Development Goals (SDG) 2030. Although the rapid technological advancements that are taking place all around the world make life easier and more comfortable, there are also numerous issues associated with these developments which are dangerously threatening the very environment in which we are living. One such problem is the growing e-waste that is being generated by the rapid discard of the electronic equipment. In this paper, we look at how e-waste management can be done to help achieve some of the goals of the Sustainable Development Goals (SDG) 2030.
Keywords: Sustainability, Sustainable Development Goals (SDG) 2030, E-waste, E-waste management etc.

Introduction - Human race has witnessed development in all spheres of life ever since the world started. Development is an ongoing process that triggers some change and enables growth and advancement of the human populace. Sustainable development is a comprehensive strategy for promoting development that aims to fulfill the current generation's needs while ensuring that future generations' needs can be met without any hindrance. It involves balancing economic, social, and environmental objectives and promoting policies, practices, and technologies that are sustainable and equitable. Realizing the utmost importance and criticality of sustainable development, all the countries in the United Nations adopted the 2030 Agenda for Sustainable Development in the year 2015. The agenda containing 17 goals encompassing 169 targets was adopted to look forward to a much greener, healthier and happier world.

Amongst all the developments that are taking place all around us, developments in the field of information technology are at the top. Today the world is witnessing technological revolution as new technological advancements and innovations are taking place at a rapid pace. This rapid shift in technology is forcing the society to continuously update itself to keep abreast with the latest changes reaping maximum benefits. However, this continuous up-gradation is resulting in a new environmental challenge as electrical and electronic products are fast becoming non-productive and obsolete with the result that a horrifying bulk of e-waste, also known as Waste Electrical and Electronic Equipment (WEEE), is being generated. This e-waste has become a threat to both the human health and environment. The electrical and electronic equipment contains harmful components which are a reason to worry during the waste management process. Although formal waste management techniques do exist, however, in view of lack of awareness and proactive actions, most of the e-waste is informally and primitively handled which results in hazardous results. Increasing levels of e-waste, and improper and unsafe treatment, and disposal through incineration or in landfills pose significant challenges to the environment and human health, and to the achievement of the SGDs. In this paper, we look at how e-waste management can be done to help achieve some of the goals of 2030 Agenda for Sustainable Development.

Objectives:

1. To study the e-waste composition, hazardous effects and e-waste management process.
2. To establish relationship between SDG and e-waste management.
3. To suggest remedial measures to manage e-waste effectively to help realize SDG.

Research Methodology: To conduct the study, literature was procured from various sources like internet, journals and books and then the qualitative analysis was done of the data collected.

E-Waste : E-waste comprises of wastes generated from used electronic devices and household appliances which are not fit for their original intended use and are destined for recovery, recycling or disposal. Such wastes encompasses wide range of electrical and electronic devices such

as computers, hand held cellular phones, personal stereos, including large household appliances such as refrigerators, air conditioners etc.

Composition of e-waste is very diverse and differs in products across different categories. It contains more than 1000 different substances, which fall under "hazardous" and "non-hazardous" categories. Broadly, it consists of ferrous and non-ferrous metals, plastics, glass, wood & plywood, printed circuit boards, concrete and ceramics, rubber and other items. Iron and steel constitutes about 50% of the e-waste followed by plastics (21%), non ferrous metals (13%) and other constituents. Non-ferrous metals consist of metals like copper, aluminum and precious metals ex. silver, gold, platinum, palladium etc. The presence of elements like lead, mercury, arsenic, cadmium, selenium, and hexavalent chromium and flame retardants beyond threshold quantities in e-waste classify them as hazardous waste. Lead is reached into the ground water by the land filling of e-waste. Toxic fumes emit into air if CRT is crushed and burned. No refined machinery or personal protective equipment is used for the extraction of different materials which have ill effect both on human health as well as environment.

I. 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. When e-waste is burnt, it releases fine particles, which can travel thousands of miles, creating numerous negative health risks to humans and animals. The air pollution caused by e-waste impacts some animal species more than others, which may be endangering these species and the biodiversity of certain regions that are chronically polluted. Over time, air pollution can hurt water quality, soil and plant species, creating irreversible damage in ecosystems.

II. Effects on Soil: Improper disposal of e-waste in landfills or troughs, causes both heavy metals and flame retardants to seep into the soil, causing contamination of soil and underlying groundwater. This disrupts both the land and water hygiene of the surrounding area. When the soil is thus contaminated, the crops when cultivated are likely to absorb these toxins which in turn, can cause many diseases, both in humans and animals.

Contamination of soil also may take place as a result of deposition of large particles released during the informal process of burning, shredding or dismantling of e-waste. 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.

III. Effects on Water: After being deposited in the soil, the harmful chemical particles then further penetrate to contaminate underlying groundwater and in the long run contaminate other water bodies like ponds, streams, lakes and rivers. This renders the water unsafe for any kind of usage by plants, animals and human beings. Acidification can kill marine and freshwater organisms, disturb biodiversity and harm ecosystems.

IV. Effects on Humans: E-waste contains toxic components such as mercury, lead, cadmium, polybrominated flame retardants, barium and lithium that are perilous to human health. These toxins have adverse effects on vital organs such as brain, heart, liver, kidney and skeletal system, to name a few. It can also have considerable adverse effect on the nervous and reproductive systems of the human body.

Recycling Methods Used: Due to the absence of any proper disposal system, enormous amount of e-waste has been generated in last 60-70 years. Both informal and formal methods exist for handling the e-waste. However, in the absence of awareness, lack of infrastructure and personal advantage, most of the e-waste is handled informally where the e-waste is collected and disposed by scrap dealers or dismantlers. These stakeholders have limited and primitive dismantling capacity. They separate the useful and useless part of the e-waste by breaking the e-waste in an improper way. The useful part is traded off whereas the useless part is either dumped off in a landfill or is burnt. In both the cases, it is harmful to the environment as poisonous gases are emitted in the air or other harmful substances are leaked in the land. At the same time, they also do not use any safety measures which increase the risk to the health of the worker.

In formal recycling method, the e-waste is collected and disposed by government authorized agency or company which do the e-waste management work in an environment friendly way. These organizations perform the e-waste management by using proper equipment and also provide proper safety measures to the worker on the recycling site. However, the awareness regarding these methods is very limited and the technology being used is expensive and requires skilled training.

SDG & E-WASTE : The 17 SDGs are responsible for the holistic sustainable development all around. There are multitudes of factors and things that need to be addressed, taken care of and improvised in order to realize these goals. One such factor is e-waste management which when done properly can help achieve some of the targets framed under some of these goals. These goals and the targets framed therein are identified as:

Sustainable Development Goal 3 is to "ensure healthy lives and promote well-being for all at all ages" (Our World in Data team, 2023). To achieve this goal, 13 different targets and 28 indicators have been specified. Out of the 13 targets, target 3.9 which relates with environmental health and aims at reducing the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination may be realized by proper handling of the e-waste.

Sustainable Development Goal 6 is to "ensure availability and sustainable management of water and sanitation for all" (Our World in Data team, 2023). SDG 6 seeks to ensure safe drinking water and sanitation for all, focusing on the sustainable management of water resources, waste water and ecosystems, and acknowledging the importance of an enabling environment. To realize this goal, 08 different targets and 11 indicators have been specified. Target 6.1 which seeks to achieve universal and equitable access to safe and affordable drinking water for all and target 6.3 which aims to reduce pollution, eliminate dumping, and minimize release of hazardous chemicals and materials can be achieved with suitable e-waste management.

Sustainable Development Goal 8 is to "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (Our World in Data team, 2023). Total of 12 targets and 16 indicators have been defined under goal 8. Target 8.3 aims to promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity, and innovation, and to encourage the formalization and growth of micro-, small-, and medium-sized enterprises. 8.8 calls for the protection of labour rights and promotes safe and secure working environments for all workers, including migrant workers, particularly women migrants, and those in precarious employment.

Sustainable Development Goal 11 is to "make cities inclusive, safe, resilient, and sustainable" (Our World in Data team, 2023). For goal 11 to materialize, 10 targets and 16 indicators have been stated. 11.6 aim to reduce the adverse per capita environmental impact of cities, by paying special attention to air quality and to municipal and other waste management.

Sustainable Development Goal 12 is to "ensure sustainable consumption and production patterns" (Our World in Data team, 2023). For goal 12 to become a reality, 11 targets and 13 indicators have been identified. 12.4 aims to achieve the environmentally sound management of chemicals and all waste throughout the life cycle and to significantly reduce their release into air, water, and soil in order to minimize their adverse impacts on human health and the environment. Target 12.5 was framed to substantially reduce waste generation through prevention, reduction, repair, recycling, and reuse.

Sustainable Development Goal 14 is to "conserve and sustainably use the oceans, seas, and marine resources for sustainable development" (Our World in Data team, 2023). It encompasses 10 targets and 10 indicators. The targets relatable with e-waste are 14.1 and 14.2. Target14.1 focuses on prevention and reduction of marine pollution of all kinds, in particular from land-based activities. 14.2 aim to sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts and take action for their restoration in order to achieve healthy and productive oceans.

Remedial Measures : To realize the above stated targets, there is a dire need to shift from informal to formal e-waste management sector which employs educated and trained manpower in the authorized and registered e-waste recycling centers to handle the e-waste using advanced technologies which minimizes air, water and soil contamination and at the same time maximizes extraction of useful metals. Although, complete shifting from informal to formal management sector is not immediately possible for lack of awareness and infrastructure, but a mid-way needs to be evolved which makes use of the best of both the informal and formal techniques. Collection and segregation of e-waste could be done informally but the shredding, dismantling and taking out of precious metals could be done using formal techniques. This will not only reduce land, water and air contamination but also provide clean and healthy working environment to the labour involved. The sound management of e-waste can create new employment opportunities and contribute to the economic growth in the recycling and refurbishing sector.

The principle of 3Rs i.e. Reduce, Reuse and Recycle needs to be incorporated. Reduce deals with both reduction in the production of electronic equipments and reduction in the amount of electronic waste generated. Reuse deals with using the same equipment for multiple purposes and furthering the life of equipment by donating it to the needy. Recycle deals with taking the used and waste equipments, extract materials of use from them, reprocess them and produce something useful from them. It, thus, converts the waste into something positive and constructive. As a result, after recycling, the waste material that is going to be finally disposed is significantly reduced and thus, harmful impact to the environment is reduced. At the same time, it ensures that the landfills are also not overtly filled. It also conserves natural resources by reusing them. It is, therefore, an instrumental step in the 3R which can be improved through innovative and more effective processes and technologies.

Rapid urbanization requires new solutions to address rising environmental and human health risks, especially in densely populated areas. Most e-waste will be generated in cities and it is particularly important to properly manage e-waste in urban areas, improve collection and recycling rates, and to reduce the amount of e-waste that ends up in dumpsites. The move towards smart cities and the use of ICTs for waste management offer new and exciting opportunities.

It is also equally imperative for all the countries to come together on a common forum and formalize and agree upon environmentally sound management of e-waste and frame laws to enforce these practices. Although, many initiatives have already been taken towards this but a lot more needs to be done for things to change and become sustainable.

Conclusion: With the ever increasing demand for electrical and electronic items, the e-waste generation is going to

increase many folds. To reduce the environmental footprint, proper recycling and disposing off techniques need to be used. Appropriate guidelines need to be laid out. As skilled personnel are required for this, proper training should be imparted. More e-waste recycling plants should be established. Newer and greener ways of designing and manufacturing products and equipments must be developed so that the generation of e-waste is minimized. Less toxic, easily recoverable and recyclable materials which can be taken back for refurbishment, remanufacturing, disassembly and reuse ought to be used. Proper management of e-waste can result in business opportunity as many people are involved in the process of collection, dismantling, segregation, refurbishment and recycling.

Sustainable environment is the need of the hour. All the major players viz. the government, the industrialists, the NGOs and the public need to sit together, frame policies and encourage the public at large to go for proper e-waste management so that we have a suitable environment to live in.

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