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Emerging Challenges of E-Waste Management: A Growing Socio-environmental Concern

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Abstract

In the past few decades, there has been a substantial increase in global demand for electrical and electronic equipment (EEE) due to the addition of advanced features, capacity, and speed etc. This has resulted in a shorter lifespan of EEE (s) and stacks of electronic waste (e-waste). Considering the global e-waste issue, this study analyses the impact of e-waste, treatment of e-waste depending upon EEE (s) (recycling, dumping, and burning), impact on the environment (air, bottom ash, dust, soil, and water), and on human health (chronic and acute diseases). In addition, the literature lacks accurate data and recent research; hence, this study bridges the research gap, specifically in the developing country's scenario. The study concludes that burning of e-waste has contaminated industrial and urban environments by exceeding environmental reference limits by involving approx. 50 hazardous elements and compounds. Moreover, dealing with e-waste has exposed workers to hazardous gases and chemicals, threatening their health and families due to lack of appropriate equipment, especially in underdeveloped countries. It is high time to learn from developed countries' research, experience, and expertise in dealing with e-waste.

Introduction

Managing EEE waste (e-waste) has become a global concern. Rapid up-gradation of technology with online purchasing and delivery facilitation, old technology has emerged as massive e-waste[1]. Moreover, there is no precise definition of e-waste, the Organization for Economic Cooperation and Development (OECD) defines it as "any appliance that uses an electric power source that has reached its end-of-life[2]".In addition, another term, waste electrical and electronic equipment (WEEE), is used, which includes goods like ovens and refrigerators. However, the line between the two is blurring owing to the rise of ubiquitous computing[2].

However, the fast-technological advancement in EEE-equipment has shortened the lifespan—for example, less than two years for computers and mobile phones—is a significant contributor to the high amount of e-waste produced[3].In 2018, the WEEE ordinance classified EEE into six categories of products i.e.,heat transfer equipment (refrigerators, freezers, air conditioners, heat pumps), screens and equipment with a surface area of more than 100 cm2,lamps, large equipment (washing machines, cookers, electric stoves, dishwashers), small equipment (vacuum cleaners, microwave ovens, VCRs, radios, hair care appliances), and small computers and telecommunications equipment (mobile phones, personal computers)[4].

However, there have beenseveral other causes for the e-waste in past two decades. The EEE brought the digital revolution by providing comfort, health, and security and facilitating society through the exchange of information[5]. This resulted in a race of technological advancements in EEE with an increase in EEE production[6]. This resulted well before the end of EEE before its useful life due to more featured EEE in the market. This approach produced stacks of e-waste with a waste-management dilemma that led to serious health and environmental issues[5].Therefore, the higher the use of EEE, the higher the rate of obsolescence, and resulting in a massive increase of about 41.8 million tonnes of e-waste with an increment of 4 to 5% each year[7].

EEEs after their utilization and when no longer required, turns into garbage, which needs cleanliness[8]. As per literature, home appliances contribute the maximum portion of e-waste (about 50%), followed by IT and communications technology equipment (approximately 30%), and consumer electronics (approximately 10%)[9]. Out of all e-waste items, these items contribute to 95% of the total quantity of e-waste created globally[2]. Moreover, the composition (chemically and physically) of E-waste is different from other forms of industrial and community garbage, and it contains both precious metals such as copper and gold, and toxic substances such as lead, mercury, and arsenic.[10]. Therefore, e-waste requires proper processing and recycling procedures to reduce environmental contamination and potential health risks[2].

Technological advancements have brought comfort to mankind, along with a global problem of e-waste stacks, replaced by high-end electronics. Fast advancements have resulted in higher e-waste issues. Considering the global problem, this study provides a clear scenario of e-waste; the extent of re-usability and re-cycling (second useful life and extraction of precious metals/components) as an effective method to reduce e-waste and its associated cost. Moreover, it shades light on the informal recycling of e-waste, socio-environ impact and its consequences on quality of life, agriculture, and livelihood etc. Concisely, e-waste has resulted in food insecurity and significant resource disputes, droughts, floods, water scarcity, health hazards, limited energy supplies, and economic and sociopolitical instability, etc. directly and in-directly.

a. Global E-waste Scenario

Due to technological advancement, the importance of EEEs has increased many times and has reduced the usable life as well, which has produced stacks of e-waste[11]**.** Moreover**, t**he rate of e-waste generation is increasing across the world. Cities throughout the globe produced 1.3 billion tonnes of solid garbage in 2012, equating to a daily impact of 1.2 kilos per person[12]. The amount of e-waste generated was roughly 44.7 million metric tonnes (Mt) globally in 2016, and about 6.1 kg per person. The global e-waste volume was estimated to exceed 46 Mt for 2017. This indicates that the annual growth rate is between 3 to 4%, and according to estimation the volume of e-waste is expected to reach 52.2 Mt in 2021[13].

Samuel Abalansa et al. (2021) conducted a study on e-waste, an environmental problem exported to developing countries: the good, the bad, and the ugly. The study argued that e-waste consists of three folded dimensions: good, bad, and ugly. The study claimed that the GOOD factors mean that EEE provides jobs and a source of raw materials for businesses, while the BAD factors mean that EEE worsens the environmental conditions in developing nations; and lastly, the UGLY factors indicate the negative impact on the health of workers involved in the e-waste process because of their contact with toxic chemicals[14].

Moreover, according to reports, five of the EU's 28 member states have reached or exceeded their targeted collection rates: Norway met 45% and Sweden even exceeded 65%. While there are still five member states that have the lowest collection rates, ranging from 10% to 20%[6]. In contrast,the rest non-recyclable was sent to the third world for reuse and later dumped.The EEE that arrive in third-world nations were of three types: one, out-of-date technology with a short life span; two, most of the goods are broken during transportation, and three, they are completely unusable. The UN Environment Program reported that 70% of toxic material in the shape of EEE is disposed of in New Delhi, India[3].

b. Pakistan's E-waste Scenario

Since 1992, an international agreement known as the Basel Convention has made it illegal to export hazardous waste to undeveloped countries, yet the practice persists[3]. Despite being a member of the Basal Convention, Pakistan is one of the major recipients of e-waste. Under the agreement, the flow of trash such as e-waste was controlled. The convention only permits the flow of e-waste if it is utilized for the same purpose for which it was generated. As a result, Pakistani competent agencies allow importing of e-waste since it will be reused[15]. Pakistan has become a significant dump-yard for large amounts of e-waste imported from the US, the EU, Japan, UK, Australia, and the Gulf nations[16]. The used types of equipment are less expensive in contrast to new equipment. However, such equipment consumes more energy, and cannot be used for a long period of time. Within a few years, this equipment will be discarded[15]. Anyhow, Pakistan has experienced significant demand for EEE, primarily for home goods (such as TVs, refrigerators, washing machines, air conditioners, ovens, etc.), telecommunications, information technology, and computers due to population growth. Moreover, the major EEE components are imported or smuggled into Pakistan and then assembled. This shows that most of the EEE industry is dependent on imported equipment. [17]. Increased demand leads to increase EEE imports, and continuing e-waste imports create future trash in Pakistan. Furthermore, the increasing demand is met through e-waste and indigenous technological industries, resulting in significant e-waste production from households, companies, industries, and government organizations. Pakistan would be unable to handle solid trash and would look like an e-waste colossus [18].

Moreover, significant research has been conducted on the harmful effects of hazardous chemicals found in e-waste worldwide. However, only a few research studies have seen conducted on e-waste generation and management in Pakistan[19]. In Pakistan, no particular health and safety regulations govern the e-waste recycling industry. Throughout the procedure, all workers are exposed to hazardous chemicals. Workers generally donot wear any safety gear and handle highly hazardous waste with their bare hands. Many workers are aware that gloves and masks are beneficial for safety, but many are unable to afford high-quality versions. Others argue that they don't require any protection and that their business is clean[20].

Sajid et al. (2019) conducted a survey study on assessing the generation, recycling and disposal practices of electronic/electrical waste in major cities of Pakistan. The study reported that about 50 kilotonnes of e-waste are imported as scrap and about 38 kilotonnes are generated locally every year. The study argued that the e-waste procedure was undertaken without the use of safety equipment. This emphasizes that there should be an e-waste management system that monitors and supervises the informal sectors[19].

Umair et al. (2015) conducted a study on the social impact of informal recycling of EEE waste in Pakistan using UNEP SETAC guidelines and reported that e-waste processing and disposal activities in Pakistan are generating toxics for the environment and damaging human and environmental health. According to the study, there is a lack of a precise figure for EEE as well as a study on the informal recycling sector. Furthermore, the study claims that ignorance and a lack of interest in environmental legislation are the main causes of Pakistan's current e-waste crisis [20].

Mohammad et al. (2019) conducted a review on generation, recycling, and disposal practices within major cities in Pakistan. According to the study, Pakistan's E-waste generation is primarily due to imports from developed countries, with only a small amount generated locally. The reports of 2014 show that total E-waste generation (import and domestic) is expected to be between 120,000 and 140,000 tonnes. Moreover, due to the lack of an institutional framework, informal cycle processing activities are carried out, and this informal procedure poses serious health and environmental risks for the habituated of the area. Due to monetary factors, the informal sector engages in these activities, and around 300% profit is obtained from this [19].

Ahmed et al. (2010) conducted a study on ICT and environmental sustainability in Pakistan. According to reports, Karachi serves as a significant landfill for e-waste from all over the world. This is a serious violation of the EPA Act of 1997, 11 which prohibits garbage disposal. Hundreds of laborers (women and children) scratch out a living in the Lyari neighborhood by dismantling EEE trash and extracting precious components such as copper. It may appear to be a handy way to make a livelihood from the garbage. They frequently burn plastics without using necessary safety precautions and affect the health of labour.

c. E-waste Importin Pakistan

Pakistan is the sixth most populatednation, yet because of its still-developing infrastructure and economy, it is categorized as a third-world nation[2]. Rapid population growth, urbanization, and low purchasing power generate a market and demand for electronic products in the country, particularly for home appliances, telecommunications, information technology, and computers[17]. People must rely on used items because they have limited purchasing power. Consequently, there is a demand on the market for more affordable used or end-of-life equipment to be brought to the local market[2]. EEE-equipment are imported or smuggled and solely assembled in Pakistan[17]. Therefore, non-recyclable and out-of-date goods are received by third-world countries such as Pakistan[3].

There is no exact data or information available regarding e-waste generation and imports[21]. Pakistan is being a member of the Basal Convention, but still one of the major recipients of e-waste[15]. However, Pakistan has put restrictions on e-waste imports. Meanwhile, other used EEE are still being imported into Pakistan as secondhand items[21]. Imported goods in Pakistan are generally categorized into four groups. These four categories are labelled as A, B, C, and D categories. Products in the A-category are appropriate for resale. Products in the B-category are in good condition and have few flaws. Products that are broken and need repair are classified as Category C, and products that are not in functioning order are classified as Category D[22].

II. E-waste Elimination Challenges

Pakistan's informal e-waste recycling industry is a significant source of revenue. The computer and E-equipment scrap is collected by Kabari (scrap dealer) and recyclers from street scrap collectors or repair shops. The scrap collector gathers unwanted equipment from individual’s door to door, or people sell their unwanted equipment to the mechanic and kabari. The recyclers buy this waste from scrap collectors or repair equipment shops on a weight basis[19]. Thus, informal e-waste recycling is a source of income for many Pakistanis living below the poverty line. Families have established cottage businesses in their homes, where men and women work together to earn a livelihood[23].

The primary concerns are how to deal with such a large number of old electronics? Moreover, it contains toxic components (such as lead and other heavy metals). As there is risk involved in this kind of equipment that might be discharged into the environment during disposal, this condition poses a substantial health and environment concern. According to estimation, over one billion pounds of lead from computers and other gadgets is expected to enter the trash stream in the United States within the next decade[24].

According to studies, e-waste disposal has a more comprehensive and distinctive procedure and management system than normal solid waste disposal[25]. This distinctive procedure makes e-waste as one of the difficult challenges to eliminate worldwide. These challenges may include large amount of e-waste,transports to disposal facility, separate from traditional solid waste, anddifficult procedure of recycling, dispose off and minimize the risk of emission. As EEE-equipment has penetrated and encircled our lives, providing more comfort, health, and security, the generation and considerable demand and its use has increased in our daily lives. The demand and buying linked with advancement andresult in shorter useful lifespan of equipment is by product [5][6][24].

Another issued raised with it that e-waste cannot be disposed of with other solid waste[25]. As e-waste is very different from traditional solid waste, therefore it needs proper handling and disposal procedure[26]. The majority of third-world nations lack the specialised waste removal infrastructure and technological capabilities required to ensure safe disposal of hazardous waste. Several medical conditions, including cancer, neurological and respiratory disorders, and congenital anomalies, have contributed to the e-waste problem in these countries[3].

One way to handle this challenge is by recycling EEE. However, the recycling costs exceed earnings, especially among developed nations with rigorous environmental rules. Therefore, exporting EEE to developing nations is a simple way to handle trash and come with the label of "bridging the digital divide". However, it is an established fact that it is a means of dumping unnecessary EEE on the poor.Developed countries discard e-waste in countries where environmental-related standards are either inadequate or nonexistent[27].

Various pilot projects were started in Pakistan to deal with E-waste: such as UNITAR Pilot Project (2006-09) for SAICM, Mercury Inventory Pilot Project (2008) has been successfully completed, Management of Mercury &Mercury-containing Waste Project (2009-10), Kasur Tannery Pollution Control Project (KTPCP) (Treating 12700 M3 tannery wastewater of 237 leather industries) and Cleaner Production Center (CPC-Sialkot) for introducing CP technologies and chrome recovery plant[28].

Lakhodair is home to Pakistan's first scientific disposal plant, which covers 52 hectares of land. This scientific facility complies with all international waste disposal requirements. The first two cells have been helping with 2000 to 2500 tonnes of waste each day for approximately ten years, with no impact on underground water or the atmosphere[29]. However, this single facility cannot process all of Pakistan's e-waste. It is difficult to transport all EEE waste to this facility, it cannot process all types of E-waste, and it can only process up to ten years. In Pakistan, yet another mobile recycling (hydrometallurgical process) facility has been established. This recycling facility for wPCBs is accomplished using a hydrometallurgical process[22].

III. E-Waste in an Environmental Context

Pakistan produces around 20 million tonnes of solid waste each year, with more than 2% annual growth rate. According to the Pakistani government, 71,000 tonnes of solid waste is produced every day in the metropolis. For example, Karachi is Pakistan's largest metropolis, and it generates about 9,000 tonnes of municipal waste. In short, Pakistan produces 0.283 to 0.612 kg of solid waste per inhabitant per day, with a 2.4% annual increase rate[29].

One of the easiest way to disposed ofthe waste is burnt and landfilled. Vacant plots, below bridges, and other such locations are unlawfully used as waste dumping points in Pakistan's main cities, from which waste is collected and transferred to disposal sites. Only 70% of home solid waste is carried to landfill sites, where it is burned up in the open air due to resource constraints. [30]

E-waste comprises several lethal materials that are discharged into the environment directly. It can be lethal if not handled in a controlled setting. E-waste, for example, consists of over 50 toxic elements such as mercury, arsenic, lead, chromium, PCBs, and other valuable materials such as gold, silver, platinum, palladium, copper, plastics, and glass. These toxic substances cause long-term health issues such as neurological and endocrine disorders, as well as cancer in some situations. Toxic chemicals are likely to pollute the environment and threaten the health of workers involved in unlawful e-waste recycling in the informal sector[7].

Organic flame retardants (FRs) are hazardous materials released during the recycling of e-waste that hasa variety of health and environmental effects. FRs are commonly used in cable insulation, plastic housings, and EEE circuit boards. Through inhalation, ingestion, or skin contact, residents living near recycling locations and employees participating in informal e-waste recycling might be exposed to these FRs[31]. Further, E-waste dumps also affect the food chain, soils, rivers, and river chains[32]. Chlorobenzene is a chemical substance used in EEE. Chlorobenzene has acute and chronic consequences for mammals, including disruption of the central nervous system, liver dysfunction, and thyroid problems. The kidneys are also affected by increasing levels of chlorination, such as tetra chlorobenzene[33]. Another issue that emerged due to e-waste is the CRT, which is nearly entirely made of glass, forms a major part of the weight of a television or a computer display (panel, funnel, and neck glass). Further, the funnel glass includes Pb, which raises the environmental risk of CRT glass reuse, and discarded CRTs have been classified as hazardous waste because of their high Pb concentration[34].

According to experts, climate change poses a significant threat to the country's agriculture-based economy. Experts are frightened about crop failure and the loss of livestock, which will result in food insecurity and significant resource disputes. Furthermore, droughts, floods, water scarcity, health hazards, limited energy supplies, and economic and sociopolitical instability would be a byproduct [15].

With the rise of e-waste, there are several critical problems to take into account. Most electronic equipment is designed to be difficult to disassemble. Corporations do not have a financial incentive to manage e-waste properly and efficiently unless it is compelled by law. Second, companies' labels on scrap show that the equipment can be reused, but in fact it won't be. Thirdly, whether e-wasteis recycled or not, it contains hazardous compounds that have the potential to contaminates the environment[1]. Finally, EEE equipment are disposed of together with household garbage, therefore the majority of recyclable household e-waste is in a condition to process further forthe recycling process. [35]. Table 1shows environmental and health hazards due to WEEE.

Table 1: Environment and health hazards- WEEE[36]**,** [22]**,** [19]

WEEE	Source	Process	Purpose	Materials	Hazards	International Agency for Research on Cancer (IARC) - Classifications
Printed Circuit Boards (PCBs)	Computers (monitor, motherboards etc.), electronic gadgets	De-soldering, components retrieving	Extraction of Copper (Cu), precious metals, and non-metals etc.	Lead (Pb), Mercury (Hg), Beryllium (Be), Cadmium (Cd), Antimony (Sb_2O_3)	Air pollution, Toxicity of workers, inhalation etc.	
Disassembled PCBs	PCBs from electronic gadgets	Burning and dumping	-	Tin, Pb, Be, Cd, Hg, Brominated dioxin,	Toxicity of workers, inhalation, ground water and surface contamination, air pollution	The IARC lists: As, Cd, Be in Group I as carcinogenic to human. In, Pb in Group 2A as carcinogenic to human. Ni, Co, and Sb_2O_3 in Group 2B as possible carcinogenic. Cu (copper 8-hydroxyquinoline), Hg in Group 3 as not classifiable as carcinogenic. Ba, TI, Zn, Rare Earth elements and Li has no listings in IARC.
Cathode ray tubes	Old electronic gadgets (monitors, televisions etc.)	Extraction of copper yoke, breaking	Extraction of useful components i.e., Cu.	Cd, phosphors (P), Pb, barium (Ba), Sb_2O_3,Zinc (Zn), Nickel (Ni), Rare Earth elements	Silicosis, glass cuts, heavy metals leaching into ground, release of phosphors (toxic)	
Batteries	Mobile phones, car, toys etc.	Hydro-metallurgical processes, DL- malic acid leaching, sieving etc. dumping	Extraction of useful components i.e., Lithium (Li), Ni, Manganese (Mn), plastic separation, terminals (cathode) materials etc.	Acids, Li, Pb Cobalt (Co), Thallium (TI), Hg (in some cases), Ni etc.	Air pollution, water contamination, landfills	
Other electronic components	semi-conductors, photovoltaic cells, laser, light emitting diodes (LED), photodiodes, transistors	De-soldering, components retrieving	Extraction of useful components i.e., rare earth elements etc.	TI, Indium (In) Arsenic (As), Rare Earth elements, Cd	Landfills, air pollution, toxicity of workers, inhalation, water contamination	

IV. E-waste Management Procedure in Pakistan

In the third world, the recycling of EEE is a daisy chain process that informal enterprises own and a significant portion of GNP is spent on EEE imports[10]. About 2% of the imported EEE is useable, the remaining e-waste is sent to the informal sector for recycling purposes[16]. The E-waste flow is shown in Figure 1. Informal enterprises use the hazardous technique on EEE for their gain without causing substantial harm to the environment or human health. For example, EEE is collected, sorted, and manually separated by companies. The procedures entail the use of primitive ways to separate valuable materials.[10]. When it comes to e-waste disposal, cost is a key consideration. Most recyclers in the country experience similar costs issues, that include

logistics and transportation[3]. As the cost is a key consideration, workers are exposed to e-waste threats, and the environment is exposed to e-waste pollutants. Even though they know that these informal recycling procedures are not good for the environment and human health, they continue with these practices[14].
To recover valuable metal from e-waste, hazardous recycling activities are carried out on informal sites. Recycling procedures such as manual dismantling, open burning, acid baths, and blowtorches are used in the open air and tiny workshops in Pakistan's e-waste recycling areas[2]. While burning wires, PCBs, and other polymers in the open to separate metals from polymer substances pollute the environment significantly[16]. Solid waste is intermingled with e-waste disposal. It poses a greater risk of environmental pollution, and the consequences are far higher than estimated[37].
When it comes to pollution sources, household solid waste (HSW) is often overlooked, yet, as seen below, despite its small volume, HSW is a constant source of pollution, and the amount of garbage generated on an annual basis is huge. Because of its domestic origin, the general public believes that HSW does not cause a significant environmental impact. The truth is that HSW includes numerous hazardous components and elements, such as lead, that are non-degradable and can seep into underground water streams, eventually reaching the human food chain via animal or plant sources[30].
Import of hazardous trash is prohibited under Section 13 of the Pakistan Environmental Protection Act 1997, and handling hazardous components is prohibited under Section 14[28]. Karachi is home to Pakistan's largest recycling garbage facility. In addition, Lahore, Faisalabad, Peshawar, Gujranwala, Islamabad/Rawalpindi, and Islamabad/Rawalpindi are also active in e-waste recycling and disassembly, although on a much smaller scale than Karachi. Karachi, as a seaport, gets e-waste shipments from all over the world. [38]. Karachi has two e-waste dump sites, while Lahore also has two. While other major cities in Pakistan are constructing suitable landfills, trash has been deposited beyond the city limits so far[29].

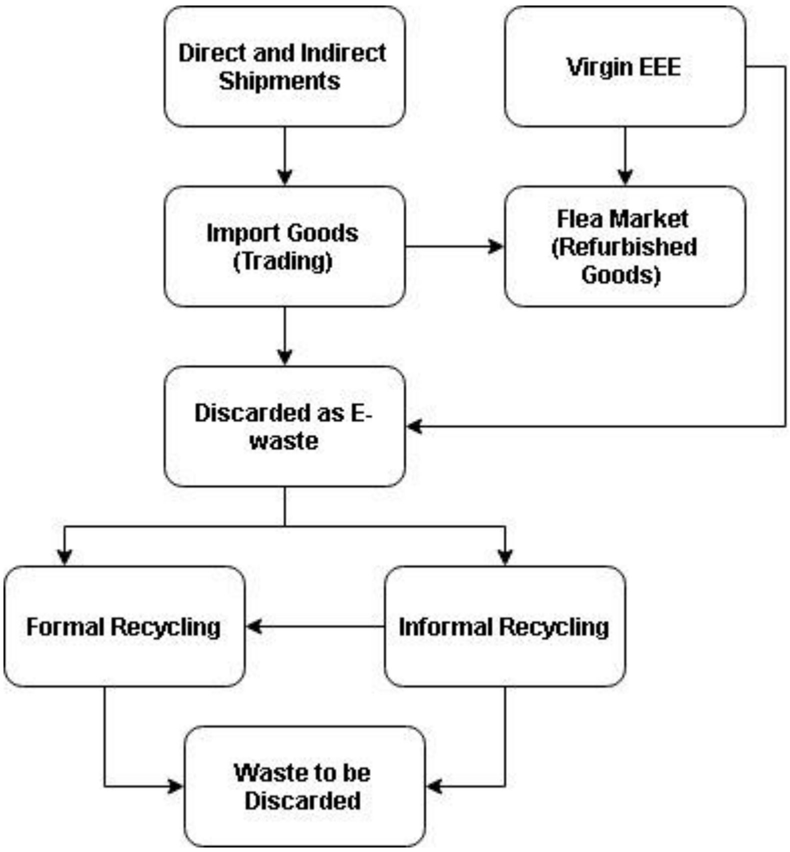

Fig 1. E-waste flow [16]

V. Labor Condition

The labor engaged in this sector carried out two kinds of activities: the collections of scraps and detailing with the extraction of metals. In the first group, the formation and activities of the informal sector are unorganized. However, there is an internal management system, and it works in a chain. Such as it starts from rag pickers to collectors, who then pass it on to scrap collectors, who then dismantle and sort it before passing it on to informal recyclers[16]. In the second group, the children and women are among the most vulnerable segments of the society since they are exposed to heavy metals, flame retardants, and polycyclic aromatic hydrocarbons (PAHs) present in e-waste and emitted during the burning process[39].

Workers dismantle all sorts of equipment while wearing no protective breathing equipment or special clothes[2]. Moreover, workers are frequently exposed to hazardous gases and chemicals that risk their health because no emission control systems or emission filters are employed[39]. The workers engaged with e-waste reported headaches, breathing issues, stress, chest pain, weakness, and dizziness. Moreover,several reports indicate that DNA damage has been reported by the people, who have been handling toxic compounds and emission of gases.Further, thesame issues are reported by people living in such places or living in e-waste settlements[40].

Conclusion

In Pakistan, e-waste recyclingis a profitable and money-making industry. Certain portion of e-waste devices are reused, recycled, or publicly burnt to extract precious metals. People engaged in these professions are less aware of the detrimental impact of e-waste on causing chronic and acute diseases. The labor engaged with e-waste does not use measures such as protective breathing masks or safety kits. Moreover, e-waste hazardous recycling activities are carried out on private informal sites to recover precious metal from e-waste. For example, FRs are frequently used in cable insulation, plastic housings, and EEE circuit boards, and recycling processes such as manually dismantling, open burning, acid baths, and the use of blowtorches are utilized in the open air. However, the private informal sector is more concerned with their profit and hazardous activities carried out without knowing the detrimental impact of e-waste disposal. Insecure e-waste disposal is polluting the air, bottom ash, dust, soil, water, and sediments in e-waste areas.

Literature details how e-waste causes environmental issues in developing countries. The main reasons for this are ignorance and the lack of environmental legislation. If laws exist, even though there is non-compliance in the informal sectors due to weak check and balance of related agencies, Moreover, electronic trash is rapidly increasing due to the high population density, skilled labour force, e-waste imported, and on-shore e-waste masses. For instance, Pakistan produces around 20 million tonnes of solid waste each year with annual growth of 2%, approx. solid waste of 71,000 tonnes everyday in the metropolis. weighing 0.283 to 0.612 kg of waste per captia per day, with a 2.4% annual increase rate.

Recommendations:

First and foremost, the government must first implement existing laws effectively and prohibit the import and movement of equipment containing toxic compounds. The government must guarantee that an e-waste-specific statute is enacted in the informal sector, ensuring standards and a certification mechanism. Furthermore, only that EEE equipment would be allowed that complies with the government's international regulations (Basel convention, EU).

Secondly, the emphasis is on providing information to the general public, enabling their involvement, and encouraging compliance. When even governments lack the desire to safeguard the environment, public awareness will take care of the environment. Thirdly, the government needs to develop better environmental decision-making policies and promote law and governance for e-waste imports and domestic generation. The credibility of the government exerts pressure on the informal sector dealing with e-waste to adhere. These policies will pressure the private sector and the general public, resulting in a decrease in severe pollution that endangers the human environment, health and well-being.

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