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E WASTE PROBLEMS - AN ANALYSIS

Bharat N. Patel*

Dr. V. Balachandran**

Abstract: *In India, yesterday's electronics are today's business. Electronic waste or e-waste is one of the emerging problems in developed and developing countries worldwide. It comprises of a multitude of components with valuable materials, some containing toxic substances, that can have an adverse impact on human health and the environment. Previous studies show that India has generated 0.4 million tons of e-waste in 2010 which may increase to 0.6 to 0.8 million tons by 2015–2016. Coupled with lack of appropriate infrastructural facilities and procedures for its disposal and recycling have posed significant importance for e-waste management in India. In the West, treating or processing e-waste is expensive, and smaller countries are running out of landfill space,The easiest way for them is to ship it out to a country like India. So, we are faced with this burden of e-waste from developed countries.*

In general, e-waste is generated through recycling of e-waste and also from dumping of these wastes from other countries. More of these wastes are ending up in dumping yards and recycling centers, posing a new challenge to the environment and policy makers as well. In general electronic gadgets are meant to make our lives happier and simpler, but the toxicity it contains, their disposal and recycling becomes a health nightmare. Most of the users are unaware of the potential negative impact of rapidly increasing use of computers, monitors, and televisions. This review article provides a concise overview of India's current e-waste scenario, namely magnitude of the problem, environmental and health hazards.

This new kind of waste is posing a serious challenge in disposal and recycling to both developed and developing countries. While having some of the world's most advanced high-tech software and hardware developing facilities, India's recycling sector can be called medieval The dumping of e-waste, particularly computer waste, into India from developed countries and all this has made e-waste management an issue of environment and health concern. Compared to conventional municipal wastes, certain components of electronic products contain toxic substances, which can generate a threat to the environment as well as to human health . For instance, television and computer monitors normally contain hazardous materials such as lead, mercury, and cadmium, while nickel, beryllium, and zinc can often be found in circuit boards. Due to the presence of these substances, recycling and disposal of e-waste becomes an important issue.

Keywords: *E-waste, Environmental hazard, Toxic substances, computer waste, health hazards, recycling*

*Ph.D. Scholar, Department of International Business and Commerce, Alagappa University, Karaikudi, Tamilnadu,India

**Professor & Head, Department of Corporate Secretaryship, School of Management, Alagappa University, Karaikudi ,Tamilnadu, India

INTRODUCTION TO E WASTE

In the 20th Century, the information and communication revolution has brought enormous changes in the way we organize our lives, our economies, industries and institution. At first, we dealt with record players, radios, VCRs and black-and-white TVs. Later on, CD and DVD players followed. Finally, air conditioners, cellular phones, refrigerators computers , laptop and smart phones arrived. Electronics have become part of the throw away culture of developed countries. Electronic gadgets are meant to make our lives happier and simpler, but they contain toxic substances, their disposal and recycling becomes a health nightmare. These have led to manifold problems including the problem of massive amount of hazardous waste and other wastes generated from electric products. Over the past two decades, the global market of electrical and electronic equipment (EEE) continues to grow exponentially, while the life span of those products becomes shorter and shorter. Rapid economic growth, coupled with urbanization and a growing demand for consumer goods, has increased both the consumption and the production of EEE.

Any improperly disposed electronics can be classified as e - waste. E-waste basically comprises electronic goods that are not fit for their original use E-waste in short is a generic term embracing various forms of electric and electronic equipment that have ceased to be of any value to their owners.

In general the electronic goods/gadgets are classified under three major heads:

- White goods: Household appliances
- Brown goods: TVs, camcorders, cameras
- Grey goods: Computers, printers, fax machines, scanners etc.Waste from the white and brown goods is less toxic when compared to grey goods

Most people are unaware of the potential negative impact of the rapidly increasing use of computers, monitors, and televisions. When these products are placed in landfills or incinerated, they pose health risks due to the hazardous materials they contain. The improper disposal of electronic products leads to the possibility of damaging the environment. As more e-waste is placed in landfills, exposure to environmental toxins is likely to increase, resulting in elevated risks of cancer and developmental and neurological disorders. This review article provides a concise overview of India's current e-waste

scenario, namely magnitude of the problem, environmental and health hazards and recycling operations.

GLOBAL SCENARIO

Globally, an estimated 60 million tons of e-waste are produced annually, with residents of the U.S. and the U.K. generating some of the highest rates worldwide at 30 kg and 22 kg per person, respectively.According to recent studies, almost 2.7 million tons of electronic waste are being generated annually in India. Out of 60 million metric tons of electronic waste (e-waste) are produced globally each year, about 15 percent of that weight is recycled mostly in developing countries. About 10 million tons of this waste —discarded televisions, computers, cellphones, and other electronics—are produced by the European Union, according to the United Nations Environment Programme (UNEP). The amount of E – Waste that is discarded every year in developed countries continues to grow rapidly.Developing countries with rapidly growing economies handle e-waste from developed countries, and from their own internal consumers. Currently, an estimated 70 percent of e-waste handled in India is from other nations, but the UNEP estimates that between 2007 and 2020, domestic television e-waste will double, computer e-waste will increase five times, and cell phones 18 times.

Informal recycling markets in China, India, Pakistan, Vietnam, and the Philippines handle anywhere from 50 percent to 80 percent of this e-waste

Quantity of E-waste generated and the content of toxic and valuable materials, it has become an emerging problem throughout the world. In 1994, it was estimated that approximately 20 million that is about 7 million tons of PCs became obsolete. In 2010 this figure has increased to over 150 million PCs. Over the past two decades, the global market of EEE continues to grow exponentially, while the lifespan of those products becomes shorter and shorter. In the United States (US) market, less than 80 million communication devices were sold in 2003, 152 million by 2008, a growth of over 90 percent in 5 years and by 2015 this numbers would be skyrocketing. Meanwhile, in 2006, more than 34 million TVs have been exposed in the market, and roughly 24 million PCs and 139 million portable communication devices have been produced. In the European Union (EU), the total units of electronic devices placed on the market in 2009 were more than 3.8 billion units, including 265 million computers, roughly 245

million in home consumer electronics, and 197 million consumer appliances. In China, approximately 20 million refrigerators and more than 48 million TVs were sold in 2001, and nearly 40 million PCs were sold in 2009. The situation is exacerbated by the rapid turnover of electronic devices. Because of the fast pace at which technology is evolving, most electronics have only a 2 to 3 year useful life. Apple sells more than 300,000 new phones every day in the world market and in this same time frame, more than 150,000 new Blackberries are also sold and 700,000 new Android phones are being activated. Most of the phones that are replaced by these new devices end up in a draw or in municipal landfills.

INDIAN SCENARIO

Of the total e-waste generated in the country, western India accounts for the largest volume at 35%, while the southern, northern and eastern regions account for 30, 21 and 14%, respectively. Sixty-five cities in India generate more than 60% of the total e-waste generated in India. Ten states generate 70% of the total e-waste generated in India. Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab in the list of e-waste generating states in India. Among top ten cities generating e-waste, Mumbai ranks first followed by Delhi, Bangalore, Chennai, Kolkata, Ahmadabad, Hyderabad, Pune, Surat and Nagpur. Similarly, a study by E-Parisaraa revealed an average middle class family generates nearly 19 kg of e-waste annually in India.

According toThe Maharashtra Pollution Control Board(MPCB) estimates, Mumbai generates around 23,000 metric tonnes of e-waste a year, and if not managed properly, this could be a major cause for concern by 2017. According to a country-level Waste Electrical and Electronic Equipment (WEEE) assessment study, Mumbai generates the maximum amount of e-waste. The total WEEE-generation in Maharashtra is 20,270.6 tonnes annually, of which Greater Mumbai generates 11,017.06 tonnes and Navi Mumbai contributes 646.48 tonnes.

A 2007 study by the Manufacturers' Association of Information Technology and the German Agency for Technical Cooperation in India found that an additional 50,000 tons of e-waste is imported to India from developed countries every year, despite the nation's bans on the dumping and disposal of foreign waste and on the importing of old computers and their

accessories. According to activists, importers have long exploited a loophole in the bans that allows for imports of used electronics as donations.

Future efforts to minimize illegal dumping will undoubtedly include a combination of aggressive legislation, new technological solutions, and increased public awareness through more education on e-Waste. Chemical and biological leaching has their own merits and demerits and there could be various technical, economic and environmental reasons for choosing one process over the other. we should know the ways and means of disposing the waste with the help of the available or new technology for a convincing betterment of our environment. The objectives of India should be 1) Minimize the generation of hazardous waste.2) Dispose of hazardous wastes within the country of generation effectively in an environmentally sound manner. 3) Establish enhanced controls on exports and imports of hazardous waste and 4)Prohibit shipments of hazardous wastes to countries lacking the legal and technical capacity.

PROBLEMS IN INDIA

The Indian information technology (IT) industry has been one of the major drivers of change in the economy in the last decade and has contributed significantly to the digital revolution being experienced by the world. New electronic gadgets and appliances have infiltrated every aspect of our daily lives, providing our society with more comfort, health and security and with easy information acquisition and exchange. India has generated about 0.2 million tons of E-waste in 2006 and in 2010 it is about 0.4 million tons and at present the quantum is increasing rapidly. Studies so far reveal that the total e-waste generation in India from both households and corporate will reach 0.5 to 0.6 million tons by 2013–2014. The following three categories of WEEE account for almost 90% of the generation:

- Large household appliances: 42%,
- Information and communications technology equipment: 33.9% and
- Consumer electronics: 13.7%.

Though E-waste is being recycled in all metros in India, Delhi is where the illegal and dangerous practices of recycling are adopted. India has become the dumping ground of all kinds of waste from the developed countries. The major challenge for formal recyclers will be to tackle this sprawling informal sector. Informal scrap dealers pay consumers by the kilogram; for an old computer, for example, a consumer might get $10 to $20. Recycling

plants won't pay. "Unfortunately, the Indian consumer is used to getting paid for their waste," says Priti Mahesh, a project manager for Toxics Link, an environmental NGO. "It will be difficult for [formal recyclers] to go from door to door and collect the waste, which the informal sector is very adept at."

The transition won't be easy: 95% to 97% of the e-waste collected in India funnels into the informal sector, in which about 1,00,000 people work, for recycling. Men and women in small groups burn the wires, soaking them in open acid baths to retrieve the copper inside. Selling a few kilos of the copper earns them. In India, most of the recycling happens in the informal sector where poor people tear apart the different components with their bare hands and without wearing any safety gear. In many such yards people are using cable waste as fuel to cook food. In fact, people are being exposed to toxins 24 hours a day as they live, cook and sleep in the same place where waste being recycled. Poor people in India are involved in the manual recycling operations of E-waste and most of the people working in this recycling sector are the urban poor with very low literacy levels and hence very little awareness regarding the hazards of e-waste toxins. There are a sizeable number of women and children who are engaged in these activities and they are more vulnerable to the hazards of this waste.

"The informal sector is well networked, has a historic presence and provides fiscal incentive to consumers on collection of waste," says Abhishek Pratap, a Greenpeace India activist. "It provides livelihood to a huge number of poor migrant laborers." According to Environment Minister Jairam India's e-waste regulations are comparable to the best in the world. "For e-waste, we have set up a couple of new integrated facilities. Not only for e-waste but chemical waste in general, we have signed a $90 million project with the World Bank. New regulations are designed to improve that infrastructure. By the end of the year, the nation's largest e-waste recycling plant is due to be up and running. Built on government land in Bangalore, it will have the capacity to recycle about 60,000 tons of e-waste annually. The government is simultaneously trying to pass a new law to oversee formal e-waste management, both through the establishment of more large-scale recycling plants and by regulating the formal disposal of e-waste.

HEALTH AND ENVIRONMENT IMPACT

Electronic products are a complex mixture of several hundred tiny components, many of which contain deadly chemicals. These chemicals are a strain on human health and the environment. The hazardous and toxic substances found in e-waste constitutes a serious challenge to the modern societies . Electronic waste has raised concerns because many components in these products are toxic and are not biodegradable. These e-wastes will have long lasting effects on the environment, when improperly disposed (incinerated/land filled instead of recycling) with domestic waste, without any controls, can contaminate the soil, water and air.

The 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 and plywood, printed circuit boards (PCB), concrete and ceramics, rubber and other items. Iron and steel constitute 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 (Cu), aluminum (Al) and precious metals, e.g. silver (Ag), gold (Au), platinum, palladium, etc. The presence of elements like lead, mercury, arsenic, cadmium, selenium and hexavalent chromium and flame retardants beyond threshold quantities of e-waste classifies them as hazardous waste .

Experts said toxic elements such as cadmium and lead in the circuit boards, mercury in switches and flat screen monitors, cadmium in computer batteries and brominated flame retardants on printed circuit boards (PCBs) are present in electronic appliances. The circuit boards are sourced from computer monitors, CPUs, keyboards, television and remote control sets, radios, cell phones and other electrical appliances.

Experts said the e-waste release gases, acid solutions, toxic smoke and contaminated ashes which is dangerous for the local environment and could lead to serious ailments including cancer. The e-waste poisons air, water and soil as well as threatens the life of those directly involved in the recycling process. "The chemicals inside the electrical appliances could pass through the ground and contaminate the ground water. Besides, many times people throw e-waste like batteries and CDs along with eatables in garbage dump. It is consumed by the animals which affect their health," said Prabha Chaturvedi, an environmentalist.

The health and environmental risks of informal recycling are high. Extracting metals like copper and gold in open acid baths, which is illegal, releases toxins such as dioxins, heavy metals, lead, cadmium, mercury and brominated flame retardants (BFRs). Acid and chemical residues contaminate water and soil. For those workers who spend endless days exposed to dangerous levels of toxic elements with little to no protection while breaking electronics down by hand, the risks are clear. Informal recyclers work without protective clothing, exposing themselves to hazardous chemicals that can lead to physical injuries — mercury, for instance, can cause brain and kidney damage, and BFRs disrupt hormonal function — and chronic illnesses like asthma and skin diseases.

Alarming levels of dioxin compounds, linked to cancer, developmental defects, and other health problems in the samples of breast milk, placenta, and hair, and the long term exposure to these substances can damage the nervous system, kidney and bones and the reproductive and endocrine systems and some of them are carcinogenic.

The environmental impact of the processing of different electronic waste components

E-Waste Component	Process Used	Potential Environmental Hazard
Cathode ray tubes (used in TVs, computer monitors, ATM, video cameras, and more)	Breaking and removal of yoke, then dumping	Lead, barium and other heavy metals leaching into the ground water and release of toxic phosphor
Printed circuit board (image behind table - a thin plate on which chips and other electronic components are placed)	De-soldering and removal of computer chips; open burning and acid baths to remove final metals after chips are removed.	Air emissions as well as discharge into rivers of glass dust, tin, lead, brominated dioxin, beryllium cadmium, and mercury
Chips and other gold plated components	Chemical stripping using nitric and hydrochloric acid and burning of chips	Hydrocarbons, heavy metals, brominated substances discharged directly into rivers acidifying fish and flora. Tin and lead contamination of surface and groundwater. Air emissions of brominated dioxins, heavy metals and hydrocarbons
Plastics from printers, keyboards, monitors, etc.	Shredding and low temp melting to be reused	Emissions of brominated dioxins, heavy metals and hydrocarbons
Computer wires	Open burning and stripping to remove copper	Hydrocarbon ashes released into air, water and soil.

E WASTE SUBSTANCES

Substances found in large quantities include epoxy resins, fiberglass, PCBs, PVC (polyvinyl chlorides), thermosetting plastics, lead, tin, copper, silicon, beryllium, carbon, iron and aluminium.

Elements found in small amounts include cadmium, mercury, and thallium.

Elements found in trace amounts include americium, antimony, arsenic, barium, bismuth, boron, cobalt, europium, gallium, germanium, gold, indium, lithium, manganese, nickel, niobium, palladium, platinum, rhodium, ruthenium, selenium, silver, tantalum, terbium, thorium, titanium, vanadium, and yttrium.

Almost all electronics contain lead and tin (as solder) and copper (as wire and printed circuit board tracks), though the use of lead-free solder is now spreading rapidly.

HAZARDOUS

Americium, Mercury, Sulphur, BFRs, Cadmium, Lead, Beryllium oxide, Perfluorooctanoic acid and Hexavalent chromium.

GENERALLY NON-HAZARDOUS (EXCEPT FOR THE ENVIRONMENT)

Aluminium, Copper, Germanium, Gold, Iron, Lithium, Nickel, Silicon, Tin and Zinc.

E-Waste components and its health hazards if done manually in an uncontrolled and informal method

	Metals	Toxic effects
1	Antimony	Irritation of the eyes, Skin, Lungs, Heart.
2	Bismuth	Inhalation problems, Skin reactions, Sleeplessness, Depression, Rheumatic pain.
3	Cadmium	Damage the lungs. Bone fracture, Damage to central nervous system, Possibly DNA, d amage, Cancer.
4	Chromium	Allergic reactions, Lung cancer, Nose irritations and nosebleeds, Upset stomachs and ulcers, Kidney and liver damage Cause of Death.
5	Cobalt	Lung effects, Hair loss, Vomiting and nausea, Vision problems, Heart problems, Thyroid damage, cause of Asthma & Pneumonia
6	Gallium	Cause throat irritation, Difficulty breathing, Chest pain, Partial paralysis.
7	Germanium	Harmful for Skin, Eyes & Blood
8	Molybdenum	Joint pains in the knees, hands, feet, it is highly toxic
9	Nickel	Lung cancer, Nose cancer, Larynx cancer and Prostate cancer, Heart disorders
10	Selenium	Collection of fluid in the lungs, Abdominal pain, Fever, Heart

		and muscle problems,
		Bronchial asthma, Diarrhoea, Enlarged liver, Burning, Bronchitis, Sore throat, Cause of Death
11	Silver	Kidney, Eye, Lung, Liver, Brain damage, Anaemia
12	Lead	Rise in blood pressure, Kidney damage, Miscarriages and subtle abortions, Brain damage, Effects fertility of men through sperm damage, Diminished learning abilities of children
13	Tin	Eye and skin irritations, Headaches, Stomachaches, Sickness and dizziness, Breathlessness, Urination problems
14	Iron	risk of lung cancer
15	Yttrium	Threat to the liver, Cause of cancer
16	Zinc	Decreased sense of taste and smell,, Birth defects, Vomiting, Skin irritations, Stomach cramps

CONCLUSION

E-waste is an important global environmental and health issue .India is placed among the other global nations which have generated more E-waste in quantity and especially urban India needs an urgent approach to tackle this issue. In reality, all metals cannot be recovered due to technology limitations and commercial viability. In real world, the major metals recovered are Gold, Platinum, Paladium, Nickel, Copper, Silver, Zinc, Iron, Aluminium. Major non metals recovered are Lead, Phosphorous. Other items are plastic and glass. It may make economic sense to focus on only a few items and dispose the remaining. Manufacturers are required to eliminate dangerous toxins from production. Recycling is the key to reduce the E-waste and it has environmental benefits at every stage in the life cycle of a computer product, from the raw material from which it is made to its final disposal. Aside from reducing greenhouse gas emissions, which contribute to global warming, recycling also reduces air and water pollution associated with making new products from raw materials.

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