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Electronic Waste Management & Policy Issues

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Abstract

India is moving in a digital age. The Government of India launched the Digital India campaign in 2015 to transform India into a digitally empowered society and knowledge economy. In 2017, 23.93% of the population accessed the internet from their mobile phone and it is expected to grow to 34% by 2022.So this means that a large part of our population is still offline. Information and Communication Technology (ICT) is proving to be an essential tool for developing countries to alleviate poverty. Growth in use of ICT devices and services, change of technology and innovations in ICT sector has become a cause of deterioration in environmental conditions and human health as the waste of electronic and electrical equipment, which contains hazardous and toxic components, is still handled in an environmentally unfriendly manner mainly in developing nations. It is a huge challenge for the nations to manage e-waste in a scientific manner and protect the environment.

In 2016 the world produced 44.7 million tons of electronic waste (e-waste), including two million tons generated in India, which has one of the fastest growing electronics industries in the world. Electronics equipment imported also adds to waste. Random disposal of e-waste leads to toxicity from exposure to cadmium, chromium, lead, brominated flame retardants and polychlorinated biphenyls through inhalation or any other direct contact. India's e-waste production is likely to touch three million tons in 2018. Industries are the major contributors, generating 70% of the e-waste while about 15% comes from households, according to an Assocham-KPMG analysis.

This paper aims at addressing the current situation of e-waste management and its policy issues.

Key Words *ICT, Digital India, Hazardous Components, E-waste Management.*

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Introduction:

Internet users have increased from 501 million in 2006 to over 1.3 billion in 2011 in developing countries clearly indicates that the sale of computers, mobile phones, and other communication equipment has grown at a very fast rate. In 2006, 44% of internet users were in developing countries whereas, in 2011, it rose to 62%. Personal computer and smartphone sales have significantly increased in recent years. Telecom communication and mobile equipment is a large part of India's e-waste, which amounts to about 12% of all e-waste. India's mobile subscriptions crossed 1.2 billion in January 2017, according to a report by Ericsson Mobility, while globally, it was around 7.6 billion in the first quarter of the year.

The report "Recycling - from E-Waste to Resources" issued at a meeting of the Basel Convention estimated that, by 2020 in countries like China and South Africa, the e-waste from computers would increase between 200 and 400% as compared to 2007and it ascend up to 500% in India. This report from the U.N. Environment Programme (UNEP) concentrates on the growth of e-waste generated by and sent to developing nations, and suggests ways to reduce the health and environmental impacts of discarded electronic equipment.

Without a comprehensive plan to collect e-waste and properly planned recycling programs, developing countries will face hazardous e-waste mountains, with serious consequences for the environment and public health. It was also estimated that by 2020, the stockpile of e-waste from mobile phones would be 18 times higher than in 2007 and it would be7 times higher in China. The report also stated that 50-80% of e-waste generated in the United States of America is exported to India, China, Pakistan, Taiwan and African countries. According to UNEP, it is estimated that e-waste is increasing by 40% per year worldwide and e-waste is the fastest-growing type of waste.20to50 million metric tons of e-waste are generated worldwide every year, which accounts for more than 5% of urban solid waste, particularly in some developing countries where the volume is expected to grow up to 500 percent over the next decade. In India, the volume of e-waste generated in 2012 is estimated to be 0.8 million tons.

Effects of e-waste on human health and environment:

E-waste is highly complex due to its composition. It comprises of multiple components some of which contain toxic substances which may impact human health and environment adversely, if not handled properly, that is, if improper recycling and disposal methods are used. So there is a need for appropriate mechanism and technology for proper handling and disposal of these chemicals.

UNEP report characterized e-waste as hazardous when they are

contaminated with lead, cadmium, mercury, polychlorinated biphenyl etc. Wastes containing insulation and metal cables coated with plastics may also be contaminated with or may contain lead, coal tar, cadmium, Polychlorinated Biphenyl (PCB) etc. are also characterized as toxic and hazardous wastes. Precious metal ash recycled from circuit boards, glass waste from cathode-ray tubes, LCD screens, and other activated glasses are classified as hazardous wastes.

Table 1-

S.No.	Hazardous Components	Effect of Hazardous components of e-waste
1	**Arsenic**	Can effect skin, lungs, Kidneys and prolonged exposure could result in cancer.
2	**Lead**	May affect kidneys, reproductive systems, nervous connections and high levels of lead may lead to blood and brain disorders and sometimes it may be fatal.
3	**Barium**	Can affect heart muscle.
4	**Chromium (PVC)**	Excessive chromium can lead to stomach problems and low blood sugar (hypoglycemia)and may damage the liver, kidneys, nerves and cause irregular heart rhythm
5	**Beryllium**	May cause lung diseases.
6	**Mercury**	Affects the central nervous system, kidneys, and immune system, it impairs fetus growth.
7	**Cadmium**	May cause severe pain in the joints and spine. It affects the kidneys and softens bones.
8	**Brominates**	Can harm reproductive and immune systems, may cause the hormonal disorder.
9	**Chlorofluorocarbon (CFC)**	May affect the ozone layer. It may cause skin cancer in human and genetic damage in organisms.
10	**Polychlorinated Biphenyl (PCB)**	1.May cause cancer in animals, can affect the immune system, 2.Reproductive system, nervous system, endocrine system. 3. PCBs persistently contaminate the environment and cause severe damage.
11	**Polyvinyl Chloride (PVC)**	PVC contains up to 56% chlorine and when burnt, produces Hydrogen chloride gas which in turn produces hydrochloric acid that is dangerous to the respiratory system.
12	**Dioxin**	These are highly toxic to animals and can lead to malfunction of the fetus, decreased reproduction and growth rates affect the immune system.

Management of e-waste:

There is no panacea for all diseases neither there is any unique or ideal model for e-waste management in developing countries, each of which has its own specific environmental, social, technological, economic and cultural conditions. Environmental management recognizes three 'R' i.e. reduce, reuse and recycle. The aim would be to **reduce** the generation of e-waste through smart technology in manufacturing and maintenance, **reuse** till functioning of electronic equipment by someone else and **recycle** those components that cannot be repaired and reused. An efficient and smart e-waste management system for developing countries have to assess the e-waste situation, recognize that e-wastes are a complex mixture of hazardous and non- hazardous substances and materials. It has to clearly state the mechanism for e-waste collection from houses, industries, and other e-waste generators and then the how this waste will be recycled in an environment-friendly way by using efficient technology.

Extended producer responsibility (EPR) where the manufacturer's responsibility for its ICT equipment extends throughout the various stages of that equipment's life cycle with internalizing the cost of managing the equipment when it is no longer in use. India passed e-waste management rules in 2016 under Environment Protection Act 1986, introducing the concept of extended producer responsibility, placing the onus of collecting and disposing end-of-life electronics on producers. The rules lay down progressive targets based on the waste generated by manufacturers. However, the environment ministry proposed lowering targets this October after the industry argued that meeting the disposal targets were not achievable given India's poor state of e-waste collection and disposal.

The formal e-waste management sector in India is currently being developed in major cities. However, informal recycling operations have been in place for a long time, with over one million poor people in India involved in manual recycling operations. Most of these people have very low literacy levels with little awareness about the dangers of the operations.The industry is unable to cope up with these targets as the majority of the e-waste collected in India is managed by an unorganized sector. Also, informal channels of recycling or reuse of electronics such as repair shops, used product dealers, e-commerce portal vendors, etc. collect a significant proportion of the discarded electronics for reuse and cannibalization of parts and components, adds the study.

E-waste includes a whole variety of small and large appliances, and electronic equipment including cell phones, TVs, refrigerators, air conditioners, computers and lamps, small appliance and large appliances, lamps. The United Nations has cautioned about the health issues and environmental impact from the processing of e-waste

(discarded electronic and electrical material) by the informal sector in India without proper safeguards. Over 10 lakh poor people in India are directly and indirectly involved in manual recycling operations, but most of these people have very low literacy levels with little awareness about the dangers of the recycling such waste without proper safety measures. The dangers come from improper and unsafe treatment and disposal through open burning or in dump sites. The main aim of the informal recycling of e-waste is to retrieve precious metals such as gold, silver, copper etc.

According to Global E-waste Monitor 2017 report, India produced 1.95 million tons of e-waste last year or about 1.5 kg per person and also the electronic imports developed countries to add to the piling of e-waste. Last year, the world produced 44.7 million tons of e-waste or 6kg in *per capita* terms, which is approximately four times more than the e-waste produced by each Indian. The report, states that only 20 percent of total global e-waste was recycled. This means that we have a long way to go and establish systems that could deal with this ever increasing huge amount of electronic waste produced.

The total monetary value of retrievable precious materials like gold, silver, copper, platinum, and palladium from last year's e-waste was around $55 billion and much of it was going to waste. A formal e-waste recycling sector is now being developed in major Indian cities and under the country's new e-waste management rules producers have extended responsibility for the handling the waste that ultimately results from their products.

The main features of the regulations are :

1. Refundable deposit scheme incentivizes recycling.
2. Creation of Producer Responsibility Organizations to handle e-waste management.

Slowly the problem is becoming acuter with cheaper smartphones and other equipment becoming readily available. The domestic electronics industry is growing at a fast pace. In the year 2016-17 domestic production of electronics items stood at $49.5 which was more than imports. Imports of electronic products stood at $43 billion. This means that more people will be able to afford to purchase new equipment and that more equipment will eventually be discarded. We are living in a world where the electronic gadget we buy today becomes obsolete in less than a year and replaced by another with more advanced version. Smartphone makers release a new model every year and it has become a fashion to update one's phone with the new version. India which has a population of 1.25 billion is one of the fastest-growing markets in the world for smartphones with 27 million units shipped in the second quarter of 2016 alone, and even though the lifespan of a mobile phone is higher in India than in the

West, one can assess the number of obsolete phones contributing to electronic waste (e-waste).Phones and other electronics contributed to 1.5 million tons of e-waste produced in India in 2015 and 90% of this e-waste was managed by the informal sector using unscientific methods that cause harm to human health and the environment.

Earlier also, to streamline e-waste management, the government of India notified Electronic Waste (Management and Handling) Rules, 2011 that became effective in May 2012. These rules were based on extended producer responsibility (EPR), a popular framework across the world for e-waste management. EPR makes manufacturers of electronic products responsible for the end-of-life management of their products. They have to set up collection centers and ensure that waste is recycled and disposed of in an environment-friendly manner. All collection centers, dismantling units and recyclers must register with state pollution control boards and comply with their norms. By shifting the burden of waste management onto manufacturers, the EPR framework, in theory, creates incentives for more environment-friendly product designs. Since manufacturers are incurring the cost of disposal, their designs will incorporate less toxic and easily recyclable materials, thereby reducing input material requirement because more inputs get reused. Four years have passed since the introduction of e-waste rules but there isn't much change on the ground.

The number of registered waste processing units under pollution control boards has gone up from 23 to about 150, according to data available from the Central Pollution Control Board. But this increase has failed to formally channelize e-waste as estimates suggest that only about 5-15% of e-waste is channeled through the formal sector. The situation of industry/ firm, which is primarily responsible for waste management under the EPR framework, is disappointing. Still, the awareness level is low about how to deposit e-waste so that it can be formally processed and recycled.

Awareness level is low on the consumer side too as most institutional waste generators such as educational institutions and industries, which generate close to 70% of the e-waste, are not aware of the rules and continue to sell their e-waste to the informal sector. Overall the compliance and impact of the e-waste management rules are not satisfactory. If no collection or recycling targets are imposed on producers under EPR regulations, producers have little incentive to ensure collection of their used products. They simply claim they have set up collection centers for those who care to deposit their products. Only highly environmentally-conscious and sensitive consumer will search for the nearest collection center. In contrast to this, a rag-picker will come to the consumer's house or at the industry disposal to collect the

waste.

The e-waste rules were amended recently (October 2016) and now include collection targets as well as a requirement that producers implement a deposit-refund system (DRS). In a DRS, an upfront deposit is charged to the consumer at the time of purchase of the product and the deposit is refunded when the product is safely returned to the producer. While this kind of framework has been successful in some scenarios for eg. Glass bottles, its success here will depend on the political will to implement the amended rules in a time-bound and strict manner.

An important characteristic of a successful e-waste management in a country such as India is the ability of regulations to integrate the large informal sector into the formal waste processing system. Unfortunately, even the amended e-waste rules completely ignore the informal sector. Millions of waste collectors carry out the door-to-door collection of waste and their livelihoods depend on their ability to collect and sell the waste to informal recyclers. The government and the manufacturers have to recognize the informal sector and find mechanisms to bring it into the fold of formal waste management. For successful waste management, we have to include all stakeholders and incorporate the informal sector into formal systems of e-waste collections.

Delhi's Case:

Mismanagement of electronic waste may be contaminating Delhi's groundwater and soil according to a study done by researchers from Jamia Milia Islamia, Delhi. Samples were taken from Krishna Vihar in North Delhi.

Soil samples from Mandoli's Krishna Vihar which has huge piles of unprocessed e-waste have tested positive for pollutants for example the high concentration of copper in topsoil to about 283mg/kg. Other samples just 5km from the site have shown copper levels to about 8.39mg/kg.

Similarly, lead in the subsoil at the dump yard was 183mg/kg which has a reference of 0.43 mg/kg. The subsoil is the layer of soil in which plants have their roots which in turn help to absorb water and other nutrients through root hairs.

This means that these toxic components once absorbed by the plant system can find their way into human tissues.

This study has also shown that heavy metal contamination in groundwater samples have also reached significant levels. Metals such as lead, cadmium, and copper were on average, 20 times higher than the reference levels considered safe as per the specifications by Central Pollution Control Board(CPCB).Also, Nickel and Chromium levels were found to be 5 times higher than levels specified by CPCB.

This has rendered water unpotable for drinking purposes as could pose a

serious risk to human health as discussed above in Table[1].

Table 2 : Heavy metal concentrations(mg/kg) in Soil samples

Site	E-Waste Site		Reference Site	
Heavy Metal	Topsoil	Subsoil	Topsoil	Subsoil
Cu	283.23	73.04	8.39	0.58
Pb	298.10	183.54	12.50	0.43
Cd	47.77	19.16	0.26	0.00
Ni	41.44	40.14	7.66	0.00
Cr	145.18	80.53	6.99	0.1
Zn	174.83	65.11	9.69	0.30

Table 3 : Heavy metal concentrations(mg/litre) in water samples

Heavy Metals	E-Waste Site	Reference Site	Standard
Cu	1.465	0.18	0.05
Pb	1.25	0.0075	0.05
Cd	0.28	0.00	0.01
Ni	0.29	0.003	0.05
Cr	0.83	0.008	0.05
Zn	1.39	0.016	5.00

EPR is an authorization given by the Central Pollution Control Board (CPCB) for collecting and managing the E-Waste. This authorization is given for five years and for obtaining an EPR, a producer is required to submit a detailed plan for the collection of the E-Waste, mode of collection, details of collection points and agency responsible for such collection.

The way forward:

By 2020 India's e-waste from mobile phones and computers will rise by about 1800 percent and 500 percent respectively as compared to 2007, according to an ASSOCHAM-KPMG joint study. India has generated about 18 lakh metric tonnes of e-waste in 2016 which is about 12 percent of the global e-waste production. It is the fifth largest producer of e-waste in the world and present capacity to formally recycle is less than 2% of the total e-waste it produces annually.

The Ministry of Environment, Forest, and Climate Change rolled out the E-waste (Management),2016 Rules under section 6,8 and 25 of the Environment Protection Act,1986 with the objective of reducing e-waste production and increasing recycling in the most efficient way possible.Thus it is suggested that government should collaborate with the industry and formulate standard operating procedures(SOP) and follow a phased approach towards the agenda of reducing e-waste to the lowest.

The government may adopt methods used by other countries for efficient collection and recycling of e-waste. For example, South Korea which is one of the largest producers of electronic goods is able to recycle 21% of the total 0.8 million tonnes of e-waste in 2015.Seoul Resource Centre recycles 20% of the Seoul's e-waste for extraction of valuable metals such as gold, copper, etc. and the rest 80% of Seoul's e-waste is used entirely for landfilling. The government may also involve private partners in recycling of e-waste like in the United Kingdom which is regulated by UK government

Globally, e-waste is expected to touch 49.8 million tons by 2018 from the current level of 47.8 million tons, with an annual growth rate of 4 to 5%.The biggest e-waste recycling market is in Delhi followed by Bengaluru and Chennai. While the informal sector's efficiency in collecting e-waste and its contribution towards resource recovery is remarkable but various health and environmental issues are related to informal recycling activities. Upon prolonged exposure to toxic substances, they may lead to damage of almost all major body systems (nervous systems, blood systems, brain development, skin disorders, lung cancer, heart, liver, and spleen damage).
Approximately 80% of e-waste workers in India suffer from respiratory diseases like breathing difficulties, irritation, coughing and choking due to improper safeguards for eg., handling waste with bare hands, no protective facemasks, workers, incomplete and improper combustion which produces harmful gases pose severe threat to the health of workers and environment at large.

Hazardous substances contained in the electronic products, such as mercury, may be lost if not recovered properly, and lead to air contamination, groundwater and soil contamination. Thus it is imperative to reach out to the workers of the informal sector and raise awareness among them about the consequences of improper e-waste management and to include them as part of the solution to e-waste related issues. It is essential that informal recyclers be included in any long-term e-waste management policy. The rules and legislation on e-waste management(2016) covers the role of formal recyclers but lacks a definite framework for the role and inclusion of informal recyclers.

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