E-Waste Management in India: Challenges and Opportunities

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Growth in the IT and communication sectors has enhanced the usage of the electronic equipment exponentially. Faster upgradation of electronic product is forcing consumers to discard old electronic products very quickly, which, in turn, adds to e-waste to the solid waste stream. The growing problem of e-waste calls for greater emphasis on recycling e-waste and better e-waste management.

Electronic waste or e-waste is generated when electronic and electrical equipment become unfit for their originally intended use or have crossed the expiry date. Computers, servers, mainframes, monitors, compact discs (CDs), printers, scanners, copiers, calculators, fax machines, battery cells, cellular phones, transceivers, TVs, iPods, medical apparatus, washing machines, refrigerators, and air conditioners are examples of e-waste (when unfit for use). These electronic equipments get fast replaced with newer models due to the rapid technology advancements and production of newer electronic equipment. This has led to an exponential increase in e-waste generation. People tend to switch over to the newer models and the life of products has also decreased.

E-waste typically consists of metals, plastics, cathode ray tubes (CRTs), printed circuit boards, cables, and so on. Valuable metals such as copper, silver, gold, and platinum could be recovered from e-wastes, if they are scientifically processed. The presence of toxic substances such as liquid crystal, lithium, mercury, nickel, polychlorinated biphenyls (PCBs), selenium, arsenic, barium, brominated flame retardants, cadmium, chrome, cobalt, copper, and lead, makes it very hazardous, if e-waste is dismantled and processed in a crude manner with rudimentary techniques. E-waste poses a huge risk to humans, animals, and the environment. The presence of heavy metals and highly toxic substances such as mercury, lead, beryllium, and cadmium pose a significant threat to the environment even in minute quantities.

Consumers are the key to better management of e-waste. Initiatives such as Extended Producer Responsibility (EPR); Design for Environment (DfE); Reduce, Reuse, Recycle (3Rs), technology platform for linking the market facilitating a circular economy aim to encourage consumers to correctly dispose their e-waste, with increased reuse and recycling rates, and adopt sustainable consumer habits. In developed countries, e-waste management is given high priority, while in developing countries it is exacerbated by completely adopting or replicating the e-waste management of developed countries and several related problems including, lack of investment and technically skilled human resources. In addition, there is lack of infrastructure and absence of appropriate legislations specifically dealing with e-waste. Also, there is inadequate description of the roles and responsibilities of stakeholders and institutions involved in e-waste management, etc. In 2016, the Ministry of Environment, Forest and Climate Change (MoEFCC) released the updated E-waste (Management) Rules, which came in supersession of the E-waste in India (GOI, 2016).

Global E-Waste Problem

International treaties such as Basel Convention aim at reducing and regulating the movement of hazardous waste between nations. Even with the Convention, illegal shipment and dumping of e-wastes continue to take place. It is estimated that 50 million tonnes of e-waste was generated globally in 2018. Half of this is personal devices such as computers, screens, smartphones, tablets, and TVs, with the remainder being larger household appliances and heating and cooling equipment. Despite 66 per cent of the world's population being covered by e-waste legislation, only 20 per cent of global e-waste is recycled each year, which means that 40 million tonnes of e-waste is either burned for resource recovery or illegally traded and treated in a sub-standard way. In the US alone, more than 100 million computers are thrown away with less than 20 per cent being recycled properly. China discards 160 million electronic devices a year. In the past, China has been regarded as the largest e-waste dumping site in the world. Hundreds of thousands of people have expertise in dismantling electronic junk.

The rate at which the e-waste volume is increasing globally is 5 per cent to 10 per cent yearly. In India, the volume of e-waste generated was 146,000 tonnes per year (Borthakur and Sinha, 2013). However, these data only include e-waste generated nationally and do not include waste imports (both legal and illegal) which are substantial in emerging economies such as India and China. The reason is that large amount of waste electrical and electronic equipment (WEEE) enters India from foreign countries. Switzerland is the first country in the world to have established and implemented a formal e-waste management system that has recycled 11 kg/capita of e-waste against the target of 4 kg/capita set by the European Union (EU).

In the EU, the EU WEEE directive clearly imposes collection, recovery, and recycling targets on its member countries. Thus, it stipulates a minimum collection target of 4 kg/capita per year for all the member states. These collection- and weight-based recycling targets seek to reduce the amount of hazardous substances disposed into landfills and to increase the availability of recyclable materials that indirectly encourages less virgin materials consumption in new products.

One-third of electrical and electronic waste in the EU is reported as separately collected and appropriately treated. The introduction of the EPR scheme in 2003 was the most important step in South Korea, and about 70 per cent of e-waste was collected by producers. Over the same period, the amount of e-waste reused and recycled was 12 per cent and 69 per cent, respectively. The remainder was sent to landfill sites or incineration plants, accounting for 19 per cent.

The lax or zero enforcement of existing regulatory framework or low level of awareness and sensitization, and inadequate occupational safety for those involved in these processes exacerbate e-waste management in developing countries compared to the EU and Japan, which have well-developed initiatives at all levels aimed at changing consumer behaviour. Therefore, there is need for developing countries to adopt effective strategies to encourage re-use, refurbishing or recycling e-waste in specialized facilities to prevent environmental contamination and human health risks.

China, Peru, Ghana, Nigeria, India, and Pakistan are the biggest recipients of e-waste from industrialized countries (Mmereki, et al., 2016). The Basel Action Network (BAN) aims to ensure that e-waste is dealt with in an environment-friendly manner. It safeguards the planet from toxic waste trade. The BAN, Silicon Valley Toxic Coalition (SVTC), and Electronics Take-Back Coalition (ETBC) constitute an associated network of environmental advocacy NGOs in the US. The three organizations' common objective is to promote national-level solutions for hazardous waste management. A recent initiative has been e-Stewards, a system for auditing and certifying recyclers and takeback programmes so that conscientious consumers know which ones meet high standards.

E-Waste Problem in India

India ranks 177 amongst 180 countries and is amongst the bottom five countries on the Environmental Performance Index 2018, as per a report released at the World Economic Forum 2018. This was linked to poor performance in the environment health policy and deaths due to air pollution categories. Also, India is ranked fifth in the world amongst top e-waste producing countries after the USA, China, Japan, and Germany and recycles less than 2 per cent of the total e-waste it produces annually formally. Since 2018, India generates more than two million tonnes of e-waste annually, and also imports huge amounts of e-waste from other countries around the world. Dumping in open dumpsites is a common sight which gives rise to issues such as groundwater contamination, poor health, and more. The Associated Chambers of Commerce and Industry of India (ASSOCHAM) and KPMG study, Electronic Waste Management in India identified that computer equipment account for almost 70 per cent of e-waste, followed by telecommunication equipment phones (12 per cent), electrical equipment (8 per cent), and medical equipment (7 per cent) with remaining from household e-waste.

E-waste collection, transportation, processing, and recycling is dominated by the informal sector. The sector is well networked and unregulated. Often, all the materials and value that could be potentially recovered is not recovered. In addition, there are serious issues regarding leakages of toxins into the environment and workers' safety and health.

Seelampur in Delhi is the largest e-waste dismantling centre of India. Adults as well as children spend 8–10 hours daily extracting reusable components and precious metals like copper, gold and various functional parts from the devices. E-waste recyclers use processes such as open incineration and acid-leeching. This situation could be improved by creating awareness and improving the infrastructure of recycling units along with the prevalent policies. The majority of the e-waste collected in India is managed by an unorganized sector.

Also, informal channels of recycling/reuse of electronics such as repair shops, used product dealers, e-commerce portal vendors collect a significant proportion of the discarded electronics for reuse and cannibalization of parts and components.

Impact of Recycling E-Waste in Developing World

Almost all e-wastes contain some form of recyclable material, including plastic, glass, and metals; however, due to improper disposal methods and techniques these materials cannot be retrieved for other purposes. If e-waste is dismantled and processed in a crude manner, its toxic constituents can wreak havoc on the human body. Processes such as dismantling components, wet chemical processing, and incineration are used to dispose the waste and result in direct exposure and inhalation of harmful chemicals. Safety equipment such as gloves and face masks are not widely used, and workers often lack the knowledge and experience required to carry out their jobs properly. In addition to this, manual extraction of toxic metals leads to entering of dangerous material in the bloodstream of the individual doing so. The health hazards range from kidney and liver damage to neurological disorders. Recycling of e-waste scrap is polluting the water, soil, and the air. Burning to retrieve metal from wires and cables has led to the emission of brominated and chlorinated dioxins as well as carcinogens which pollute the air and, thereby, cause cancer in humans and animals. Toxic chemicals that have no economic value are simply dumped during the recycling process. These toxic chemicals leach into underground aquifer thereby degrading the local groundwater quality and rendering the water unfit for human consumption as well as agricultural purposes. When e-waste is dumped in landfills, the lead, mercury, cadmium, arsenic, and PCBs make the soil toxic and unfit for agricultural purposes. Very recent studies on recycling of e-waste has pointed towards increasing concentrations of PCBs, dioxins and furans, plasticizers, bisphenol-A (BPA), polycyclic aromatic hydrocarbons (PAH), and heavy metals in the surface soil of the four metro cities of India, that is, New Delhi, Kolkata, Mumbai, and Chennai where e-waste is being processed by the informal sectors (Chakraborty et al., 2018 and 2019). In those studies, it has been observed that the sites engaged in metal recovery processes are the prime sites for such persistent toxic substances. Studies from the same group also reported that the persistent organic pollutants produced or released during the recycling process are escaping in the ambient air due to their semi-volatile nature.

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Opportunities of E-Waste Management in India

The Ministry of Environment, Forest and Climate Change rolled out the E-Waste (Management) Rules in 2016 to reduce e-waste production and increase recycling. Under these rules, the government introduced EPR which makes producers liable to collect 30 per cent to 70 per cent (over seven years) of the e-waste they produce, said the study.

The integration of the informal sector into a transparent recycling system is crucial for a better control on environmental and human health impacts. There have been some attempts towards integrating the existing informal sector in the emerging scenario. Organizations such as GIZ have developed alternative business models in guiding the informal sector association towards authorization. These business models promote a city-wide

collection system feeding the manual dismantling facility and a strategy towards best available technology facilities to yield higher revenue from printed circuit boards. By replacing the traditional wet chemical leaching process for the recovery of gold with the export to integrated smelters and refineries, safer practices and a higher revenue per unit of e-waste collected are generated.

E-waste is a rich source of metals such as gold, silver, and copper, which can be recovered and brought back into the production cycle. There is significant economic potential in the efficient recovery of valuable materials in e-waste and can provide income-generating opportunities for both individuals and enterprises. The E-Waste Management Rules, 2016 were amended by the government in March 2018 to facilitate and effectively implement the environmentally sound management of e-waste in India. The amended Rules revise the collection targets under the provision of EPR with effect from October 1, 2017. By way of revised targets and monitoring under the Central Pollution Control Board (CPCB), effective and improved management of e-waste would be ensured.

How Can Governments, City Administration, and Citizens Help?

The ASSOCHAM report (2017) suggests that the government may look at collaborating with the industry to draw out formal/standard operating procedures and a phased approach towards the agenda of reducing e-wastes to the lowest. Alternatively, the government may also refer methods adopted by other countries for efficient collection and recycling of e-wastes. For example, South Korea, one of the largest producers of electronics managed to recycle 21 per cent of the total 0.8 million tonnes of e-waste that it produced in 2015, said the study.

Considering the adverse impacts caused by untreated e-waste on land, water, and air; the government should encourage the new entrepreneurs by providing the necessary financial support and technological guidance. Establishment of start-ups connected with e-waste recycling and disposal should be encouraged by giving special concessions. The unorganized sector has a well-established collection network. But it is capital-intensive in case of organized sector. Therefore, if both the sectors coordinate and work in a harmonious manner, the materials collected by the unorganized sector may be handed over to the organized sector to be processed in an environment-friendly way. In this kind of scenario, the government can play a crucial role between the two sectors for successful processing of the e-waste. It is high time that the government takes a proactive initiative to recycle and dispose of e-waste safely to protect the environment and ensure the well-being of the general public and other living organisms.

The principle of EPR is increasingly being applied for management of e-waste across many countries, and its relative effectiveness and success has been demonstrated in EU countries. Instruments for implementation of EPR can be a mix of economic, regulatory, and voluntary/informational. While producers are responsible for e-waste management (EPR), consumers, retailers, state governments, municipalities, NGOs, CSOs, Self-Help Groups (SHGs), local collection agencies such as extracarbon.com and others should play an appropriate role in collection, facilitation, and creation of infrastructure to make e-waste management a success.

At present, Design for Environment (DfE) is attracting much attention in the world as a new method to solve environmental pollution. DfE principle in the product design is a process to significantly reduce the environmental impact of products being put into the market. It is often seen that the robust rules in India are ineffective due to slack implementation.

The citizens have a very important role to play in e-waste management. We casually throw many small gadgets along with dumped waste and many people openly burn those accumulated waste. A number of hazardous substances such as dioxins and furans are released in the process which we breathe. This is a very unhealthy practice, which we should immediately stop. Some of the very progressive Resident Welfare Associations (RWAs) have separate bins clearly marked for collecting e-wastes. All the other residential societies should follow this practice. Students and Women SHGs can be mobilized for this activity in their respective RWAs.

Conclusion

E-waste management is a great challenge for governments of many developing countries such as India. This is becoming a huge public health issue and is exponentially increasing by the day. In order to separately collect, effectively treat, and dispose of e-waste, as well as divert it from conventional landfills and open burning, it is essential to integrate the informal sector with the formal sector. The competent authorities in developing and transition countries need to establish mechanisms for handling and treatment of e-waste in a safe and sustainable manner.

Increasing information campaigns, capacity building, and awareness is critical to promote environment friendly e-waste management programmes. Increasing efforts are urgently required on improvement of the current practices such as collection schemes and management practices to reduce the illegal trade of e-waste. Reducing the amount of hazardous substances in e-products will also have a positive effect in dealing with the specific e-waste streams since it will support the prevention process.

Mobile phone manufacturer Nokia is one of the very few companies that seem to have made serious effort in this direction since 2008. The companies were made responsible for creating channels for proper collection and disposal of e-waste in accordance with a Central Pollution Control Board (CPCB) approved EPR Authorization plan in India. Recently, the import license of some of the big companies were suspended for violation of E-waste rules. Such measures have a great impact on effective implementation of e-waste management in India. Any task undertaken must have its share of incentives which attract stakeholders. In the field of e-waste management, the government must announce incentives, which could be in the form of tax concessions or rebates, to ensure compliance across the electronics industry. Additionally, the e-waste collection targets need to be regularly reviewed and renewed to ensure compliance across India on collection of e-waste.

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