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Electronic waste in India: Problems and policies

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ABSTRACT

Electronic waste or E-waste is relatively a novel addition to the ever-growing hazardous waste stream. It includes discarded electronic and electrical equipment. Developing countries are facing enormous challenges related to the generation and management of E-waste which are either internally generated or imported illegally; India is no exception to it. However, the existing management practices related to E-waste in India are reasonably poor and have the potential to risk both human health and the environment. Moreover, the policy level initiatives are not being implemented in an appropriate way. The austere problem of E-waste along with its policy level implications is looked upon in the paper. During the course of the study it has been found that there is an urgent need to address the issues related to E-waste in India in order to avoid its detrimental future consequences.

Keywords: E-waste, hazardous waste, risk, management.

1. Introduction

The manufacturing of electrical and electronic equipment (EEE) is one of the emerging global activities. The main factors identified to be responsible for the increased consumption and productions of electrical and electronic equipment are rapid economic growth, coupled with urbanization and industrialization. The Indian Information Technology (IT) sector is one of the major contributors to the global economy. At the same time, it is responsible for the generation of the bulk of E-waste or Waste Electrical and Electronic Equipment (WEEE) in India. Although the global E-waste problem has been able to attract attention across the world, not much emphasis has been given to the E-waste engendered in developing countries. Developing countries like India, today, is burdened with the colossal problem of E-waste which is either locally generated or internationally imported, causing serious menace to human health and environment. The hazardous components in electrical and electronic equipment are a major concern during the waste management phase. In the context of India, recycling of Waste Electrical and Electronic Equipment is not undertaken to an adequate degree.

However, one of the major issues related to E-waste is that there is no standard definition of WEEE/E-waste. A number of countries have come out with their own definitions, interpretation and usage of the term "E-waste/WEEE". The most widely accepted definition and description of WEEE/ E-waste is as per the European Union directive. The Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste

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electrical and electronic equipment (WEEE) covers all electrical and electronic equipment used by consumers. For the purposes of this Directive, following definitions are applied:

1. 'electrical and electronic equipment' or 'EEE' means equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields falling under the categories set out in Annex IA and designed for use with a voltage rating not exceeding 1 000 Volt for alternating current and 1 500 Volt for direct current;

2. 'Waste electrical and electronic equipment' or 'WEEE' means electrical or electronic equipment which is waste within the meaning of Article 1(a) of Directive 75/442/ EEC, including all components, subassemblies and consumables which are part of the product at the time of discarding.

Categories of electrical and electronic equipment covered by this Directive within ANNEX IA are as follows:

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7. Toys, leisure and sports equipment
8. Medical devices (with the exception of all implanted and infected products)
9. Monitoring and control instruments
10. Automatic dispensers

A wide range of products are included within each category mentioned above.

In India, E-waste is covered in Schedule 3 of "The Hazardous Wastes (Management and Handling) Rules, 2003". Under Schedule 3, E-waste is defined as "Waste Electrical and Electronic Equipment including all components, sub-assemblies and their fractions except batteries falling under these rules". "Guidelines for Environmentally Sound Management of E-waste" formulated by the Ministry of Environment and Forest, Government of India, in the year 2008 followed the same definition.

According to the very recent "the e-waste (Management and Handling) Rules, 2011", 'electrical and electronic equipment' means equipment which is dependent on electric currents or electro-magnetic fields to be fully functional and 'e-waste' means waste electrical and electronic equipment, whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded.

A wide range of literature is available on the generation and management of E-waste, especially in the developed countries. However, the work done on the Indian scenario of E-waste management is comparatively fewer. Sepúlveda, A.; Schluep, M.; Renaud, F.G.; Streicher, M.; Kuehr, R.; Hagelüken, C.; Gerecke, A.C.(2009) say that with the increasing global legal and illegal trade of waste electrical and electronic equipment (WEEE) comes an equally increasing concern of poor WEEE recycling techniques. Authors Oyuna Tsydenova and Magnus Bengtsson (2007) stated that along with many other issues such as the

components and hazardous substances in Waste Electrical and Electronic Equipments (WEEE), the hazards and risks associated with treatment of WEEE in both developed and developing countries should be addressed in detail. Realizing the growing concern over E-waste, the Government of India (GOI) has been supporting several initiatives. Of particular importance is the assessment conducted by the Central Pollution Control Board (CPCB) on the management and handling of E-waste leading to the preparation of "Guidelines for Environmentally Sound Management of E-waste" in May, 2008 and "the e-waste (Management and Handling) Rules, 2011".

2. Methodology

The study was conducted in the framework of "Waste and Risk" as proposed by Joost Van Loon in "Risk and Technological Culture: Towards a sociology of virulence" (2002).
Waste represents uncontrolled matter out-of-place, freely interacting and reacting, cultivating bacteria, fungi and toxins that may pose direct threats to our health (Loon 2002). Waste is regarded as that matter which is to be discarded or made to disappear, often by simple means of removal such as refuse collection, landfill dumps, incineration etc. According to Loon, waste is perhaps the most universal example of ecological risks in everyday life. Nearly all ecological risks relate in one way or another to waste, more specifically to pollution. One can have the example of "solid-waste pollution" in this regards. Whether it is nuclear waste, biomedical waste or electronic waste, risks are always embedded in the materials involved in these waste. Two of the reflections specified by Loon are considered for the purpose of the study. The reflections are Principle of "Out of Sight, Out of Mind" and "Cause and Effect" Relationship. Attempt has been made to connect these reflections to the problem of E-waste.

2.1 Principle of "Out of Sight, Out of Mind"

The principle of out of sight, out of mind has for a long time been useful in keeping the lid on the negative side-effects of industrialization (Loon, 2002). During this period, toxicity was allowed to build up in the soil, in the air and in the water. Only periodically the toxic side-effects are noticed in terms of epidemiological anomalies of clusters of chronic illnesses, cancers or miscarriages. Unlike the spectacular examples of accidents and catastrophes, these largely escaped the news media (Loon, 2002). This principle is applied to the issues related to E-waste in Indian context. Most of the people in India do not know how to dispose their obsolete electrical and electronic gadgets. Generally, the obsolete electronic goods lie unattended at the Indian houses and offices because of lack of knowledge about the management of the same. More often than not, the gadgets are sold to the scrap vendors at certain cost. Otherwise these are discarded with the regular municipal solid waste. Few people practice "extended producer responsibility" and indulge themselves in "take-back" systems. But none of these consumers pay attention to the processes these electronic goods have to go through once these are discarded. The real trouble with electronic goods actually begins once discarded. As soon as the wastes are out of their sight, these are out of their minds too.

2.2 "Cause and Effect" Relationship

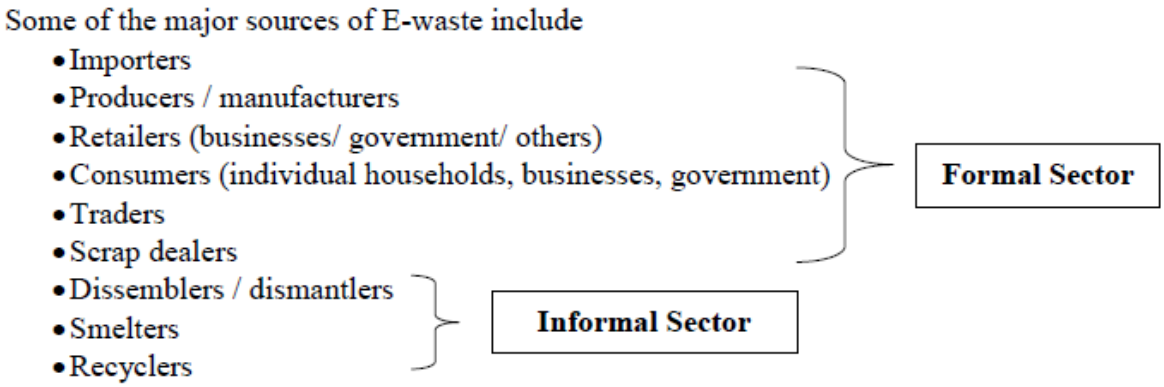
The relationship between cause and effect is important in all kinds of waste. Here the causes may be characterized as the causes for the generation and rapid obsolescence of electrical and electronic equipment. The reasons for prompt generation and obsoleses of E-waste include rapid economic growth, urbanization, industrialization, increased consumerism etc. The

effects are the health and environmental risks associated with E-waste. The effects of improper disposal of E-waste are observed relatively after a long period of time. When an electronic gadget is disposed of with all its hazardous elements embedded in it, precarious health and environmental effects are not observed immediately. It takes considerable amount of time to have an outlook of the actual risk from the waste. This intensifies the problem of realization of the hazards from waste.

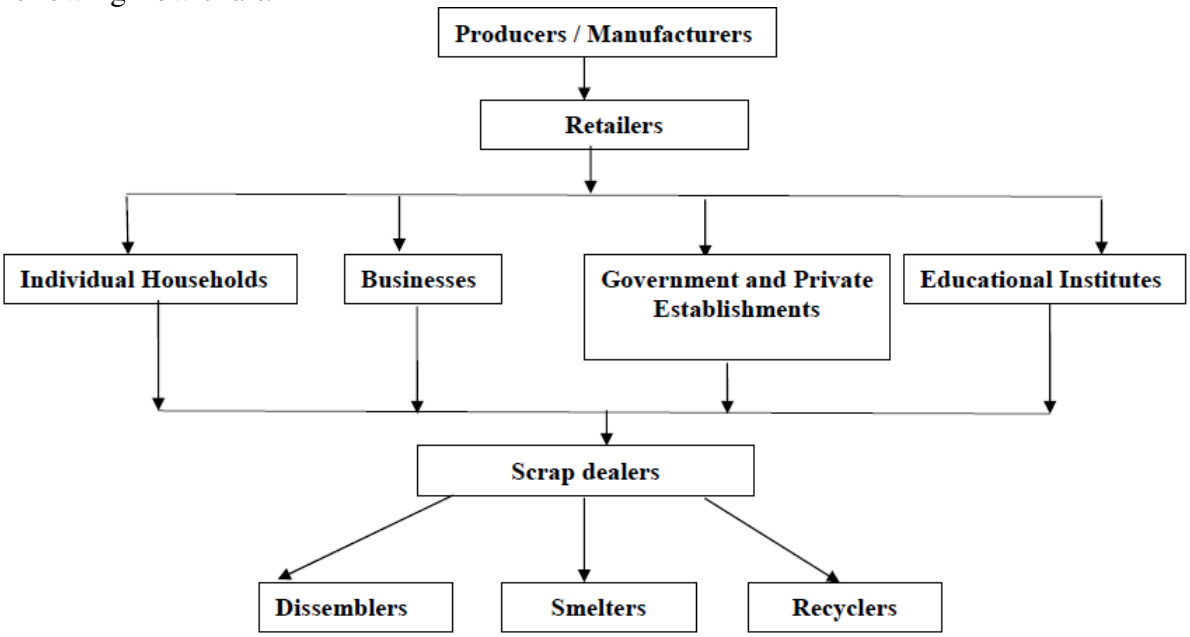
3. Major issues related to E-waste in India

While considering the problems related to E-waste in India, there are five major components which should be focused upon. These are Main Sources of E-waste in India, Magnitude of the Problem with respect to the Indian scenario, Health and Environmental Implications of E-waste, Current Management practices of E-waste in India and Policy level initiatives in the country.

3.1 Main Sources of E-waste



The involvement of various sectors could be observed as the sources of generation of E-waste. The general flow of E-waste across different sectors are tried to represent by the following flow chart.



3.2 Magnitude of the Problem with respect to the Indian scenario

In Indian context, the electronics industry has emerged as the fastest growing segment of Indian industry both in terms of production and exports. The Information Technology Revolution of the early 1990s intensified the problem of E-waste in India. 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 the top ten cities generating E-waste, Mumbai ranks first followed by Delhi, Bangalore, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur (Guidelines for Environmentally Sound Management of E-waste, 2008).

The recycling of E-waste is a major concern in India. The workers in the recycling sector are dominated by the urban poor with very low literacy levels and hence they have very little awareness regarding the potential hazards of E-waste. Among the urban poor, there are a substantial number of women and children engaged in various recycling activities which further exaggerate the problem of E-waste as they are more vulnerable to the hazards from this kind of waste.

One of the major concerns related to E-waste, particularly in developing countries like India and China, are dumping of E-waste from some developed countries. Large quantities of used electronics are typically sold to countries like India, China and other countries in the Asia Pacific region. These electronics have very high repair capability and high raw material demand. This can result in high accumulations of residue in poor areas without strong environmental laws. Major reasons for these exports are cheap labour and lack of environmental and occupational standards in Asia. In this way the toxic effluent of the developed nations would flood towards the world's poorest nations.

According to a Delhi-based non-governmental organization (NGO) Toxics Link, India annually generates $1.5 billion worth of E-waste domestically, with the booming IT sector being the largest contributor, as 30 percent of its machines reach obsolescence annually. Bangalore, the IT hub of India, alone generates 8,000 tons a year.

3.3 Health and Environmental Implications of E-waste

Electronic and Electrical Equipment are composed of an enormous amount of components. Many of them fall under the hazardous category. Majority of these components contain toxic substances that have adverse impacts on human health and the environment if not handled properly. Often, these hazards arise due to the improper recycling and disposal processes that are in practice in most of the developing countries including India. Such offensive practices can have serious aftermath for those staying in proximity to the places where E-waste is recycled or burnt.

Disposal of E-wastes is an unembellished problem faced by many regions across the globe. Electronic wastes that are landfilled produces contaminated leachates which eventually pollute the groundwater. Acids and sludge obtained from melting computer chips, if disposed on the ground causes acidification of soil. For example, Guiyu, Hong Kong a flourishing area of illegal E-waste recycling, is facing acute water shortages due to the contamination of water resources. This is due to disposal of recycling wastes such as acids, sludges etc. in rivers.

Mercury leaches when certain electronic devices, such as circuit breakers are destroyed. The same is true for polychlorinated biphenyls (PCBs) from condensers. When brominated flame retardant plastic or cadmium containing plastics are landfilled, both polybrominated diphenyl ethers (PBDE) and cadmium may leach into the soil and groundwater. It has been found that significant amounts of lead ion are dissolved from broken lead containing glass, such as the cone glass of cathode ray tubes, gets mixed with acid waters and are a common occurrence in landfills.

In addition, uncontrolled fires may arise at landfills and this could be a frequent occurrence in many countries. When exposed to fire, metals and other chemical substances, such as the extremely toxic dioxins and furans (TCDD tetrachloro dibenzo-dioxin, PCDDs-polychlorinated dibenzodioxins. PBDDs-polybrominated dibenzo-dioxin and PCDFs-poly chlorinated dibenzo furans) from halogenated flame retardant products can be emitted[1]. The most dangerous form of burning E-waste is the open-air burning of plastics in order to recover copper and other metals. The toxic fall-out from open air burning affects the local environment and broader global air currents, depositing highly toxic byproducts in many places throughout the world.

Incineration of E-waste possesses another threat. It can emit toxic fumes and gases, thereby polluting the surrounding air.

Moreover, shipping of hazardous waste to developing countries is a major alarm. It happens because of cheap labour and lack of environmental legislations in developing countries.

3.4 Management of E-waste in Indian Context

In India, it has been observed that in most of the cases, electronic items are stored unattended because of lack of knowledge about their management. Such electronic junks lie in houses, offices, warehouses etc. Generally, these wastes are mixed with household wastes, which are finally disposed of at landfills. This necessitates implementation of appropriate management measures including stringent regulations. The management practices currently in operation in India have severe health and environmental implications.

The composition of E-waste consists of diverse items many of which contain hazardous elements. Therefore, the major approach to treat E-waste is to reduce the concentration of these hazardous chemicals and elements through recycle and recovery. In the process of recycling or recovery, certain E-waste fractions act as secondary raw material for recovery of valuable items. In Indian context, primarily recycling, reuse and recovery are done as measures to treat E-waste. The recycle and recovery includes the unit operations like dismantling, segregation of ferrous metal, non-ferrous metal and plastic by shredder process, refurbishment and reuse, recycling / recovery of valuable materials and treatment/disposal of dangerous materials and waste. Dismantling includes removal of parts of the electrical and electronic equipment containing perilous substances (CFCs, Hg switches, PCB); removal of easily accessible parts containing valuable substances (cable containing copper, steel, iron, precious metal containing parts etc.). Refurbishment and reuse of E-waste has potential for those used electrical and electronic equipment which can be easily renovate to put to its original use. Recycling / recovery of valuable materials includes recycling and recovery of valuable materials from the E-waste stream like non-ferrous metals in smelting plants, precious metals in separating works. As most of the electrical and electronic equipment contain many precious metals, this process is an important step in the management of E-

waste. The materials of potential hazard are disposed of in landfill sites or sometimes incinerated. However, the process of incineration is quite expensive. CFCs are treated thermally, PCB and Mercury is often recycled or disposed of in underground landfill sites.

In India, primarily two types of disposal options based on the composition are in practice. These are Landfilling and Incineration. However, the environmental risks from landfilling of E-waste cannot be neglected because the conditions in a landfill site are different from a native soil, particularly concerning the leaching behaviour of metals. In addition it is known that cadmium and mercury are emitted in diffuse form or via the landfill gas combustion plant. Although the risks cannot be quantified and traced back to E-waste, landfilling does not appear to be an environmentally sound treatment method for substances, which are volatile and not biologically degradable (Cd, Hg, CFC), persistent (PCB) or with unknown behaviour in a landfill site (brominated flame retardants). As a consequence of the complex material mixture in E-waste, it is not possible to exclude environmental (long-term) risks even in secured landfilling (Guidelines for Environmentally Sound Management of E-waste, 2008).

Advantage of incineration of E-waste is the reduction of waste volume and the utilization of the energy content of combustible materials. By incineration some environmentally hazardous organic substances are converted into less hazardous compounds. Disadvantage of incineration are the emission to air of substances escaping flue gas cleaning and the large amount of residues from gas cleaning and combustion (Guidelines for Environmentally Sound Management of E-waste, 2008). Waste incineration plants contribute significantly to the annual emissions of cadmium and mercury.
The assessment of E-waste recycling sector in India indicates that E-waste trade starts from formal dismantling sector and moves to informal recycling sector (Guidelines for Environmentally Sound Management of E-waste, 2008). The entire E-waste treatment is being carried out in an unregulated environment, where there is no control on emissions. There are two E-waste dismantling facilities in formal sector in India. These facilities are M/s. Trishiraya Recycling facilities, Chennai and M/s E-Parisara, Bangalore[2].

3.5 Policy level initiatives in India

In view of the ill-effects of hazardous wastes to both environment and health, several countries exhorted the need for a global agreement to address the problems and challenges posed by hazardous waste. However, the policy level initiatives regarding E-waste in India is quite rudimentary and needs immediate attention. Following are some of the policy level initiatives in India regarding E-waste.

3.5.1 The Hazardous Wastes (Management and Handling) Amendment Rules, 2003

Under Schedule 3, E-waste is be defined as "Waste Electrical and Electronic Equipment including all components, sub-assemblies and their fractions except batteries falling under these rules". The definition provided here is similar to that of Basal Convention. E-waste is only briefly included in the rules with no detail description.

3.5.2 Guidelines for Environmentally Sound Management of E-waste, 2008

This guideline was a Government of India initiative and was approved by Ministry of Environment and Forest and Central Pollution Control Board. It classified the E-waste according to its various components and compositions and mainly emphasises on the

management and treatment practices of E-waste. The guideline incorporated concepts such as "Extended Producer Responsibility".

3.5.3 The e-waste (Management and Handling) Rules, 2011

This is the very recent initiative and the only attempt in India meant solely for addressing the issues related to E-waste. These rules are not implemented in India as yet and will only come into practice from 1st May, 2012. According to this regulation, 'electrical and electronic equipment' means equipment which is dependent on electric currents or electro-magnetic fields to be fully functional and 'e-waste' means waste electrical and electronic equipment, whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded. These rules are meant to be applied to every producer, consumer or bulk consumer involved in manufacturing, sale purchase and processing of electrical and electronic equipment, collection centers, dismantlers and recyclers of e-waste. Responsibilities of producers, collection centers, consumers, dismantlers, recyclers etc. are defined and incorporated in these rules.

4. Findings and conclusion

In India, the amount of E-waste generated is rising rapidly. With the increasing dependence on electronic and electrical equipment, the rise of E-waste generation is well expected in the country. However, the management of the same is a major challenged faced by the country. As for example, in India, there are only two authorized small E-waste dismantling facilities functioning in Chennai and Bangalore. Nevertheless, the increasing generation of E-waste asks for many more such units across the country. There is no large scale organized E-waste recycling facility in India and the entire recycling exists in unorganized sector. Moreover, the management practices are often poorly designed and have a lot of health and environmental repercussions. Involvement of urban poor, especially women and children and illegally imported E-waste from developed countries further exaggerate the problem of E-waste in India. The lack of public awareness regarding the disposal of electronic goods and inadequacy of policies to handle the issues related to E-waste enhance the problem in India. In most of the cases, the bulk of E-waste remains unattended in households and public offices. Rarely some sectors like some of the IT companies practice Extended Producer Responsibility or Take Back Policies. Due to the lack of awareness, some people discard E-waste with regular municipal solid waste which is an extremely dicey practice. People tend not to care about the faith of the waste once these are discarded, thus satisfying the principle of "out of sight, out of mind". Indian people are still to realize the associations between the cause of generation of E-waste and its effects including detrimental health and environmental effects. Another important factor in Indian context is that although the information technology revolution started in India way back in early 1990s, the first rule exclusively dealing with E-waste came up only recently after almost 20 years in the form of "e-waste (Management and Handling) Rules, 2011". Proper implementation of the "e-waste (Management and Handling) Rules, 2011" is exceedingly essential to address the ever-growing pile of E-waste in the country.

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