



# A REVIEW ON GLOBAL ELECTRONIC WASTE MANAGEMENT

Arun Kanti Guha

**Abstract**—The quantity of E-wastes are increasing day by day Globally. People are using various types of electrical and electronic items in homes, industries, business organizations and offices worldwide. As a result at the end-use huge quantity of E-wastes are generated in the globe. In 2019, 53.6 million metric tons E-wastes were generated all over the world. As a result, these E-wastes are becoming a threat to human health and environment. There are several options for E-waste management, such as land filling, recycling, reuse etc. A literature survey has done and discussed in this article.

**Keywords**—E-waste, land filling, recycle, life cycle.

## I. INTRODUCTION

A large quantity of electronic items are produced and used globally. Various types of electronic goods are used in different countries of the World. Most common items are televisions, refrigerators, land telephone sets, cell phones, computer items, stereos, photo copiers, fax machines etc. Many famous companies of the Universe are producing above mentioned items every day. Peoples are using those items and after certain period used items are becoming unusable as a result items are becoming wastes. These wastes are called electronic wastes. Electronic waste can be denoted as E-waste. In practice, all secondary electronic goods which are discarded by users after end-use are called E-wastes.

In a recent article [1] authors reported that, in 2016, owners of various electronic goods produced 44.7 million metric tons e-wastes all over the world. It was found that the quantity of generated E-wastes increased in following years [2]. The quantities of e-wastes were 50 million metric tons, 51.8 million metric tons and 53.6 million metric tons in 2017, 2018 and 2019 respectively [2].

Contribution of electronic items in annual waste production could be calculated mathematically [3]. It depends on three factors, mass, quantity and average life

cycle. We can calculate by using simple equation,  $E = MN/L$ , where,  $E$  = contribution of the item,  $M$  = mass in kilogram,  $N$  = total number in both of market and consumption,  $L$  = average life cycle [3]. Life cycles of the various electronic products are shown in Figure 1 [3].

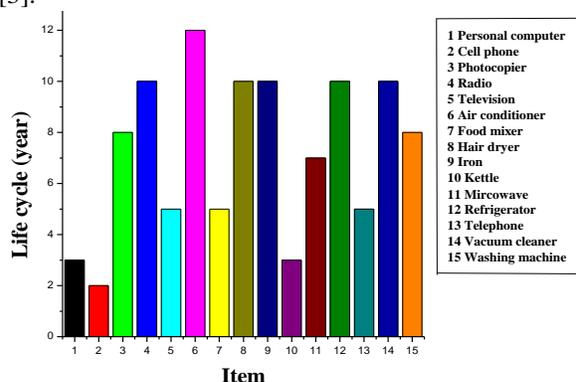


Fig. 1. Bar chart of life cycle vs. item of electronic products

In this review article, global E-waste production, components of generated wastes, harmful effects and different management options practiced worldwide have been discussed based on recently published articles.

## II. DISCUSSIONS

### A. E-Waster Situation in Bangladesh

Quantity of E-wastes, resultant detrimental effects and options of appropriate management in Bangladesh will be discussed in this section. 2.8 million metric tons E-wastes are generated annually in Bangladesh. A study report on item wise E-wastes generated in Bangladesh was found in literature which listed in following table [4].

Recently The Daily Star, a leading English newspaper of Bangladesh reported that [5] 1.30 lakh tons E-wastes were generated in 2010, it raised to 4 lakh tons in 2018 and projected quantity in 2035 is 46.2 lakh tons.

Generally, E-wastes release hazardous heavy metals, such as Hg, Pb, Cd, Cr and Zn. Coinage metals, Cu, Ag and Au with Fe are also present in E-wastes. There are

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some common practices in E-waste handling in Bangladesh. Now a days, old type CRT televisions are discarded by owners and they are using LED and smart televisions. Some of old televisions are repaired and low income people use those sets. Many of unusable televisions are dumped creating environmental pollution.

TABLE I  
LIST OF GENERATED E-WASTES FROM VARIOUS COMMON ITEMS USED IN BANGLADESH [4].

Sl.	Item	E-Waste (metric tons) within period	
1	Television	12,122,255.00	(1971-2010)
2	Computer	2,103,687.00	(1980-2010)
3	Mobile phone	24,932,160.00	(1989-2010)
4	CFL Bulb	5,669.00	(2009-2010)
5	Mercury Bulb	1,861.32	2001-2010)
6	Thermometer	8,513.59	(1971-2010)
7	Medical and Dental Equipment	199,595.00	2000-2010)

As per the report [4], other electronic items such as computers, mobile phones, CFL bulbs and mercury bulbs are dumped at home and outside home. A small quantity of the items is recycled.

The highest quantity of disposal/ storing of E-wastes are found in different areas of Dhaka City, such as Islampur, Kamrangirchar, Gingira, Mirpur and Mohammadpur [4]. As a result people are residing in those areas are in high risk of hazards created by E-wastes.

In Dhaka, huge quantity of E-wastes are generated. In a study it was found that [4], 475 tons E-wastes are recycled daily which is 20-30% of total E-waste generated and remaining E-waste dumped to land filling areas, open areas, rivers and other water bodies located in the mega city.

It is observed that people of Bangladesh sale unusable items to conventional recycling shops. Shop owners are not aware about the hazardous materials and toxic effects of rejected E-wastes. They process those items using very harmful traditional techniques so that they are in high risk.

Uncontrolled dumping of E-wastes in Bangladesh creates health hazards. It is also reducing fertility of land because of abnormal dumping for land filling without following standard methods.

To mitigate pollution problem from E-waste proper handling of E-wastes is essential. According to report of The Daily Star, Government is framing rules for proper E-waste management which should be obeyed by all concerned

## B. E-Waste Situation in Other Countries

### 1) E-waste situation in India:

India is facing challenge for E-waste management [6]. Authors reported that, India facing problem because of generation of E-wastes mainly from computer items. In another report [7] authors reported that, policy implications about E-waste management in Indian ICT sector. Authors mentioned that, consumers of native organizations create major E-wastes.

In 2017, authors [8] described E-wastes as complex toxic materials need certain handling. Authors also described that appropriate E-waste management is a matter of global environmental issue. Authors focused on behavioral pattern of disposal and awareness of E-wastes. Authors also considered the value of this problem. Authors critically reviewed global and Indian situation of E-wastes and they found disposal issues are very important for proper E-waste management. Authors concluded that proper disposal issues should be considered by implementing between both of developed and other developing countries as well as internally in these countries. Authors reported complexities in India because of economic and cultural reasons. They also mentioned that device based management methods could be a fruitful solution to resolve this crisis.

In an article, authors [9] reported that developed countries addressed well about E-waste management but India could not because of different reasons. They mentioned that India is a rapidly developing country so that it is very difficult to implement E-waste management options perfectly. Authors pointed that there are other reasons behind implementation of proper E-waste methods. Those are economy of the country, shortage of essential infrastructure and laws.

### 2) E-waste situation in China:

In a report [10], authors significantly mentioned about success history in recycling of E-wastes in China. Authors focused that recycling of E-wastes enhanced in manufacturing of electronic items at the last decade in China. Because of recycling industrialization in rural area of the country happened which played significant role in economy.

In a recent report, authors [11] stated that, China is in leading position in manufacturing of electronic products globally. As a result generation of E-wastes is also in large quantity there. Authors mentioned that recycling and other treatment processes are creating impacts to human health as well as environment. As per the report, it was found that different household electronic items are recycled in China showed in figure 2.

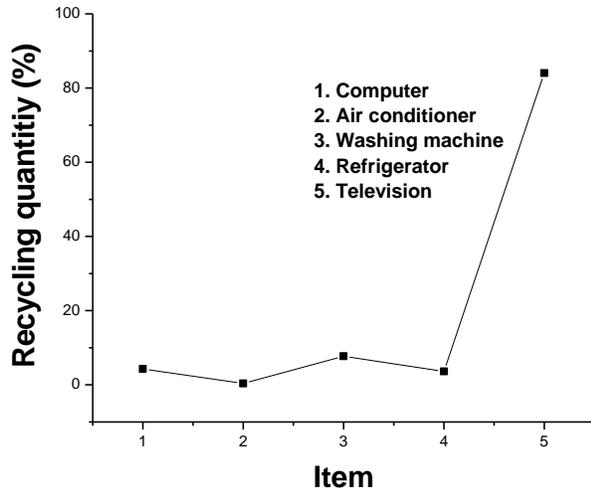


Fig. 2. Household electronic items recycled in China

From the above figure it is well understood that resident televisions are recycled in large amount in China. Different challenges to manage E-waste have been focused in this paper. Firstly, lack of appropriate E-waste management law, secondly, faulty E-waste collection methods, thirdly, challenge in implementation of proper technology and eventually motivation in participation of country people.

In another paper [12], authors reported after authentic survey that, people are interested to sell unusable electronic items instead of dumping for proper treatment. Authors reported the order of cost liabilities for E-waste management as producer (63.6%) > municipality (27.4%) > consumer (9%).

### 3) E-waste situation in Nigeria:

Authors reported [13] that exponential growth of manufacturing of electronic items happened in Nigeria. As a result drastic change in features has been happened resulting enhancement of capabilities, lowering in product price and increase of internet users in Nigeria. As a result, huge amount of E-wastes generated. Another remarkable problem was found in Nigeria. They imported second hand ICT based devices from developed countries. For this reason E-wastes generated within short time. Authors proposed that recycling can play a vital role to manage E-waste.

Authors [14] discussed risk factors of recycling of electronic items in Nigeria. Authors explained that recycling of electronic items which were unregulated created harms to human healths. Authors reported that, people buy repaired common electronic items in different hubs of the country. Authors also mentioned that, business of hazardous E-waste in Nigeria is not approved legally as per Bamako Convention.

### 4) E-waste situation in United States:

In 2005, large quantity of E-waste was used for land filling purpose in United States. That quantity was 1.36 million metric tons. In this paper [15], author proposed recycling process to manage E-waste in US. Authors proposed a new system of recycling system which is called e-market for returned deposit.

In a PhD thesis author [16] reported that in 2014, 7.8 million tons of E-wastes were generated in US which was 17% of global E-wastes. Author critically explained policy of US of E-waste management along with real practice. Authors showed sources of E-wastes in the Delaware state of US in various segments (Figure 3.)

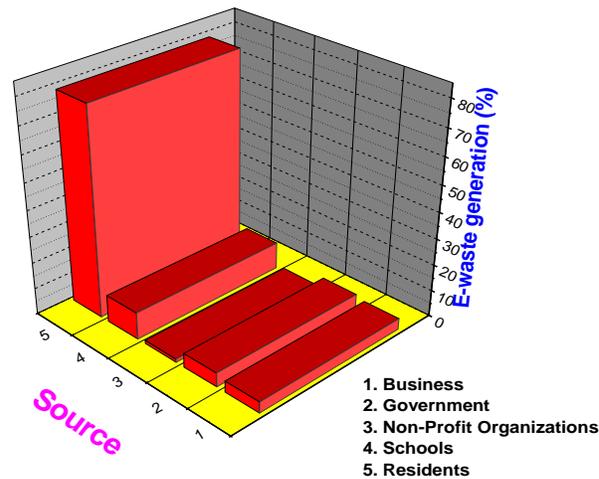


Fig. 3. Weight percentage of E-wastes of various sources in USA

Besides common E-waste management options such as land filling, incineration and recycling author also explained management of specialty materials such as CRT, materials which contain toxic mercury, batteries, cartridges etc. Figure 3 shows that highest quantity of E-wastes generates from residential source in US.

### 5) E-waste situation in Switzerland:

Authors discussed a concept named extended producer responsibility in the field of E-waste management in Switzerland [17].

Switzerland created positive image in E-waste management globally. In a paper [18] authors mentioned that, Switzerland started E-waste management initiative in 2003. The authority of Switzerland started works for proper E-wastes management in different countries of the World such as China, India and South Africa. They realized that E-wastes should be properly managed globally otherwise expected outcomes will not be achieved. Swedish initiative was evaluated worldwide well. Authors mentioned in the paper that, three vital factors were

included in Swedish E-waste control laws, those were, (i) stopping illegal dumping from consumers, (ii) controlling of presence of E-waste to municipal waste and (iii) application of 3R (Reduce, Recycle and Reuse) and minimization of disposal.

### C. Analysis on general and E-wastes

In general, wastes can be classified in five categories. Those are, (i) liquid waste, (ii) solid waste, (iii) organic waste, (iv) recyclable waste and (v) hazardous waste.

Waste in liquid form is called liquid waste. Liquid wastes can be classified in two types, industrial and household. The wastewater comes out after industrial processing is designated as industrial wastewater. It is also called effluent, such as, textile, tannery, paper and pharmaceutical wastewaters. A large quantity of textile wastewater is generated in textile dominating countries, like China, India, Pakistan and Bangladesh. In 2016, 217 million m<sup>3</sup> of waste water was generated in Bangladesh from textile sector [19]. In a paper authors [20] mentioned high values of physicochemical parameters of textile effluent of Bangladesh which create harmful environmental impact.

Solid wastes include different types of solid materials such as plastics, garbage and sludge left in industrial, commercial and residential areas. As per report of World Bank, global annual municipal solid waste production is 2.01 billion metric tons [21].

Organic waste means domestic rotten food waste. In a recent report it was mentioned that 1.3 billion tons of food wastes were generated in each year globally [22].

There are a large quantity of recyclable wastes generate each year all over the World. Plastic items are most common recyclable wastes. In 2015, 20% of global plastic wastes were recycled [23].

Hazardous wastes are those wastes contain huge toxic materials. E-waste is considered as one kind of hazardous waste. Nuclear wastes, wastes generated after ship breaking are also included in this type of category. 400 million tons of hazardous wastes are generated each year globally [24].

Comparing to other wastes, generation of E-wastes is not negligible. 53.6 million metric tons E-wastes were generated in 2019 globally [2]. Use of global electronic items is increasing day by day. Many years ago people thought only about solid and liquid wastes. But time has changed; now we have to think about E-wastes to protect our planet.

### D. Global E-waste management policy

Developed countries, like USA is conscious about generation, handling and management of E-wastes. As per the PhD thesis [16], US Government follows conventional E-waste management options such as land

filling, incineration and recycling. Besides they also export to developing countries. Both of national and sub national policies are available in USA. The Govt. of US follows “Resource Conservation and Recovery Act” (RCRA) of 1976 as federal legislation.

As per literature survey it is understood that, Switzerland has become remarkable for implementation of appropriate E-waste policies globally [18].

In India E-waste rule 2011 is revised in 2016. Under new rule, all stakeholders such as dealers, manufactures etc. have been included in this new rule [25].

China made a fund to subsidize E-waste recycling in 2018. They made compulsory E-waste management regulation in 2011 which is known as “China WEEE Regulation” [26].

The Department of Environment (DoE) of Bangladesh has published a draft of E-waste management rule in 2019. It is expected that it will be approved by concerned authority for proper initiative of E-waste management in our country. This rule restricts use of 15 substances in electrical items. This rule will be applicable to all stakeholders of our country including producer, manufacturer and others [27].

## III. A. SUGGESTIONS FOR E-WASTE MANAGEMENT

Considering above discussion, the following suggestions are listed below for global as well as local E-waste management for better planet.

### A. Global

- a) More technological developments are required besides common E-waste management options such as land filing, incineration, recycling, dismantling etc.
- b) Exporting to developing countries from developed countries should reconsider from environmental and health viewpoints.
- c) Developed countries may make a fund for global E-waste management.
- d) International agreements should be signed between developed and other countries for safe E-waste management globally.

### B. Bangladesh

- a) First of all, characterization of locally generated electrical and electronic wastes should be done for assessment of contents of hazardous and useful components of E-wastes generated in Bangladesh.
- b) Regulatory framework needs to be established soon and proper implementation in both of rural and urban areas is necessary.
- c) Appropriate survey of import, export, production and consumption of electrical and electronic



- items of Bangladesh needs to be done.
- d) Approximate quantity of annual E-waste generation in Bangladesh should be assessed.
- e) Proper education and training of E-waste management need to be provided to all stakeholders.
- f) A comprehensive study needs to be done regarding assessment of suitability of proper E-waste management options in Bangladesh.
- g) An initiative is necessary to recover useful components in E-wastes of Bangladesh.

#### IV. CONCLUSION

After review of E-waste management methods of different countries of the world, it was found that a large quantity of E-wastes generate every year all over the world because of modern civilization. After life cycle, unusable electronic products create E-wastes. There are several ways to manage proper E-wastes globally; life cycle assessment is one of the most important methods. It was observed that most of the countries use recycling method for E-waste management. Other options are also used, such as land filling, recovery etc.

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