

Bamboo: The Best Substitute for Reducing E-waste Problem

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Abstract: The rapid revolution in Electronics and Information technology sectors has improved the quality of human's life style. The wide spread use of electronics equipments have made communication easier, boosted business markets, and created employment opportunities. No doubt, this development gives so many benefits, but mismanagement has led to fast growing surplus of electronics waste called e-waste. E-scrap, e-waste or Waste Electrical and Electronics equipments (WEEE) refers to all items which are discarded by its owner as waste (whether they are recyclable, repairable, reusable or destined for waste). E-waste contains non-degradable plastics, carcinogenic chemical, acids and toxic heavy metals like Mercury, Lead ,cadmium, nickel etc. which mixed with air , soil and underground water causing harmful effects on human health as well as on environment and aquatic life. So, this waste is not only harmful for human and environment, but also becoming a great threat for the whole world. Therefore, proper management system and some regulations are necessary while handling e-waste and where its possible biodegradable components should be used. This paper attempts to provide a concept of e-waste, problems associated with these materials, current and green methods of e-waste disposal and some regulations which tackle this issue. Further, the paper also suggests overcoming e-waste problem with "Bamboo" as the products of bamboo are eco-friendly and biodegradable in nature.

Keywords —BAN (Base Action Network), Electronic-waste, Environmental impact, Media, NRDC (National Research Development Corporation), Waste management

I. INTRODUCTION

One of the major problem to which we are subjected today is e-waste, which is also called electronics waste as shown in Fig 1[1]. According to Global e-waste report 2017, every year million metric tonnes of e-waste is produced by the world. In 2017, the world generated 46.9 million metric tonnes of e-waste and it is expected that , this waste amount will grow to 52.2 million metric tonnes in 2021 with annual growth rate of 3 to 4%[2]. The top five countries that producing e-waste are India, China, US, Japan and Germany .China is the top most e-waste producer in the world, which generates 7.2 million metric tonnes of e-waste every year and it is expected to the growth of 27 million metric tonnes by 2030.India is the fifth largest producer of e-waste and it is discarding roughly 19.5% lakh tonnes of e-waste every year.



(a)



(b)



(c)

Fig 1: (a) Computers as E-waste (b) Cell -Phones as E-waste (c) Other E- waste items

E-waste is a popular name given to discarded equipments or items which are nearing the end of their useful life. Such waste covers wide range of electrical and electronics items like televisions, VCRs ,computers , fax machines , laptops, audio equipments, cell-phones , LCD/plasma, batteries and house-hold appliances (washing machine , microwave, oven , gas cooker) etc. There are so many reasons for e-waste generations:

- I. Developments in Electronics, Electrical and Information technology sectors. New technology makes previous products obsolete. For example: VCRs are replaced by Blue-ray players.

- II. The low prices of electronics articles make them easily and universally available.
- III. A constants improvement of products leads to new models every year like cell-phones, TVs etc.
- IV. Young generation between the ages 15-35 and economic status are responsible for the highest demand for electronics items in the country.

Table 1: Electrical & Electronics components with associated pollutants

S.no	Electrical and Electronics Items	Pollutants
1	Mobile phones	Lithium , copper, tin cobalt, silver , Gold
2	LED Light emitting diodes)	Arsenic
3	Computers	Lead,Mercury,cadmium and Beryllium
4	LCD(Liquid crystal displays)	Mercury
5	PCB (Printed Circuit boards) , relays , switches	Lead, Copper, cadmium , Arsenic, Brominates flame-proofing agent
6	CRT(cathode ray tubes)	Cadmium , lead , Barium
7	Batteries	Lithium , copper, cadmium,cobalt, silver , Gold , Nickel , Zinc
8	Photocopy machine	Mercury , Selenium

E-waste products should be properly disposed , if not then they are of grave danger to environment , aquatic life and human health , because E-waste product contain toxic heavy metals like Lead , Beryllium, Mercury , cadmium , nickel etc. , carcinogenic chemical and acids, Which go into the land, contaminating ground water and soil. The Table 1 shows some electronics components and pollutants associated with them [3] and Table 2 gives the detailed of different health problem associated with these pollutants [4].

Table2: Detail of different harmful elements with Health hazardous

S.no	Pollutants of e-waste material	Health Hazard
1	Mercury(Hg)	Affects Kidneys & immune system, damage central nervous system, skin cancer, respiratory disorders.
2	Lead (PB)	Affects reproductive system & kidneys , mental development in children ,
3	Cadmium	Causes severe pain in spine & joints , accumulates in liver & Kidneys
4	Beryllium(Be)	Causes Lung cancer , skin

		cancer
5	Barium (Ba)	Damage heart and Liver , muscle weakness
6	Acids	Fumes of these acids contain Sulphur & chlorine dioxide which causes corrosive to eye and skin , affects respiratory system
7	Plastics including PVC	Burning of these plastics produces dioxin which affects Immune system , corrosion to lung tissues , development problems in children

II. DISPOSAL METHODS OF E-WASTE

Following Methods Are Used To Dispose E-Waste Materials:

- I.Landfills
- II.Acid baths
- III.Incineration

I. **Landfills:** This is the most common methodology of e-waste disposal. Around 65% of the e-waste ends up in landfill, without being recycled. Soil is excavated and trenches are made for burying the e-waste in it. The acids and heavy metals flow into the land, contaminating ground water and soil as a result causes human health and environmental problems. So, this is not an eco-friendly sound process for disposing the e-waste [5].

II. **Acid baths:** Acid bath involves soaking of the electronics circuits in the powerful sulphuric, hydro-chloric or nitric acid solution. This method is useful to extract copper from the circuit board. The recovered metal is used to manufacture the other products while the hazardous acid wastes drain into the local water sources. This method is also used to dissolve the lead to extract Gold and silver.

III. **Incineration:** This method involves combustion of electronics waste at high temperature. During gasification process limited air is given to materials which convert this into fume, ash and tar. It also includes pyrolysis process. In pyrolysis, the material is heated in the absence of air that converts the substances into fume, charcoal and oils. This method is quite advantageous as the waste volume is reduced, but it also not free from disadvantages such as emission of carbon monoxide, sulfur dioxide, nitrogen oxides in the environment.

III. GREEN METHOD TO DISPOSE E-WASTE

The above stated methods are not safe for human health and environment, because e-waste materials contain toxic heavy metals, acids, carcinogenic chemicals and non-degradable plastics .So, the eco-friendly or green methods by which we can dispose the e-waste are [3][5]:

- i. **Recycling:** One great way of decomposing and disposing off the e-waste is recycling. The recycling is done by dismantling, sorting and recovery of valuable materials. The waste discarded by the developed countries should never be exported to the developing nations. Products like cell-phones, computers should be recycled in a very efficient manner. If can't recycle it, then take them to the organizations that will do the work for us in an efficient manner. This will help in reducing greenhouse gas emissions, prevent health problems and create jobs.
- ii. **Creating something new out of the old equipments:** Instead of going to the market and buy every new item that is launched, we can just try to create something new and unique out of old equipments. Like we can convert I-pad into hard drive and old computer into music jukebox.
- iii. **Re-use:** Re-use the old accessory for different purposes and should never be throw n, decompose or burn them as shown in Fig 2[8]. The environmental and social benefits of reuse of old electronics equipments include diminished demand for new products.



Fig 2: Pen stand from E-waste

- iv. **Look for disposal programs:** For disposing e-waste we must contact a professional electronics retailer who would tell us about different disposal programs or we can call up the private waste management authority of our city. They will surely help us in disposing the e-waste in more eco-friendly manner.
- v. **Donating outdated Items:** Tablets, Cellphones, computers etc not useful for us, should be donated to some people or charitable institutes, who might use them for some productive work. In simple language we can say that "One man's trash is another man's treasure".
- vi. **Visit civic institutions:** Many organ-izations have initiated some programs, where they assigning certain place and date for people to come and drop-off their e-waste. Government should encourage Universities and schools to start such programs for e-waste disposal.
- vii. **Give back to electronic companies:** There are many electronics compa-nies and retailers who would take back our old equipments at a very cheap rates or offering us some discount on

purchase of latest version equipment. For example: Presently Reliance Company take old phone of any company along with Rs 500 and offers new cell-phone with free unlimited call and data for 6 months in Rs 600 recharge.

- viii. **Sell-off outdated items:** We can sell-off our outdated cell-phones , tablets or computers through online websites like eBay,OLAX,craigslist etc.This will help us to get rid of outdated items as well as earning some money.
- ix. **Give your e-waste to certified e-waste Recycler:** BAN (Base Action Network) is a non-profit organization of recycling companies, which have been assigned the task of recycling waste in a safe and responsible manner. We need to find an e-waste recycler company who is officially certified by BAN, so that we don't have to worry about polluting environments, affecting human health or risk of losing our personal details to criminals.

IV. E-WASTE MANAGEMENT AND REGULATIONS

The Key roles played in producing e-wastes are:

- i. Consumers, Domestic, Recyclers, Industries and offices , Scrap-dealers etc
- ii. Insufficient funding provided by government that limits the management of e-waste in effective way.
- iii. Awareness among people about side effects of e-waste on human health as well as on environment.
- iv. Inadequate strict Laws and policies

Moreover, the developing countries having lack of well-established system for separation, collection, storage and disposal of e-waste are also responsible for this.

Therefore to overcome these problems the strict policies, Laws, awareness programs, high tech machinery and sufficient funds should be provided by the government. Some environmental agencies such as NRDC(National Research Development Corporation), OGEPA (Ogun state Environmental Protection Agency), BAN (Basel Action Network), Municipal waste management authorities (MWMA) along with other advocates are currently working on ensuring the strong implementation of the Laws against e-waste exporters and take action against unapproved\illegal e-waste collectors & dismantlers. [3]

The NRDC, BAN has created a certificate system for recycling, refining and refurbishing companies known as e-Stewards certification. This certification ensures that recycling & refining is done in such a manner that protects human health and environment. Government also plays an important role in establishing recycling by allocating sufficient grants. Govt gives incentives to attract private sectors partners who set-up recycling company. This will create job opportunities for many people and reduce the financial pressure on the nation. Like LAWMA (Lago's State waste management Authority) is retrieving e-waste and offers a new brand computer system for every five waste computer systems [6]. The goal is just to take the hazard away from public. Retailers and manufacturers should be encouraged to adopt this system and if possible

the collection or disposal centers should be built for the consumers or otherwise tie-ups with domestic or municipal for collection of e-waste through special collection programs.

V. BAMBOO

Bamboo is one of the most important components of development and no other plant can compete with its utilities [7]. Bamboo the fastest growing plant that belonging to the true grass family “Poaceae” in the planet as shown in Fig 3.[8] All over the world, there are about 1250 species & 90 genera of bamboo plants.



Fig 3: Bamboo Tree

Bamboo is sustainable and an eco-friendly material as: (a) It grows much faster than conventional trees (3-6 yrs versus 30-50 yrs), so it recovers deforestation & soil erosion quickly; (b) It releases about 35% more oxygen than the hard-wood trees thus reducing global warming effect; (c) In future, it will remove the problem of E-waste due to its biodegradable nature; (d) It has strong, flexible & light weight woody stem. Because of its highly multipurpose properties bamboo is suitable for numerous end products/purposes worldwide such as: construction, handicraft industry, city furniture, textile & paper industry, household products, bicycles, laptop, electric fan, wind mill blades, photo voltaic panels or monopiles etc

In addition to above fields, bamboo fibres are utilized in textile industry for manufacturing summer clothes, masks, bandages, surgical gowns (Hospitals), napkin, food-packing etc. due to its anti-bacterial, anti-ultraviolet, eco-friendly and biodegradable nature. Sony Company of Japan, uses bamboo to create large volume Li-battery suitable for mini-type & portable computers, cell phones, bamboo based keyboards and mouse etc. Table 3 gives comparison between conventional electronics products and bamboo products [8] This shows that approximately 30 to 70% body of electronics items is made of plastics, which is non-biodegradable in nature and takes roughly 100 years to decompose. On the other hand, bamboo products are biodegradable and eco-friendly in nature. Moreover, in auto-mobile sector, bamboo is used to make bamboo electric cars, bamboo bicycles, bamboo horse carriage and for many other applications. So, the bamboo can play a vital role in reducing the e-waste problem.

Table 3: Comparison between conventional electronics products with bamboo products

Product name	Electronics products	Bamboo products
Cell-phone		
Calculator		
Key-Board With mouse		
Laptop		
Audio system		

VI. CONCLUSION

The utilization and demand of electrical and electronics equipments are increasing day by day and majority of people are not aware about the threats faced by e-waste. Therefore, adequate laws should be enacted by central and local government for e-waste disposal. Awareness programs for

public, retailers and manufactures should be conducted regularly. It is the responsibility of government to provide sufficient grants, issue certificate like e-stewardship, motivate private sectors by providing incentives to them, use biodegradable materials like bamboo to reduce e-waste problems. Such initiatives will be helpful in discarding e-waste, protecting environment as well as human health and generate employment. Moreover, the help of media can also be taken to fulfill this task.

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