

## **E Waste Management in India : A Survey of Current E Waste Handling Practices in some area of Aurangabad City (Maharashtra)**

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**Abstract**—In recent decades, the use of electronic and electrical devices has increased significantly, leading to rapidly rising amounts of waste electrical and electronic equipment (WEEE). Electronics industry is considered as the world's largest and fastest growing manufacturing industry. The electronic devices reach at the end of their useful life: they become a waste (e-waste) of waste Electrical and electronics equipment (WEEE). 'e-waste' is a term used to describe old, end-of-life electronic appliances such as computers, laptops, TV's, radios, refrigerators etc., which have been discarded by users. Increased consumption of electrical and electronic equipment due to its utilization in the day to day life of individuals has indirectly explained the increase in the generation of e waste. The management of e waste has become an environmental concern in many developing countries as urbanization continues to take place. The current practices of e-waste management in India suffer from a number of drawbacks like unhealthy conditions of informal recycling, inadequate legislation, and poor awareness. India is facing the problem of e-waste management due to lack of awareness among people about dangerous effect of e-waste on environment and human being through informal e-waste collection and absence of implementation of rules for the process of e-waste in environment friendly manner. This paper focuses on the current status of e waste in India, problems associated with e waste, e waste handling practices, strategies and rules for handling e waste. The aim of this paper is also to identify the attitude of consumers towards e waste handling practices, e waste disposal and e waste recycling in some areas of Aurangabad City (Maharashtra).

**Keywords**— E- waste, OECD, hazardous, WEEE, PCs

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### **I. INTRODUCTION**

Electronics industry is considered as the world's largest and fastest growing manufacturing industry. There has been a rapid growth combined with rapid product obsolescence resulting in discarded electronics. This in turn has emerged to be the fastest category of waste material in the industrial and corporate world. Electronic waste, "**E-waste**" or "Waste Electrical and Electronic Equipment" ("**WEEE**") consists of any broken or unwanted electrical or electronic appliances. As per the CPCB (Central Pollution Control Board, India) Guidelines, 2008, E-waste is defined as 'Waste generated from used electronic devices and household appliances which are not fit for their originally intended use and are destined for recovery, recycling and disposal'. E-waste includes all hardware and accessories, including networking equipment, monitors, central processing units (CPUs), printed circuit boards (PCBs), wires, printers, ink cartridges, keyboards, mice, facsimile and copying instruments etc. In addition, E-waste encompasses a wide range of electrical and electronic devices such as cellular phones, personal stereos; as well as large household appliances, such as refrigerators and air-conditioners. The Indian information technology sector is also largely contributing to the global economy. At the same time, it is generating bulk of e-waste or Waste Electrical and Electronic Equipment (WEEE). The e-waste has become a matter of concerns in most of the developing countries like India, where in past not much emphasis given on it. In developing countries like India

the e-waste has become a massive problem which is either locally generated or internationally imported, which causes serious hazard to human health and environment. The electrical and electronic equipment contain harmful component which are a reason to worry during the waste management process [1].

## II. DEFINITIONS OF E WASTE

### 2.1 OECD (2001)

WEEE / E-waste have been defined as “any appliance using an electric power supply that has reached its end-of-life.”

### 2.2 WEEE Directive (EU, 2002a)

“Electrical or electronic equipment which is waste including all components, subassemblies and consumables, which are part of the product at the time of discarding.” Directive 75/442/EEC, Article 1(a) defines “waste” as “any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force.”

**2.3 Basel action network:** the e-waste is defined as “E-waste includes a wide and developing range of electronic appliances ranging from large household appliances, such as refrigerators, air-conditioners, cell phones, stereo systems and consumable electronic items to computers discarded by their users”

### 2.4 Life cycle of E waste:

#### The ‘Four-Phase-Model’ — from EEE to WEEE

The material flow model covers four phases of EEE as well as end-of-life EEE (WEEE):

**Phase I:** Production and sales of EEE, including import, export, and input of equipment for re-use from repair of WEEE.

**Phase II:** Consumption of EEE, use of EEE in households, offices and industry.

**Phase III:** Collection of end-of-life EEE (WEEE), including transfer to treatment/disposal sites, import/export.

**Phase IV:** Treatment/disposal alternatives for WEEE, landfill, incineration, shredder, repair and disassembly, material as well as energy recovery, including the emitted material or substances[2]

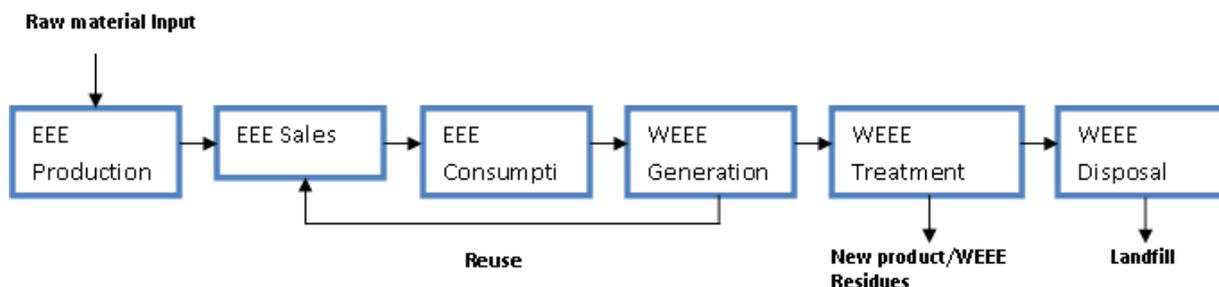


Figure 1 . Life Cycle of E Waste

### III. E- WASTE CATEGORIES

Identification of E- waste categories	
1. Large House hold Appliances:	Washing machines, Dryers Refrigerators, Air conditioners, etc
2. Small House hold Appliances:	Vacuum cleaners, Coffee Machines, Irons, Toasters, etc.
3. Office, Information & Communication Equipment:	PC's, Laptops, Mobiles, Telephones, Fax Machines, Copiers, Printers etc.
4. Entertainment & Consumer, Electronics and Toys, Leisure, Sports and Recreational Equipment, and Automatic Issuing Machines:	Televisions, VCR/DVD/DC players, Hi-Fi sets, Radios, etc, and Electric train sets, coin slot machines, treadmills etc and Vending machines, parking ticket equipment etc.
5. Lighting Equipment:	Fluorescent tubes and lamps, sodium lamps etc (Except Incandescent Bulbs, Halogen Bulbs) etc.
6. Electric and Electronic Tools:	Drills, electric saws, Sewing Machines, Lawn Mowers etc
7. Security & health care equipment:	Surveillance and Control Equipment (e.g. CCTV cameras, scanning equipment), and Medical Instruments and Equipment (e.g. x-ray and heart lung machines) etc.
8. Mixed WEEE	

*Table 1. E Waste categories*

#### 3.1 Composition of E-Waste

Composition of e-waste is very diverse and differs in products across different categories. It contains more than 1000 different substances, which fall under “hazardous” and “non-hazardous” categories. Broadly, it consists of ferrous and non-ferrous metals, plastics, glass, wood & plywood, printed circuit boards, concrete and ceramics, rubber and other items. Iron and steel constitutes about 50% of the e-waste followed by plastics (21%), non ferrous metals (13%) and other constituents. Non-ferrous metals consist of metals like copper, aluminium and precious metals ex. silver, gold, platinum, palladium etc. The presence of elements like lead, mercury, arsenic, cadmium, selenium, and hexavalent chromium and flame retardants beyond threshold quantities in e-waste classifies them as hazardous waste.[3]

##### 3.1.1 Hazardous Substances in e-Waste

Electrical and electronic equipment contain different hazardous materials which are harmful to human health and the environment if not disposed of carefully. While some naturally occurring substances are harmless in nature, their use in the manufacture of electronic equipment often results in compounds which are hazardous.

##### 3.1.2 VALUABLE SUBSTANCES IN E-WASTE

Electrical and electronic equipment contain various fractions of valuable materials. Most of the valuable substances are found in printed circuit boards, which occur in relevant quantities mainly in the categories Office, Information and Communication Equipment as well as Entertainment and Consumer Electronics. Besides well known precious metals such as gold, silver, platinum and palladium also scarce materials like indium and gallium start to play an important role, due to their application in new technologies (e.g. flat screens, photovoltaic's). [4]

### 3.13 Environmental and health hazardous of e waste: [5]

Chemical	Uses	Health effects(HE)/Environmental effects (EE)
Mercury	Fluorescent tubes, flat screen monitors	Accumulates in food chain HE: highly toxic ; sensory impairment, dermatitis, ,memory loss; muscle weakness; damage to central nervous system and kidneys EE: death, reduced fertility, slower growth and development in animals
Lead	Electrical solder, CRT monitor glass	HE: highly toxic; damage to nervous system, blood systems; kidneys ,reductive organs EE: highly toxic; similar effects for animals and aquatic life
cadmium	Contact switches; light sensitive resistors, nickel – cadmium batteries	HE: severe lung damage; kidney damage; bone toxicity EE: harmful to microorganisms and to ecosystem
Polyvinyl chloride(PVC)	Insulation on wires and cables	HE: respirator problems/lung damage; poisonous when burnt
Beryllium	Heat insulation for CPUs and power transistors	HE: a known carcinogen to humans; lung damage-chronic Beryllium disease; Beryllium related allergies and sensitivity
Bromated flame retardants(BFRs)	Flame retardant in most electronic devices	Build up in the environment. HE: impaired development of the nervous system, liver damage; damage to endocrine system.

*Table.2 Environmental and health hazardous of e waste*

## IV. GLOBAL SCENARIO OF E-WASTE

The Global e-waste scenario shows:

- Industrialization nations like the USA are the largest producer and consumer of electronic goods.
- 48.5 million Computers discarded in the United States each year.
- 1.5 million of those machines end up in landfill annually.
- 50-80 percent of e-waste collected or recycling is exported from the U.S. to Asia.
- Each European on an average contributes 14 kg. Or 6.5 million metric tonnes, per year.
- China had the highest growth in number of computers users per capita in the period 1993-2000. It grew at massive 1052% compared to a world average of 181%.
- Computer sales continue to grow at 10% plus rates annually. Sales of DVD players are doubling per year.[6]

## V. PRESENT E-WASTE STATUS IN INDIA

In India most of activities like collection, transportation, segregation, dismantling, etc., is done by unorganized sectors manually. Being a rich source of reusable and precious material, E waste is also a good source of revenue generation for many people in India. The big portion (rag pickers) of the Indian population earned their livelihood by collecting and selling the inorganic waste-like plastics, polythene bags, glass bottles, cardboards, paper, other ferrous metals, etc. In India, most of the

operations related to E-waste such as collections, segregation, dismantling, recycling, and disposals are performed manually. In absence of the adequate technologies and equipment, most of the techniques used for the recycling/treatments of E-waste are very raw and dangerous. Table reveals the trend in growth of E-waste in India that is continuously rising over the years. In 2007 E-waste generation is 332979, but in 2009 it is 402905 MT. more than previous record. In 2011 the production of E-waste is 487515, and it is 84610 more than 2009. So we conclude that the E waste rising over the year with a healthy pace and it is an alarming signal for Indian environmentalist, planners and administrates.[7]



Source: Department of Information Technology

Chart: CopperBridge Media

Figure 2. Projection of E-waste generation in India.

Sr. No.	States	E-waste Generated in MTA	Metropolitan Cities and others	E-waste Generated in MTA
1.	Maharashtra	20270.59	Mumbai	11017.1
2.	Tamil Nadu	13486.24	Delhi	9729.15
3.	Andhra Pradesh	12780.33	Bangaluru	4648.4
4.	Uttar Pradesh	10381.11	Chennai	4132.2
5.	West Bengal	10059.36	Kolkata	4025.3
6.	Delhi	9729.15	Ahmadabad	3287.5
7.	Karnataka	9118.74	Hyderabad	2833.5
8.	Gujarat	8994.33	Pune	2584.2
9.	Madhya Pradesh	7800.62	Surat	1836.5
10.	Punjab	6958.46	Nagpur	1768.9

Table 3 E-waste Generation [Consumer Voice,2009].[8]

## VI. E-WASTE MANAGEMENT AGENCY

Some of the most successful countries on E-Waste management system are Netherland and Switzerland. The Swiss E-Waste management system can be viewed as an ERP based system, where each stake holder has their own clear definition of role and responsibility. In India some of the Indian Enforcement Agencies are involved in E-Waste Management System.

- **Ministry of Environment and Forests (MOEF):** This agency is responsible for identification of hazardous wastes and provides permission to exporters and importers.
- **Central Pollution Control Board (CPCB):** It is constituted under the Water (Prevention and Control Pollution). It coordinates with the State Pollution Control Board, implements the

rule of imports and monitors the procedures, condition of authorization, imports and exports management and hazardous waste.

- **State Pollution Control Board (SPCB):** It constituted under the water (prevention and Control of Pollution) to grant and update authorization.
- **Port and customs Authorities:** Authorities verify the documents and inform the Ministry of Environment and Forests of any illegal traffic and waste from imports and exports.[9]

## VII. COMMONLY USED E WASTE HANDLING PRACTICES IN INDIA

Nowadays electrical appliances prove convenience and satisfaction in everyday’s life and their usage become more in households. Rapid development of technology in electrical and electronic industries not only offers a wide range of product choices but also price choices. Once a household has used the electrical and electronic equipment until its end of life, the equipment will undergo the mechanism of disposal. A survey is done using of 400 peoples in Aurangabad to know awareness in people about e waste and its hazardous effects as well as to analyze the disposal methods used by people shows the following communally used e waste handling practices.

### Methodology

The present research is a based on primary data collected from a sample of 500 people randomly selected by author within the city limits of the Aurangabad city. Target people in the age group of 18yrs to 50yrs. To create awareness of hazardous effects of e waste a questionnaire is used for teaching and non-teaching staff and students in the college as well as the questionnaire is also filled from the housewives which again include well qualified and less qualified. A survey from ICT employees is also conducted. The survey is useful to find out the disposal methods used by the target people. Survey results shows following outcomes. A survey is done using of 400 peoples in Aurangabad to know awareness in people about e waste and its hazardous effects as well as to analyze the disposal methods used by people shows the following communally used e waste handling practices .

Target peoples are students in Maulana Azad college and employees in Rafiq Zakaria campus, housewives from different areas in Aurangabad city.

Awareness Questions

Q.1 Do you know what e-waste or waste of electrical and electronic equipment is?

Answer: Yes/NO

Target people	Response	
	Yes	No
Teaching Employee	100	0
Non-Teaching	100	0
Students	90.91	0.09
ICT Employees	100	0
Housewives(well Qualified)	77.89	22.11
Housewives (qualified up to 12 <sup>th</sup> )	24.46	75.54

*Table 7.1*

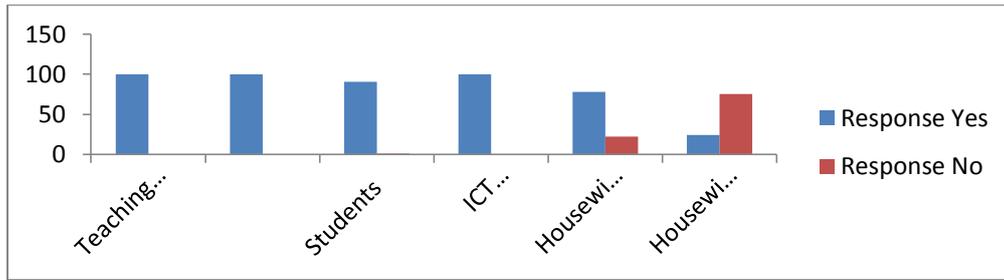


Figure 7.1 Graphical representation of table 7.1

Q.2 Are you aware of hazardous effects of e waste?  
 Answer: Yes/No/Not Specific

Target people	Response		
	Yes	Not Specific	No
Teaching Employee	88.91	11.09	0
Non-Teaching Employee	50	28.57	21.42
Students	31.81	27.27	31.81
ICT Employees	89.12	10.88	0
Housewives(well Qualified)	39.37	25.44	35.19
Housewives (qualified up to 12 <sup>th</sup> )	2.1	26.33	71.57

Table 7.2

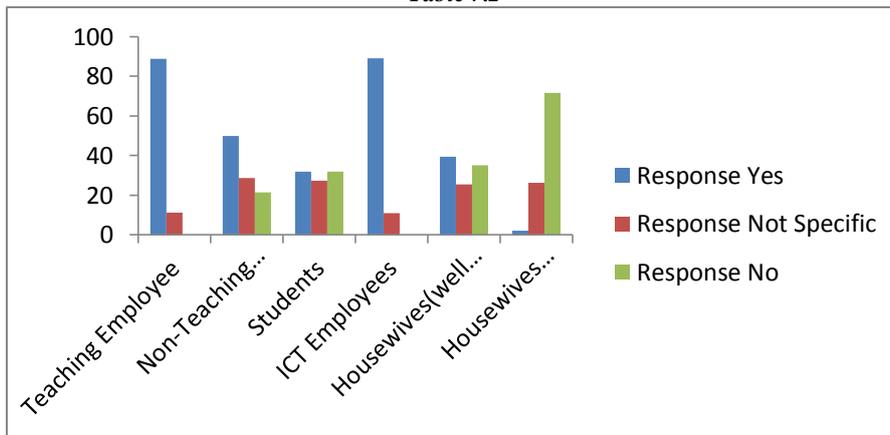


Figure 7.2 Graphical representation of table 6.2

Q.3 Are you aware that some hazardous fractions in e-waste need a special treatment in order to be safely disposed of?  
 Answer: Yes/No

Target people	Response	
	Yes	No
Teaching Employee	88.21	11.79
Non-Teaching Employee	51.23	48.77
Students	16.11	83.89
ICT Employees	89.19	10.81
Housewives(well Qualified)	24.79	75.21
Housewives (qualified up to 12 <sup>th</sup> )	1.3	98.7

Table 7.3.

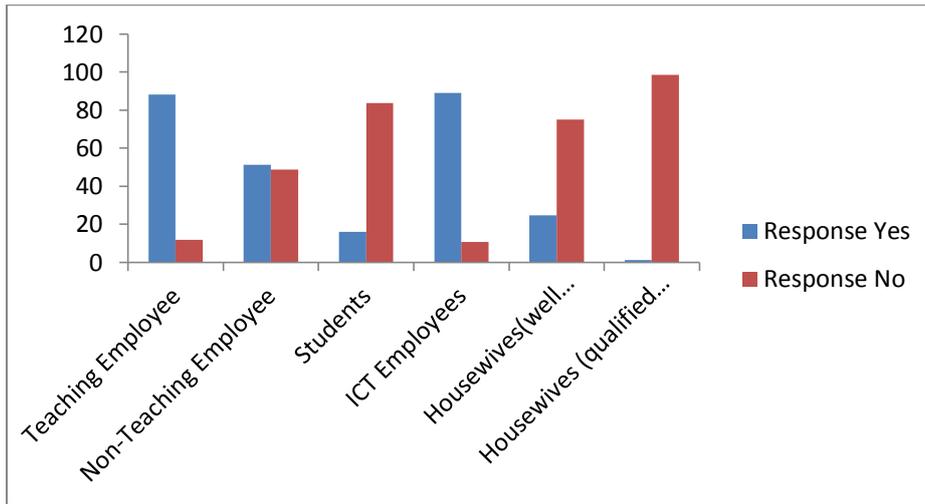


Figure 7.3 Graphical representation of table 7.3

Q.4 Do waste collectors come and pick up waste at your door? Do they pick up e-waste too?  
 Answer:a).YES, everything b). YES, but no e-waste c). NO

Answer	YES, everything	YES, but no e-waste	NO
Response	98.23	0	1.77

Table 7.4

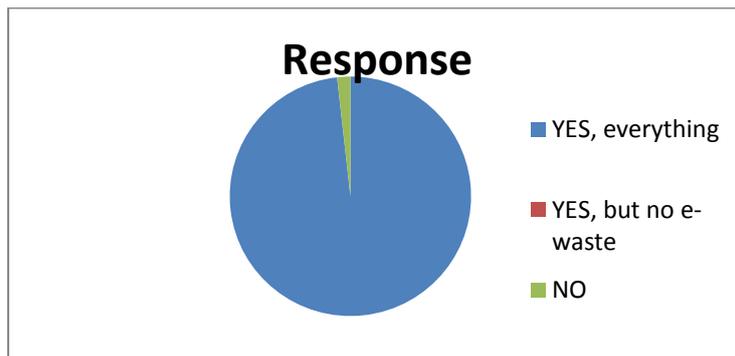


Figure 7.4. Graphical representation of table 7.4

Q.5 which waste collection system is used?  
 Ans: Informal/Private/ Municipal collection

Collection System	percentage
Informal	2.3
Private	0
Municipal collection	97.7

Table 7.5

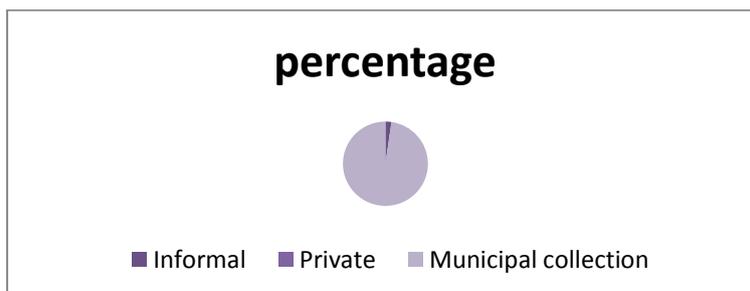


Figure 7.5. Graphical representation of table 7.5

Q.6 Is the current e-waste collection convenient to you?

Answer: Yes/No

Target people	Response	
	Yes	No
Teaching Employee	40.59	59.41
Non-Teaching Employee	68.94	31.06
Students	72.58	27.42
ICT Employees	12.11	87.89
Housewives(well Qualified)	78.99	21.01
Housewives (qualified up to 12 <sup>th</sup> )	89.87	10.13

Table .7.6

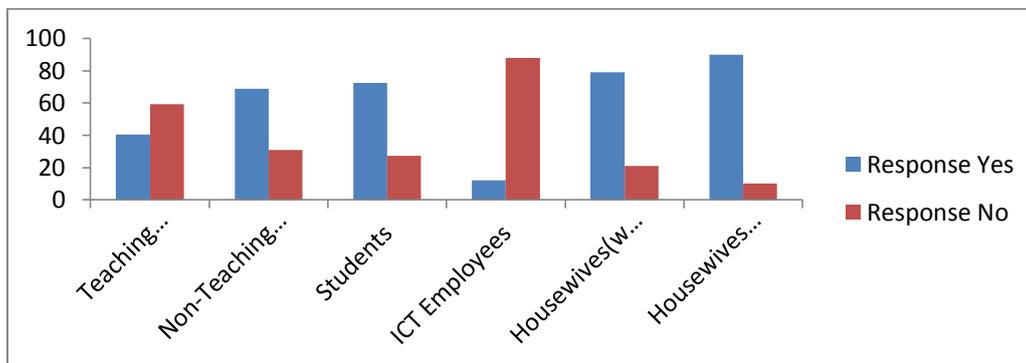


Figure 6.6 Graphical representation of table 7.6

Q.7 Would you give out your e-waste to the waste collectors for free if you could be sure that the waste will be well taken care of in a way that is useful and that does not pollute the environment?

Answer: Yes/No

Target people	Response	
	Yes	No
Teaching Employee	51.66	43.34
Non-Teaching Employee	47.44	52.56
Students	49.11	50.89
ICT Employees	74.46	25.54
Housewives(well Qualified)	32.12	67.88
Housewives (qualified up to 12 <sup>th</sup> )	12.11	87.89

Table 7.7

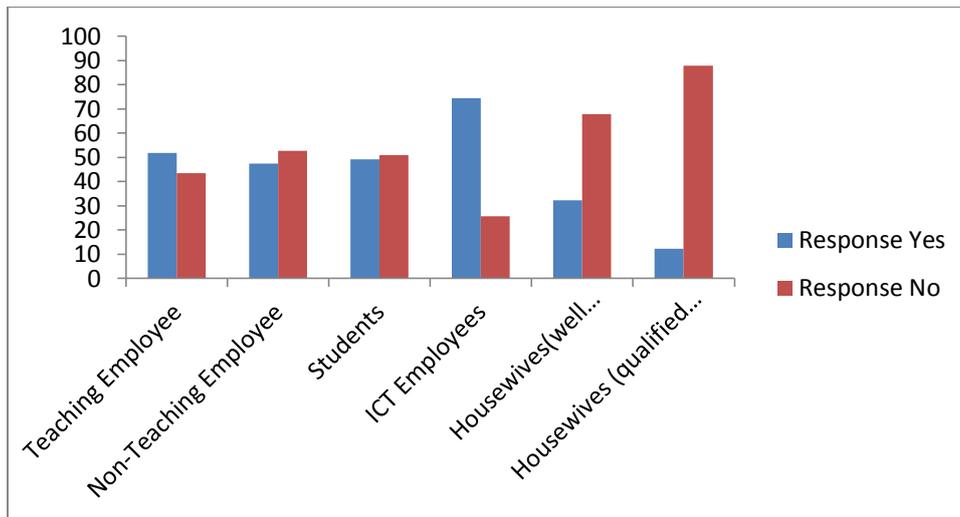


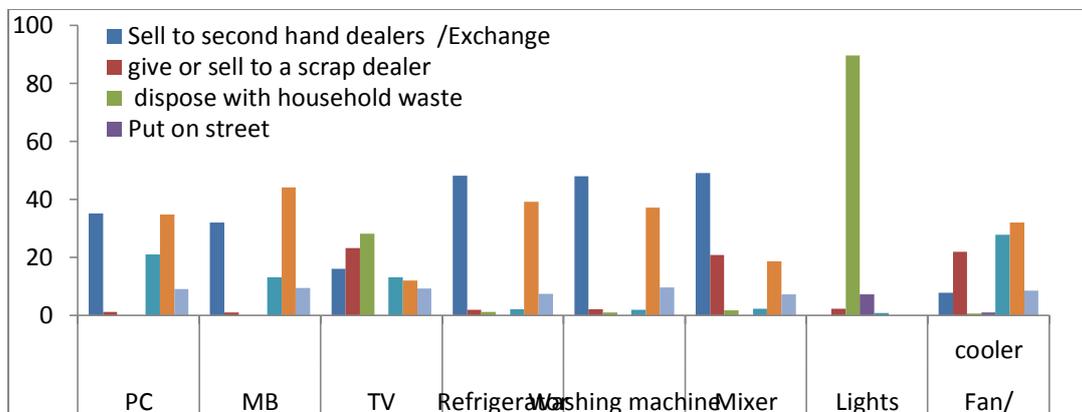
Figure 7.7. Graphical representation of Table 7.7

**VIII. COMMONLY USED DISPOSAL METHODS BY THE TARGET PEOPLE:**

Disposal Method	PC	MB	TV	Refrigerator	Washing machine	Mixer	Lights	Fan/ cooler
Sell to second hand dealers /Exchange	35.12	32.13	16.12	48.15	47.98	49.12	0	7.8
give or sell to a scrap dealer	1.28	1.03	23.25	1.9	2.1	20.83	2.35	21.9
dispose with household waste	0	0	28.11	1.2	1.11	1.7	89.56	0.76
Put on street	0	0	0	0	0	0	7.2	1.07
store at home	21.04	13.24	13.14	2.2	1.9	2.4	0.89	27.9
sell to individual	34.79	44.11	12.12	39.17	37.23	18.72	0	32.09
donate	9.05	9.49	9.26	7.38	9.68	7.23	0	8.48

Figure 8. Commonly used disposal methods by the target people

**PC: Personal Computer**  
**MB : Mobile**  
**TV: Television**



Graphical Representation of figure 8.

### **8.1 Findings of consumer awareness towards e waste**

- The study reveals that 82.21 % target qualified people are aware of the e waste, and 17.79 % people are unaware of e waste.
- The results of survey shows that near about 70% respondent are unaware of hazardous effects of e waste. It was found that near about 30% respondent are aware of hazardous effects of e waste.
- The study shows that average 50.21% respondent are aware of hazardous effects of e waste.
- The result also shows that average 21.58% respondent is partially aware of hazardous effects of e waste.
- The study reveals that average 26.66% respondent is not aware of hazardous effects of e waste.
- The study also shows that less qualified and lower age group is unaware or partially aware of the hazardous effects of e waste.
- The level of awareness is low which suggest that there is an urgent need to educate the people about WEEE.
- The study reveals that 45.18% percent of the qualified respondents are aware of e waste recycling initiatives and safe disposal policies 54.87 per cent are un aware of the recycling and safe disposal methods policies.
- The result shows that the solid waste collectors from Municipal Corporation also collect e waste from near about 99% respondents.
- The result also shows that 48.41 % respondent shows convenience in waste collection system, 51.59% respondent shows inconvenience in waste collection system.
- The study reveals that the willingness to free donate the e waste for formal recycling ranges from less than 55.52% percent 44.48% people are not ready to donate e waste.

### **8.2 Findings of commonly used e waste handling practices by consumers**

- Study reveals that most commonly used method for disposal of personal computers is sell to second hand dealer or exchange, sell to individual, and store at home , very few people donate the personal computers, no one uses to put the pc on street.
- Results shows that most commonly used method for disposal of mobiles is sell to second hand dealer or exchange, sell to individual, and store at home , near about 9 to 10% people donate the mobiles, no one uses to put the mobile on street.
- Study shows that the most commonly used method for disposal of television is give or sell to a scrap dealer , dispose with household waste, sell to second hand dealer or exchange, sell to individual and store at home, no one uses to put the television on street.
- Study reveals that most commonly used method for disposal of refrigerator is sell to second hand dealer or exchange, sell to individual, and store at home, 7-8% people donate the refrigerator, no one uses to put the refrigerator on street.
- Results shows that most commonly used method for disposal of washing machine is sell to second hand dealer or exchange, sell to individual, and store at home , near about 9 to 10 % people donate the, no one uses to put the washing machine on street.
- Study reveals that most commonly used method for disposal of mixer grinder is sell to second hand dealer or exchange, sell to individual, and give to scrap dealer, 7-8% people donate mixer grinder, no one uses to put the mixer grinder on street.

- Results shows that most commonly used method for disposal of tube lights and bulb is to dispose with household wastes the percentage is about 89-90%, 2-3% people used to give to scrap dealer and 7-8% people use to put on street .
- Study reveals that most commonly used method for disposal of fans and coolers is give to scrap dealer , sell to second hand dealer or exchange, sell to individual, and store at home , very few people donate fans and coolers, no one uses to put the fans/coolers on street.

### 8.3 Suggestions:

1. There is a need to develop effective national e waste management policy.
2. There is a need to initiate proper legislations.
3. Awareness needs to be created through the use of social media.
4. There is a need to gradually eliminate harmful substances used in manufacturing of EEE products.

## IX. CONCLUSIONS

The result of the shows that computer waste generated in the coming years would be even greater in view of shortening lifespan and increasing demand by people. This growth has significant economic, environmental and social impacts. Presently there is no legislative binding framework and for e-waste management no e-waste collection mechanism at place. There is an urgent need to decide a strategy for E-waste problem in developing country like India. People engaged in this profession are not aware about the hazardous l effects of e-waste causing them chronic and acute diseases. There is needed to make aware people also about the environmental aspects of E-waste. Awareness campaign about e- waste should be arranged in schools and college highlighting the measures that an individual can take to reduce the E-waste. Criteria are to be developed for recovery and disposal of e-wastes. An effective take-back program providing incentives for producer's to design products that are less wasteful, contain fewer toxic components, and are easier to disassemble, reuse. End-of life management should be made a priority in the design of new electronic products.

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