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Primary inventorization of electronic waste in Rewa Madhya Pradesh

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Abstract

The electrical and electronic waste (e-waste) is one of the fastest growing wastes in India. The Increasing “market penetration” in developing countries, and “high obsolescence rate” make e-waste as one of the fastest growing waste streams. The e-waste has become a matter of concern because of the presence of toxic and hazardous substances present in electronic goods and if not properly managed, it can have adverse effects on environment. Environmental issues and trade associated with e-waste has driven many countries to introduce interventions. Hence, there is strong need to adopt sustainability practices to tackle the growing threat of e-waste. This paper is based on secondary data which study the e-waste composition, Global and Indian e-waste scenarios and different hazardous materials found in the e-waste, Best Available Practices to find the hazardous materials, guideline for the manufacturer and public awareness about the proper disposal of e-waste. Rapid changes in technology, changes in media (tapes, software, MP3), falling prices, and planned obsolescence have resulted in a fast-growing surplus of electronic waste around the globe. This paper presents an overview of the problem and suggests some concrete solutions to tackle the issue.

Keywords: E-waste, Inventorization, Environmental issues, Hazardous substances

Introduction

E-Waste: Electronic waste may be defined as discarded computers, office electronic equipment, entertainment device electronics, mobile phones, television sets and refrigerators. This definition includes used electronics which are destined for reuse, resale, salvage, recycling, or disposal. Because loads of surplus electronics are frequently commingled (good, recyclable, and non-recyclable), several public policy advocates apply the term “e-waste” broadly to all surplus electronics.

The largest and fastest growing manufacturing industry is the “electronic industry” due to tremendous growth in the field of information technology all over the world. All electronic and electrical items such as computers, televisions, mobile phones etc. on completion of their useful life, are being discarded rapidly and contribute to the huge quantum of e waste (Robinson, 2009) ^[11]. The management of the waste of electrical and electronic equipments (WEEE) is a global environmental problem that has created significant environmental damage in the world in view of the high value of the recoverable content in WEEE and the high volume of used equipment that are being discarded. The recycling and recovery of materials from WEEE has become a business opportunity of increasing significance. The WEEE is frequently moved from the developed countries to the developing countries for processing. In the case of countries such as China, India and Nigeria, there is simple evidence that WEEE has been imported into these countries and processed in an unregulated manner for recycling and recovery purposes.

As the fastest growing components of municipal waste across the world, it is estimated that more than 50 million ton of e-waste is generated globally every year. China already produces about 2.3 million tons of e-waste domestically, second only to the U.S. with about three million tons.

In India, E-waste is one of the fastest growing waste streams. It contains more than a 1000 different substances, which fall under hazardous and non-hazardous categories.

Iron and steel constitutes about 550% of the e-waste followed by plastics (21%), nonferrous metals (13%) and other constituents 16%.

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In India there are 10 states that contribute to 70% of the total e-waste generated, while 65 cities generate more than 60% of the total e-waste. The disposal of e-waste is a particular problem faced in many regions across the globe. Environment and human health is affected by e-waste. E-waste can be very harmful to animals and humans. It is of concern mainly due to the toxicity and carcinogenicity of some of the substances if processed improperly. The present study was mainly focused on the inventorization of e-waste and also determines present status of e-waste based on source of generation for future action plan.

E-waste policy and regulation

The Policy shall address all issues ranging from production and trade to final disposal, including technology transfers for the recycling of electronic waste. Clear regulatory instruments, adequate to control both legal and illegal exports and imports of e-wastes and ensuring their environmentally sound management should be in place. There is also a need to address the loop holes in the prevailing legal frame work to ensure that e – wastes from developed countries are not reaching the country for disposal. The Port and the Custom authorities need to monitor these aspects. The regulations should prohibit the disposal of e-wastes in municipal landfills and encourage owners and generators of e-wastes to properly recycle the wastes. Manufactures of products must be made financially, physically and legally responsible for their products. Policies and regulations that cover Design for Environment (DfE) and better management of restricted substances may be implemented through measures such as:

- Specific product take-back obligations for industry
- Financial responsibility for actions and schemes
- Greater attention to the role of new product design
- Material and/or substance bans including stringent restrictions on certain substances
- Greater scrutiny of cross-border movements of Electrical and Electronic Products and e-waste
- Increasing public awareness by labeling products as 'environmental hazard'

The key questions about the effectiveness of legislation would include:

- What is to be covered by the term electronic waste?
- Who pays for disposal?
- Is producer responsibility the answer?
- What would be the benefits of voluntary commitments?
- How can sufficient recovery of material be achieved to guarantee recycling firms a reliable and adequate flow of secondary material?

A complete national level inventory, covering all the cities and all the sectors must be initiated. A public-private participatory forum (E Waste Agency) of decision making and problem resolution in E-waste management must be developed. This could be a Working Group comprising Regulatory Agencies, NGOs, Industry Associations, experts etc. to keep pace with the temporal and spatial changes in structure and content of e-waste. This working group can be the feedback providing mechanism to the government that will periodically review the existing rules, plans and strategies for E-waste management. Mandatory labeling of all computer monitors, television sets and other household/industrial electronic devices may be implemented for declaration of hazardous material contents with a view to identifying environmental hazards and ensuring proper material management and e-waste disposal. The efforts to improve the situation through regulations, though an

important step; are usually only modestly effective because of the lack of enforcement. While there has been some progress made in this direction with the support of agencies such as GTZ, enforcement of regulations is often weak due to lack of resources and underdeveloped legal systems. Penalties for noncompliance and targets for collection or recycling are often used to ensure compliance.

Extended producer responsibility (EPR): It is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of the product's life cycle, including its final disposal. In principle, all the actors along the product chain share responsibility for the lifecycle environmental impacts of the whole product system. The greater the ability of the actor to influence the environmental impacts of the product system, the greater the share of responsibility for addressing those impacts should be. These actors are the consumers, the suppliers, and the product manufacturers. Consumers can affect the environmental impacts of products in a number of ways: via purchase choices (choosing environmentally friendly products), via maintenance and the environmentally conscious operation of products, and via careful disposal (e.g., separated disposal of appliances for recycling). Suppliers may have a significant influence by providing manufacturers with environmentally friendly materials and components. Manufacturers can reduce the life-cycle environmental impacts of their products through their influence on product design, material choices, manufacturing processes, product delivery, and product system support (Sergio and Tohr, 2005) [13]. The system design needs to be such that there are checks and balances, especially to prevent free riders. The goals of the product designer could include reducing toxicity, reducing energy use, streamlining product weight and materials, identifying opportunities for easier reuse, and more. Manufacturers have to improve the design by: (i) the substitution of hazardous substances such as lead, mercury, cadmium, hexavalent chromium and certain brominated flame retardants; (ii) measures to facilitate identification and re-use of components and materials, particularly plastics; and (iii) measures to promote the use of recycled plastics in new products. Manufacturers should give incentives to their customers for product return through a "buy back approach" whereby old electronic goods are collected and a discount could be given on new products purchased by the consumer. All vendors of electronic devices shall provide take-back and management services for their products at the end of life of those products. The old electronic product should then be sent back to be carefully dismantled for its parts to be either recycled or re-used, either in a separate recycling division at the manufacturing unit or in a common facility. Collection systems are to be established so that e-waste is collected from the right places ensuring that this directly comes to the recycling unit. Collection can be accomplished through collection centers. Each electronic equipment manufacturer shall work cooperatively with collection centers to ensure implementation of a practical and feasible financing system. Collection Centers may only ship wastes to dismantlers and recyclers that are having authorization for handling, processing, refurbishment, and recycling meeting environmentally sound management guidelines. Sustainability of e-waste management systems has to be ensured by improving the effectiveness of collection and recycling systems (e.g., public-private-partnerships in setting up buy-back or drop-off centers) and by designing-in additional funding e.g., advance recycling fees.

Materials and Methods

Site Selection

The study of E-waste Inventorization was conducted in Rewa city, M.P. The household and business entities, institutions are the consumers of electrical and electronic equipments and also the e-waste generators. Hence they were targeted in this study (Fig-1). The selection of the survey location was based on the population density and also the socioeconomic status of the areas.

Field Studies and Data Collection

Field studies were collected through questionnaire based survey and give better result than mail survey. Information on knowledge level, attitude and practice on use and electrical electronic equipments disposal was collected using questionnaires, provided by Pollution Control Board Rewa. The study was covered following categories of electronic waste such as television, personal computers, mobile phones, refrigerators, air conditioners, washing machines for

estimations and quantifications of e-waste produced. There were two main target respondents included in the survey. These were Household, business entities & institutions. The distribution of the e-waste survey questionnaires were started on the 1st March and ended on the 31st April 2015. A total of 200 sets of questionnaires were collected through site visit interviews.

Data compilation and analysis

A database was designed by using the Microsoft Office-Excel software for data analysis. The obtained data from returned questionnaires was compiled according to study location and group of target respondents. A serial number is used to control data from being entered twice into the database. Coded values were used for non-numerical data provided by the respondents. For data analysis the SPSS (Statistical Package for the Social Sciences) software to analyze the various categories of respondents, EEE types and equations for summarizing and calculating the data.

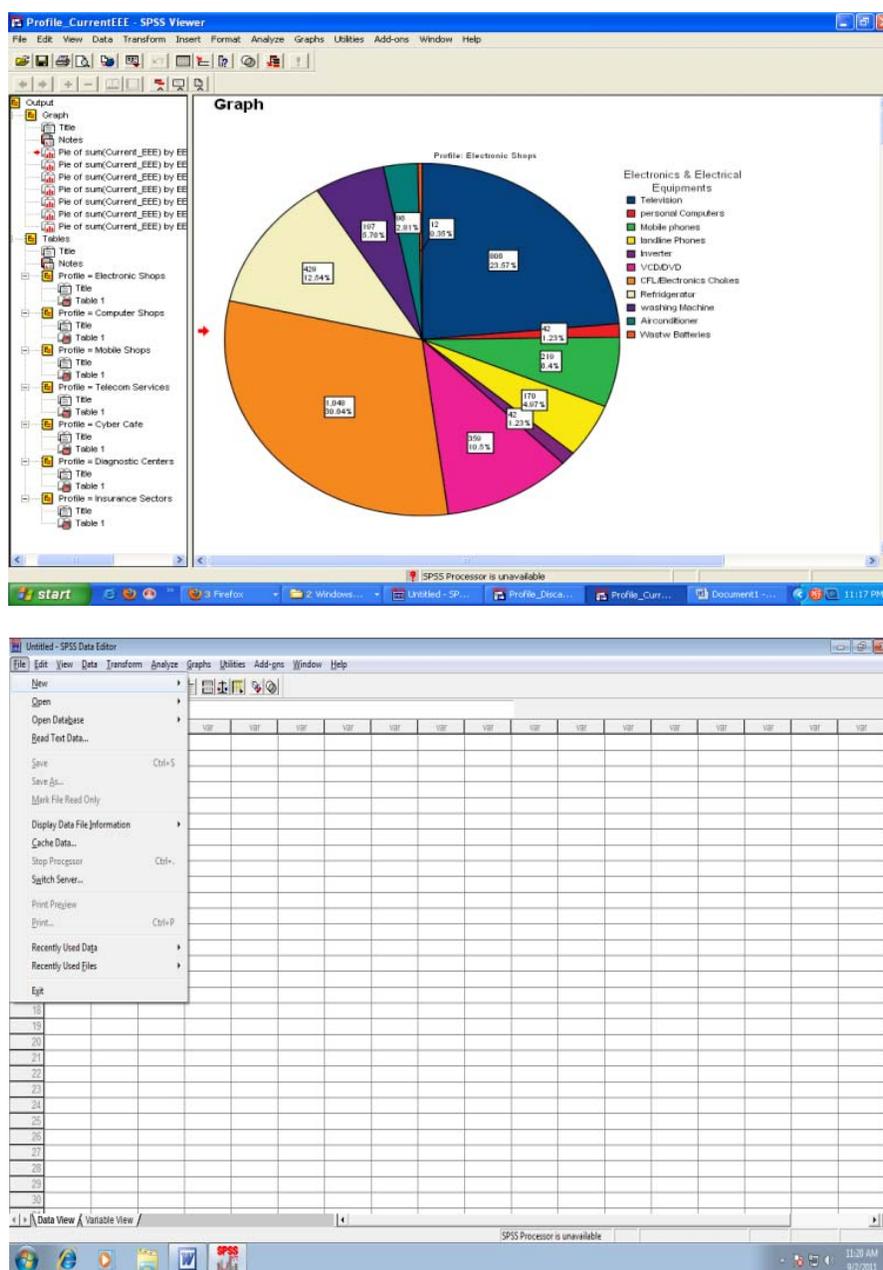


Fig 1: Image of SPSS Software

Result and Discussion

The Generation of E-Waste from Rewa city was analyzed by collected the information on generation of e-waste by direct interview from following two sectors. These are:

Generation of electronic waste from households

To collect the information on generation of e-waste from households by television, computers, mobile phones,

refrigerators, air conditioners, washing machines, waste batteries etc. For the household category, 100 responses are required in this survey. The target for this category was met with a total of 100 (100%) answered and completed questionnaires returned out of 100 questionnaires distributed. The questionnaires were received by the interviewer during the personal interviews.

Table 1: Use & discard pattern for television sets in households Category

S. no.	Income Wise Category	Used T.V.	Percentage of Used T.V.	Discarded T.V.	Percentage of Discarded T.V.
1	High Income	01	0.59	0	0
2	Upper Middle Income	10	5.91	3	16.66
3	Middle Income	68	40.23	11	61.11
4	Low Income	90	53.25	4	22.22
	Total	169		18	

Table 2: Use & discard pattern for computers in households Category

S. no.	Income Wise Category	Used Computer	Percentage of Used Computer	Discarded Computer	Percentage of Discarded Computer
1	High Income	01	2.63	0	0
2	Upper Middle Income	08	21.05	0	0
3	Middle Income	25	65.78	02	100
4	Low Income	04	10.52	0	0
	Total	138		02	

Table 3: Use & Discarded pattern for mobile phones in household Category

S. no.	Income Wise Category	Number of Used Mobile Phone	Percentage of Used Mobile Phone	Discarded Mobile Phone	Percentage of Discarded Mobile Phone
1	High Income	02	1.32	01	1.23
2	Upper Middle Income	24	15.89	15	18.51
3	Middle Income	75	49.66	50	61.72
4	Low Income	50	33.11	15	18.51
	Total	151		81	

Table 4: Use & discard pattern for Refrigerator in household Category

S. no.	Income Wise Household	Number of Used Refrigerator	Percentage of Used Refrigerator	Discarded Refrigerator	Percentage of Discarded Refrigerator
1	High Income	01	1.07	00	0
2	Upper Middle Income	12	12.90	01	16.66
3	Middle Income	60	64.51	04	66.66
4	Low Income	20	21.50	01	16.66
	Total	93		06	

Table 5: Use & discard pattern for Washing Machine in household Category

S. no.	Income Wise Household	Number of Used Washing Machine	Percentage of Used Washing Machine	Discarded Washing Machine	Percentage of Discarded Washing Machine
1	High Income	01	1.69	00	0
2	Upper Middle Income	08	13.55	00	0
3	Middle Income	50	54.74	01	100
4	Low Income	00	0	00	0
	Total	59		01	

Table 6: Use & discard pattern for Air Conditioner in household Category

S. no.	Income Wise Household	Number of Used Air Conditioner	Percentage of Used Air Conditioner	Discarded Air Conditioner	Percentage of Discarded Air Conditioner
1	High Income	01	4.76	00	0
2	Upper Middle Income	05	23.80	01	50
3	Middle Income	15	71.42	01	50
4	Low Income	00	0	00	0
	Total	21		02	

Table 7: Use & discard pattern for Waste Batteries in household Category

S. no.	Income Wise Household	Number of Used Waste Batteries	Percentage of Used Waste Batteries	Discarded Waste Batteries	Percentage of Discarded Waste Batteries
1	High Income	00	0	00	0
2	Upper Middle Income	01	4.54	01	5.88
3	Middle Income	20	90.90	15	88.23
4	Low Income	00	4.54	01	5.88
	Total	22		17	

Table 8: Way of Disposal Method in House-hold Category

S. no.	Way of Dispose	Quantity	Percentage
1	Discard with Municipal waste	75	75
2	Give/Sell to collector	05	5
3	Bye back to dealer/manufacturer	0	0
4	Give/Sell to friend	10	10
5	Bring to Recycling centre	0	0
6	Other (e.g. Keep at home)	10	10

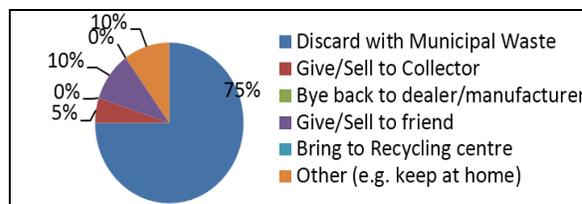


Fig 2: Way of Disposal in House-hold Category

Table 9: Total Generation of WEEE in House-hold Category

S. no.	Types of EEE	Discarded Quantity during 5 years	E-waste Generation in Kg	E-waste Generation in Percentage
1	Television	18	540	59.25
2	Personal Computer	02	56	6.14
3	Mobile phone	81	8.1	0.88
4	Refrigerator	06	180	19.75
5	Washing Machine	01	27	2.96
6	Air Conditioner	02	100	10.97
7	Waste Batteries	17	0.289	0.031
	Total	127 Units	911.389	

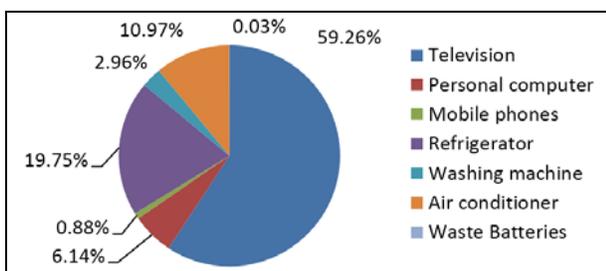


Fig 3: Total Generation of WEEE In House-hold Category

Generation of electronic waste from Business entities and institutions

Use & discarded pattern were analyzed for business entities and institutions. In this category, Bank, Insurance Company, School, & internet cafes etc. are included.

Similar to house-hold the total number of business entities & institution conducted during survey is 100 & break-up is as follows: 30 Computer Collages, 10 Insurance Company, 35 Internet cafes, 5 School, 10 Bank & 10 Govt. & Pvt. Offices.

Table 10: Use & discard pattern for all EEE – Business entities & Institution

S. no.	Types of EEE	Used EEE by Business entities	Percentage of Used EEE by Business entities & Institution	Discarded EEE by Business entities & Institution	Percentage of Discarded EEE by Business entities
1	Television	18	0.81	0	0
2	Personal Computer	1652	74.85	320	73.90
3	Mobile phone	120	5.43	12	2.77
4	Refrigerator	28	1.26	01	0.23
5	Washing Machine	0	0	0	0
6	Air onditioner	374	16.94	90	20.78
7	Waste atteries	15	0.67	10	2.30
	Total	2207		433	

In this category the most EEE used by business entities & institution is Personal Computer 73.90% and least EEE used by business entities & institution is Washing Machine 0%.

Table 11: Total Generation of WEEE in Business & Institution Category

S. no.	Types of EEE	Discarded Unit	WEEE Generation in Weight(Kg)	Percentage
1	Television	00	00	0
2	Personal Computer	320	8960	66.40
3	Mobile phone	12	1.2	0.008
4	Refrigerator	01	30	0.22
5	Washing Machine	00	00	0
6	Air Conditioner	90	4500	33.35
7	Waste Batteries	10	1.7	0.012
	Total	433	13492.9	

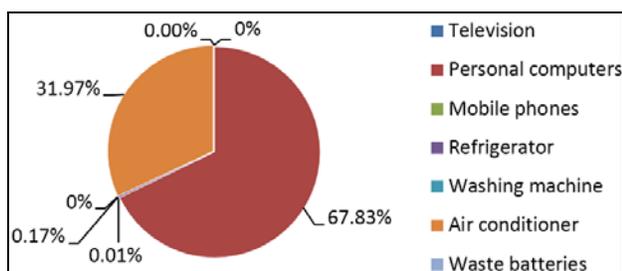


Fig 4: Total generation of WEEE in Business entities & Institution

Assessment of e-waste generation in Rewa

Based on the information that has been obtained during survey conducted in Rewa, about 14.40 MT of WEEE, from all 2 categories surveyed & the break-up is as follows: 0.911MT from 100 house-holds, 13.49 MT. from 100 business entities & institutions.

According to the survey, Rewa city has generated 72.0 Metric tons of E-waste in Year 2015 (during last 5 years) and annual E-waste generation from Rewa from all sectors is 28.8 MT.

Table 12: Total Generation of E-Waste in Rewa city in 2015 (During last five years)

S. no.	Category	E-waste generation in MT
1	House-hold category	4.55
2	Business entities & Institutions	67.45
	Total	72.00 MT

Conclusion

The rapid growth and faster change in modules of electrical and electronic equipment are major issue that enhances the amount of e-waste generation. The hazardous nature of e-waste is one of the rapidly growing environment problems of the world. Mass population of Rewa city spends their money in purchasing of different type electrical and electronic items for maintain their status symbol. The primary data which collect from interviews with various economic classes of households, and various categories of business entities and institution suggests that the generation of e-waste in Rewa city is going to increased day by day. Most of the e-waste generated from business entities & institutions usually exchange the e-waste generating items from the authorised companies which take the items as such under buy-back scheme. It was also found that most of the irreparable electronic & electrical waste has been kept in store by the institutions etc. & they are not serious to sort it out.

During the survey of households in Rewa city for e-waste generation, it was observed that most of the people dispose off the TV/AC/Mobile/Computer/Washing Machine / refrigerator by giving them to other persons or to Kabadis or some even keep these dead items in their own houses. Occasionally, they also throw it along with the domestic waste to the Municipal Solid waste dumping site. Thus it was observed that the overall e-waste generated in Rewa city was either given back to the registered manufacturing companies of TV/Computers/Mobile/Washing machine/refrigerators/AC etc. Under Buy-back scheme or it is collected by the authorized/non authorized collectors coming from Delhi. The third way of e-waste disposal found in Rewa is through dumping of the e-waste in MSW dumping site or in garbage dumps. From these sites, however, it is assumed that Kabadis sort it out & sale them to various agencies.

It is observed that most of the population here is not aware of e-waste & its hazardous impact on human health &

environment. The common thinking is that the e-waste can be disposed off by simply throwing it away by the formula of 'out of sight & out of mind' i.e. the e-waste should not be seen in our premises & we are not bothered about its disposal in proper way & its impact on the local public. The record of e waste generation must be maintained by Municipal Corporation of the city & awareness raising programmes and activities on issues related to the environmentally sound management (ESM), health and safety aspects of e-wastes in order to encourage better management practices should be implemented for different target groups & on mass basis.

The guidelines for e-waste management issued by MoEF (12th May, 2011) must be used from time to time to find the solutions of the e-waste problem. The Collection centres if set up in the state, shall ensure that the e-waste collected by them is stored in a secured manner till it is sent to registered dismantler or recycler as per new rules issued by the Ministry of Environment & Forest, and Climate Change, Notification, New Delhi, the 23rd March, 2016.

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