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Evaluation of the environmental and human health implications of household e-waste disposal

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Abstract

The e-waste means electrical and electronic equipment, whole or in part discarded as waste by consumer or bulk consumer as well as rejects from manufacturing, refurbishment and repair process (MoEF). Non-functional earphones, headphones, old discarded TV, unused radio, lot of non-operated cable, damaged and broken mobile chargers, useless parts of electronics etc. are completely stored and occupied in every common man's house. With or without sufficient knowledge, opportunities and facilities making this type of scenario even worse. The deposition of e-waste increasing rapidly day by day and so as the household or domestic e-waste nowhere in calculation. The improper disposal of e waste leads to deadly situations to both human health and environment. So, there is need for awareness programmes and facilities to dispose electrical and electronic equipment in a proper manner. If the proper disposal of Electrical and Electronic Equipment (EEE) happened at a grass root level i.e., household level, half of the problems of e waste is solved. From the study it was found that all the respondents disposed e-waste with the municipal waste that is solid waste. The knowledge of respondents was appreciable but the awareness yet to be accomplished towards e-waste. The respondents were aware about the effects of risk of hazardous materials on human health and environment that are present in e-waste.

Keywords: Disposal, Domestic, E- waste, EEE

INTRODUCTION

E-WASTE: E-waste contains poisonous substances similar as mercury, lead or brominated honey- retardants to name but a many. Upon dragged exposure during unsafe e-waste recycling conditioning, these substances lead to damage of nearly all major body systems similar as nervous systems, blood systems, brain development, skin diseases, lung cancer, heart, liver, and spleen damage. This is particularly applicable in the informal sector, as a considerable number of informal e-waste workers don't take any health preventative safeguard measures. As per the Associated Chambers of Commerce and Industry of India (ASSOCHAM) report, about 80 of e-waste workers in India suffer from respiratory affections like breathing difficulties, vexation, coughing and choking due to indecorous safeguards. With bare hands and no defensive facemasks, workers & children are generally among

the most exposed to poisonous smothers on a diurnal- base. Tube lights, motherboards and cartridges are burnt on open dears, spewing lead, mercury and cadmium into the air.

Over 1,60,000 Metric Tons of external solid waste is generated daily in the country. Per capita waste generation in metropolises varies from0.2 kg to 0.6 kg per day depending upon the size of the population. This is estimated to increase at1.33 per cent annually. The total waste volume generated by 2047 is estimated to be about 260 million tons per time. It's estimated that if the waste isn't disposed off in a more methodical & scientific manner, further than,400 square km of land, which is original to the size of megacity of Delhi, would be needed in the country by the time 2047 for its disposal. The Indian artificial sector generates an estimated 100 million tons/ time of non-hazardous solid wastes, with coal ash from thermal power stations alone accounts for further than 70 million tons/ time. Over 8 million tons/time of dangerous waste is generated in India and about 60 of these wastes, i.e.,4.8 million tons/time is estimated to be recyclable and the remaining3.2 million tons/time is non-recyclable. In India, roughly1.5 of the total e-waste generated is reclaimed by formal recyclers or institutional processing and recycling, and another 8 of the e-waste generated is rendered useless and goes to landfills.

Objectives:

- To study socio-economic status of respondents of Udham Singh Nagar district of Uttarakhand state.
- To determine type, purchase pattern, use-reuse pattern of Electrical and Electronic Equipment (EEE) and disposal methods of e waste.
- To assess the knowledge, awareness and effect of risk of hazardous materials on human health and environment.

Hypothesis

H_{01}: There exists no significant relationship between age and knowledge towards e-waste.

H_{02}: There exists no significant relationship between education and knowledge towards e waste.

H_{03}: There exists no significant relationship between education and awareness towards e waste.

H_{04}: There exists no significant relationship between age and awareness towards e waste.

Materials and methods:

Types of research: descriptive research

Variables:

Independent variables
- Age
- Education
- Occupation
- Income
- Family member
- Type of family

Dependent variables
- Knowledge towards e-waste
- Awareness towards e-waste
- Potential hazards on health and environment

Intervening variables
- Type of purchase of EEE
- Use and reuse pattern
- e-waste disposal

Scales used:

- **Knowledge test** was standardized for assessing the knowledge of the respondents regarding the e waste. The respondent's knowledge was tested in terms of high and low level of knowledge with regards to different aspects of e waste.
- **Awareness scale** was developed to collect the information regarding level of awareness among respondents towards e waste.

Locale of the study: the present study was carried out for respondent's behaviour towards e waste. Considering the objective of the study research was carried out at Bazpur block of Udham Singh Nagar district of Uttarakhand state.

Sampling design: Purposive sampling procedure was adopted to select the study area and simple random sampling was adopted to select the sample in the study.

Sample size: For descriptive data, total sample size of 120 respondents selected with irrespective of gender.

Method of data collection:

Data was collected from 120 respondents personally by using interview schedule and questionnaire method. Assessment of demographic characteristics of the respondents was done by interview schedule regarding age, education, occupation, income, type of family, etc. five-point Likert scale were developed to know the awareness level of respondents towards e waste.

Analysis of the data

The collected data was tabulated and analysed with the help of descriptive (frequency, percentage and mean) and rational statistics. For the analysis of the data various parameters were categorized as follows:

Table 1

	Category	Score
1.	Age (year):	
	a) <20	1
	b) 21-30	2
	c) 31-45	3
	d) 46>	4
2.	Education of respondents	
	a) Post graduate	1
	b) Graduation	2
	c) Intermediate	3
	d) High school	4
	e) Primary school	5
	f) Illiterate	6

3.	Occupation of respondent	
	a) Professional	1
	b) Home maker	2
	c) Self employed	3
	d) Students	4
	e) Others	5
4.	Occupation of the head	
	a) Legislators, senior officials & managers	10
	b) Professionals	9
	c) Technicians and associate professionals	8
	d) Clerks	7
	e) Skilled workers and shop & market sales workers	6
	f) Skilled agriculture & fishery workers	5
	g) Craft & related trade workers	4
	h) Plant & machine operators and assemblers	3
	i) Elementary occupation	2
	j) Unemployed	1
5.	Monthly family income (Rs)	
	a) >1,99,862	12
	b) 99,931-99,861	10
	c) 74,755-99,930	6
	d) 49,962-74,754	4
	e) 29,973-49,961	3
	f) 10,002-29,972	2
	g) <10,001	1
6.	No. of members in family	
	a) 2-6	1
	b) 7-10	2
	c) 11>	3
7.	Types of family	
	a) Nuclear	1
	b) Joint	2
	c) Extended	3

Statistical analysis of the data

In the present study frequency, percentage, Chi square test and Fisher's exact test were used for the analysis of the data.

Results and Discussion

Table 2: Demographic profile of the respondents (N=120)

S. No.	Category	Frequency	Percentage
1.	Age (year):		
	a) <20	18	14.8
	b) 21-30	63	51.6
	c) 31-45	21	17.2
	d) 46>	18	14.8
2.	Education of respondents		
	a) Post graduate	25	20.83
	b) Graduation	70	58.33
	c) Intermediate	15	12.50
	d) High school	5	4.17
	e) Primary school	5	4.17
	f) Illiterate	0	0
3.	Occupation of respondent		
	a) Professional	35	29.17
	b) Home maker	40	33.33
	c) Self employed	10	8.33
	d) Students	29	24.17
	e) Others	6	5.00
4.	Occupation of the head		
	a) Legislators, senior officials & managers	11	9.2
	b) Professionals	26	21.7
	c) Technicians and associate professionals	13	10.8
	d) Clerks	16	13.3
	e) Skilled workers and shop & market sales workers	8	6.7
	f) Skilled agriculture & fishery workers	13	10.8
	g) Craft & related trade workers	18	15
	h) Plant & machine operators and assemblers	9	7.5
	i) Elementary occupation	6	5
	j) Unemployed	--	--

5.	Monthly family income (Rs)		
	a) >1,99,862	13	10.8
	b) 99,931-99,861	10	8.3
	c) 74,755-99,930	17	14.2
	d) 49,962-74,754	31	25.8
	e) 29,973-49,961	34	28.3
	f) 10,002-29,972	10	8.3
	g) <10,001	5	4.2

6.	No. of members in family		
	a) 2-6	109	90.8
	b) 7-10	11	9.2
	c) 11>	--	--
7.	Types of family		
	a) Nuclear	109	90.8
	b) Joint	11	9.2
	c) Extended	--	--

Table 2 defined the complete demographic and socio- economic profile of the respondents with frequency and percentage.

From the collected data it was found that about 96.7% of respondents dispose microwave by selling to second hand dealer whereas 1.7% used to donate and sold to scrap dealer. In case of electronic cooker or kettle 52.5% used to sell to second hand dealer were followed by 1.7% of respondents gave it to e waste centres and 44.2% sold it to scrap dealer and 1.7% kept at their house. For heater & geezer 52.5% used to sell to second hand dealer whereas 1.7 % donated and 44.2% sold to scrap dealer and 1.7% use to kept at their house.

It was found that the most of the respondents given their office equipment (computers, laptops, mobiles, landline etc.) to the scrap dealer and some of the respondents sold their office electrical equipment to the second-hand dealers and few of them donate their equipment. It was found that 55% respondents were heard about the term e waste and 45% have not heard about the term e waste. The collected data clearly envisaged that majority of 79.2% respondents clearly knew that e waste in an electronic waste while 20.8% respondents did not have knew about it. Three fourth of the respondents were having knowledge about formation of e waste by electrical and electronic equipment and 25% were not aware. Majority of respondents were having knowledge about minimising the pollution which helps in recycling while only 37.5% respondents were not having knowledge towards it. The formal recycling includes scientific way for extraction of metals, for this 62.5% were having knowledge while 37.5% were not having knowledge regarding this.

It is evident from the data that 15% respondents were agreed that e waste enters human body through inhalation, ingestion and dermal contact (i.e., nose, mouth and skin) whereas majority of 85% of the respondents had no knowledge about it. 20% of the respondents were having knowledge that improper disposal of e waste causes negative impact on environment while 78% were those who had no knowledge.

Majority of the respondents reported that e waste is determined with irrespective of brands but only 20% of them didn't accept this statement. Besides this, nearly 82.5% had no knowledge that electrical and electronic devices have very short life span while 17.5% respondents were those who had knowledge about electronic devices.

Moreover, the data showed that majority of respondents i.e., 96.2% respondents knew that donating and exchange of EEE reduces e waste while only 3.8% respondents were not having knowledge about this. More than seventy per cent of respondents were having knowledge about refurbished products that are normally tested for functionality and defects before they are sold to public while only 29% respondents were not having knowledge towards it.

There were 57% of respondents who were having high knowledge and 43% were found to have low knowledge towards e waste. Out of 120 respondents 68 were having high knowledge and rest of 52 were having low knowledge towards e waste.

Regarding awareness of respondents towards e waste nearly 19.2% respondents were extremely aware that India ranks top 2 on deposition of e waste in Asian continent and 9.2% moderately aware. Nearly 33% were somewhat aware towards it and 12.5% respondents were slightly aware for the same. Approximately 26% respondents said that they were not at all aware towards it.

When asked about the star rated appliances 21.7% were extremely aware to the statement that star rated appliances saves energy and 22.5% were moderately aware for that, 39.2% respondents were somewhat aware, 11.7% were slightly aware for the same, and 5% were not at all aware.

The data pertaining to respondent's response towards effect of risk of hazardous materials on human health and environment revealed that majority of the respondents were found to be given good responses. There were 75% of respondents have good opinion and knowledge and 25% found to have low knowledge towards it. Out of 120 respondents 90 were having good knowledge and opinion followed by only 30 respondents having low knowledge and opinion over impact of hazardous materials associated with human health and environment.

Testing of hypothesis

Chi square values were computed for independent variable (age, education, occupation and family monthly income) with the respondent's knowledge towards e-waste and awareness towards e-waste. Results of chi square values are presented in table 3.

S. No.	Variables	Degree of freedom	Calculated chi square values	Table value	Fisher's test	Results
1.	Age/Knowledge towards e waste	3	21.70	7.815	27.388	Significant
2.	Education/Knowledge towards e waste	4	41.302	9.488	43.833	Significant
3.	Age/Awareness towards e waste	3	3.68	7.815	3.259	Non-significant
4.	Education/Awareness toward e waste	4	32.381	9.488	25.066	Significant

The chi square test results revealed that the null hypothesis is rejected for age and education over knowledge towards e-waste which implies that they are dependent on each other. Similarly, with respect to awareness on e-waste the factor like age was independent which implies that there was no significant difference between age over awareness on e-waste. Since they are independent and null hypothesis was accepted. For awareness of e-waste the education has significant relationship with each other. Hence, null hypothesis was rejected.

Conclusion

Based on findings of the research it was concluded that most of the respondents were in the age group of 21-30 years, majority were graduates and home makers by occupation. It was found that existence of nuclear family was more prefer to purchase electronic by both medium offline and online. It was evident from the results that respondents possessed almost all electrical and electronic equipment and purchase new products when products reached its end of life. Electronic were mostly repaired and reused but dispose them either by giving to second hand dealer or to scrap dealer. Knowledge of respondents towards electronic waste was good except in the areas of recycling and management of e-waste. While overall awareness towards e-waste was not bad as majority were slightly aware. Respondent's response towards effects of risk of hazardous materials on human health and environment was appreciable.

Future recommendations

1. The same type of research can be done in other cities and village of other states of India to know the awareness and knowledge level of respondent's and take further steps ahead.
2. Intervention study research on domestic e-waste could be more helpful.

3. Research on e-waste recycling and disposal should be promoted among higher educational institutes.

Implications of study

1. The study regarding e-waste helps in proper management and dispose of e-waste at household level.
2. The proper campaigns to aware e-waste management are appreciable as most of respondents are highly educated and are educated and are unaware of this.
3. Housemakers are much interested in upcycling, hence this domestic e-waste can be used as "Best out of waste".
4. Take back policies and EPR (Extended Producer Responsibility) should be encouraged more and provide knowledge to public.
5. The negative impact on environment due to improper disposal methods of e-waste should be made aware to respondents.
6. The channel for effective collection of e-waste needs to be set-up and need to be effectively popularized among masses.
7. Local government should promote entrepreneurship and provide subside for better management of e-waste.

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