

Transforming Hazard into Resource: A Critical Study of E-Waste Management in Srinagar, Jammu & Kashmir

Mohd Iqbal Khan^{1*}, Syed Irfan Shafi², Shakeel Ul Rehman³

1. Corresponding Author, Department of Management Studies, Islamic University of Science and Technology, Awantipora, Pulwama, Kashmir. Email: ikhan7073@gmail.com
2. Department of Management Studies, Islamic University of Science and Technology, Awantipora, Pulwama-Kashmir. Email: drsyedirfanshafi@gmail.com
3. Department of Management Studies, Islamic University of Science and Technology, Awantipora, Pulwama-Kashmir. Email: srehman275@gmail.com

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Abstract:

The Rapid proliferation of electronic devices in India has led to an alarming rise in electronic waste (E-Waste) , posing severe environmental and public health challenges Informal recycling practices dominate the sector characterized by unregulated dismantling and primitive recovery techniques that release hazardous pollutants. Although formal recycling mechanism exist under the Central Pollution Control Board (CPCB) , their reach and efficiency remain limited . India currently ranks among the top five global generators of e-waste , with Jammu & Kashmir (J&K) emerging as a critical concern due to the absence of a structured disposal framework . This Study investigates e-waste management practices in Srinagar, with a focus on stakeholder perceptions , disposal behaviors, awareness of government regulations, and willingness to contribute financially towards sustainable management . A mixed -methods approach was applied , incorporating surveys and interviews across academic institutions, households, government bodies, and private enterprises. Findings reveal significant gaps in awareness, regulatory implementation, and accessibility of formal recycling facilities, resulting in the dominance of informal channels . However , more than half of respondents expressed readiness to pay extra for proper disposal , indicating potential for policy -driven interventions. This study concludes that effective e-waste management in J&K necessitates a comprehensive state level frame work incorporating public awareness , extended producer responsibility (EPR) , formalized collection systems , and integration of circular economy principles. Policy recommendations emphasizes public private partnerships , capacity building sensitization to transform e-waste from an environmental hazard into an opportunity for sustainable development and employment generation. India has set a goal of establishing a Circular Economy policy for recycling resources in the near future. To further efforts to build a circular society, we analyzed the current status of E-waste recycling and related social issues, including the case of Srinagar town. Some policy suggestions on establishing recycling systems are recommended.

Keywords E-Waste Management, Informal Recycling Practices, Circular Economy, Stakeholder Perceptions, Extended Producer Responsibility (EPR)

Introduction

Environmental pollution from E-waste and/or waste electrical and electronics equipment (WEEE) is an important issue in this age of electronics. Domestic generation of E-waste, such as televisions, refrigerators, air conditioners, personal computers, mobile telephones, and washing machines, is increasing in most Asian countries (A. Terazono. 2006).

India Directives on the Restriction of Hazardous Substances and on Waste Electrical and Electronics Equipment were covered under the Environment and Forests Hazardous Wastes (Management and Handling) Rules 2008. An exclusive notification on E-waste (Management and Handling) Rules, 2010 under the Environment (Protection) Act, 1986 has been notified (S.O. 1035) on 12th May 2011 to address the safe and environment friendly handing, transporting, storing, recycling of e-waste and also to reduce the use of hazardous substances during manufacturing of electrical and electronic equipments. (S Chaterjee (2011). But various issues geared toward developing a sustainable recycling system still need to be addressed

Each country needs a system of recycling that takes into account not only its resources but also economic and social considerations, such as the need to build a materials recovery infrastructure and address the polarization between rich and poor. Intergovernmental cooperation and/or international integrated organization for checking specific waste material balance data may also be needed. In this paper, we report on the status of E-waste recycling systems in India. We first outline the current status of E-waste recycling in India, including a case study of Srinagar (Kashmir) town. We then briefly examine other approaches to E-waste recycling. In the last section, we offer our conclusion, namely that Srinagar case showed that both negative environmental externalities and the inventory status of E-waste items and material flow analysis are important issues for CE policy makers in India.

Current status of E-waste in India

Electronic waste (e-waste), that is, waste arising from end-of-life electronic products such as computers and mobile phones, is one of the fastest growing waste streams in the world today. Annual global production of e-waste is estimated to surpass 50 million tons in 2020. (balde et al 2017)

India is ranked fifth in the world amongst top e-waste producing countries after the USA, China, Japan, and Germany and recycles less than 2 per cent of the total e-waste it produces annually formally. Since 2018, India generates more than two million tonnes of e-waste annually, and also imports huge amounts of e-waste from other countries around the world. Dumping in open dumpsites is a common sight which gives rise to issues such as groundwater contamination, poor health, and more. The Associated Chambers of Commerce and Industry of India (ASSOCHAM) and KPMG study, Electronic Waste Management in India identified that computer equipment account for almost 70 per cent of e-waste, followed by telecommunication equipment phones (12 per cent), electrical equipment (8 per cent), and medical equipment (7 per cent) with remaining from household e-waste. (Chakraborty & Manish ,2019)

2 India is among the top five e-waste producing countries in the world with estimated annual production of 2 million tons. Like some of the other developing countries, e-waste management in India is dominated by the informal sector with estimates of more than 90 per cent of the waste being processed in this sector. E-waste contains several precious metals, rare earth metals, ferrous and non-ferrous metals, plastic, wood and glass. Unscientific practices in the processing of e-waste are associated with several environmental and health externalities. (Toxic links 2014)

Some of the major electronic devices that are responsible for increasing e waste in india are televisions ,laptops, mobile phones, desktops. The forecast of e waste generated from these devices are shown in table below

Table: 1.1 Generation of e-waste every year (in metric tons)

DEVICES	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
DESKTOPS	59,558	66,429	67,102	49,648.5	41699	35947	32511	29211	27432	25767	23567
Laptops	12640	15248	20673	25280	32360	40367	50769	60299	67352	70987	76987
Mobile Phones	22919	23101	28827.5	33475	36172.5	38870	41925	44784.5	48934	54325	57896
Television	130200	145800	168000	184200	202770	221550	241500	265300	286500	307650	335640
Total E waste Generated Ever Year	225317	250578	284602.5	292613.5	313001.5	336734	366705	399594.5	430218	458729	494090

Source: Ahmed et al. (2014), Rukmina rao (2021)

Scenario of e-waste in India Some of the major electronic devices that are responsible for increasing e-waste in India are television, laptops, mobile phones and desktops. The forecast of the e-waste generated from these devices are shown in table 1.2 below

Table 1.2 : Major E-Waste Producing States in India

S.no	City	Generated E-Waste (in metric tons per year)
1	Mumbai	120,000
2	Delhi	98,000
3	Banglore	92,000
4	Chennai	67,000
5	kolkata	55,000
6	Ahmedabad	36,000
7	Hyderabad	32,000
8	Pune	26,000

Source: Ghosal (2016), Veena joon et al (2017), Rukmini Rao (2021)

In India, 60% of the total generated e-waste is kept in warehouses and the remaining 40% is sent for recycling or recovering processes. A large amount of energy can be saved if the generated electronic waste is recycled properly. The recyclers collect the e-waste at a very low cost from the persons involved in gathering waste from the communities, and recycle metals such as copper, iron, aluminium and steel through primitive techniques. A large amount of pollutants are infused in the environment through these primitive techniques. The formal recyclers are registered by control pollution control board (CPCB) each year. Presently, 23 formal recyclers are registered who treat the generated e-waste in the country through formal techniques. These recyclers are given only a particular amount of e-waste to be treated (Vats and Singh, 2014). India ranks fifth in the world in generating e-waste (Dutta, 2017).

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The concept of the Circular Economy (CE), a new economic development paradigm, is an effective approach to solve resource and environmental problems. According to the “Administration Regulations on Recycling Resources” issued jointly by indian Ministry of Commerce, National Development and Reform Commission (NDRC), Ministry of Public Security, Ministry of Construction, State Administration for Industry and Commerce, and State Environmental Protection Administration (SEPA), recycling resources are waste products, first point, that have lost their original intended use wholly or in part through the processes of production and consumption; , second point, that could regain their use through recycling and processing. Recycling resources include scrap metals, waste paper, waste cotton, waste light chemical engineering raw material (such as rubber, plastics, agrochemical packing, and the miscellaneous bone and hair of animals), waste glass, and other products. Of course, E-waste is also a recycling resource. The E-waste inventory is defined as the aggregated information on the material flow of the E-waste from generation to reuse, recycling, and disposal, including transboundary movement (inflow into and outflow from the target country) as well as material

balance data from recycling facilities. Therefore, the inventory status of various E-waste items and material flow analysis are important for CE policymakers in india.

During 2007, Manufacturers' association for Information Technology (MAIT), India and GTZ, India had, carried out an inventory on e-waste, arising out of three products: computers, mobile phones, and televisions. The total quantities of generated e-waste in India, during 2007, were 3, 32, 979 Metric Tonnes (MT) (Computer: 56324MT, Mobile Phones: 1655MT, and Televisions: 275000MT) (Sources: Report on "E-waste Inventorisation in India", MAIT-GTZ Study, 2007). The finding of the study is given as under:

Table 1.3 :

Sr.no	items	Weights (MT)
1	Domestic Generation	332979
2	Imports	50000
3	Total	382979
4	WEEE available for recycling	144143
5	WEEE actual recycled	19000
6	Projected quantity of WEEE by 2011 (without including the imports)	467098

Source: chaterjee .s (2007)

From 2000 to 2005, the number of cathode-ray tube (CRT) color TVs, refrigerators, air conditioners, computers, and mobile phones in mainland india increased rapidly. Please note that statistical data on CRT-type black and white TVs are not published in urban area of india. The accumulated number of [smartphone users in India reached over 748 million in 2020](#), India had 1.2 billion mobile subscribers in 2021, of which about 750 million are smartphone users (PTI 2022). The accumulated number of printed-circuit boards (PCBs) grew to 107.4 billion; if 5% of this accumulated amount becomes waste, the annual amount of waste PCBs can be estimated to be about 5.4 billion. India generated 1,014,961.2 tonnes of e-waste in 2019-2020, ranking third after USA and China. (Singh, 2021). Some research projects concerning with PCBs was carried out, for example, using glass-nonmetals, a byproduct of recycling waste PCBs, are used to replace wood flour in the production of phenolic molding compound . There are two methods of E-waste collection for the average indian citizen: in the informal method, E-waste is sold to a traveling individual (often someone who used to work on a farm) or to an electrical appliance repair shop or secondhand shop; in the formal method, E-waste is traded in, generally at a department store, supermarket, or electrical appliance store, to the original manufacturer.. E-waste recycling in india includes four sectors: individual recyclers, supply and marketing cooperatives, manufacturers, and dismantling companies. As mentioned above, the traveling recyclers purchase used items and often either dis mantle or repair them for the secondhand market. This unordered E-waste recycling method is currently flourishing in india. It is an inexpensive system, but it has created serious environmental pollution. In the formal recycling process through a supply and marketing cooperative, E-waste is collected by an individual or at a secondhand market or recovery point. The waste is then dismantled by a company that can either be part of the cooperative or an outside contractor. Formal recycling through manufacturers involves the collection of E-waste through retailers or a trade-in service. The manufacturer then handles the waste itself or it employs a third party. For formal recycling by a dismantling company, most of E-waste is collected by an international manufacturer and a little part by individual; recycled materials still flow to the network of the international manufacturer. Positive aspects of E-waste recycling include saving natural resources, protecting the environment, and solving underemployment problems. The E-waste recycling industry is labor-intensive, and there are currently hundreds of millions of redundant workers in the countryside in China. We estimate that about 20 million off-farm workers are currently engaging in recycling-related activities. However, existing problems with E-waste recycling activities include secondary pollution, occupational health and safety, safety of products made from recycling materials, insufficient in technical standards, and security of society (for example, stealing, etc.). Domestic material flow of E-waste in various regions in india is subject to a westward-moving trend, primarily from cities to the countryside.

Case Study of Srinagar City, Kashmir province

J&K State Scenario: The global e-waste Monitor-2017 report rightly warns about the “tsunami of e-waste” that is emerging in the coming years as it is going to cross 120 mt. (million metric tons) by 2050. Government in partnership with industry is supposed to craft the Environmentally Sound Management (ESM) practice to minimize the hazards of e-waste (Herat, & Agamuthu, 2012; Liang, & Sharp, 2016). In the current scenario, e-waste is now becoming a serious issue in our state of Jammu & Kashmir (J&K-India), as the state is going to become the dumping yard for e-wastes. So, every individual and institution of the state is solely responsible for this mess. The state government has not designed any formal mechanism for the proper disposal of e-waste. As per the Report-2009-10 by J&K State Pollution Control Board, total E-waste generation was estimated to be approximately 492.32 tons with per capita generation of 0.054 kg in the State. The total annual e-waste for the year 2012-2013 has been found approximately 3260.4 tons with per capita generation of e-waste has been estimated to be approximately 0.26 kg for the year 2012-2013, which is approximately 5 times higher than previous data (Anonymous, 2016). After 2013, no such survey was taken up by the organization. So, it is obvious that per capita generation e-waste in the state has increased tremendously so it is the duty of every individual to think about these issues before using these gadgets extensively. Moreover, the state government is supposed to design a comprehensive policy, wherein they are supposed to define electronic waste clearly while coming up with any integrated e-waste management policy and a regulatory regime for its implementation. In this scenario, the state is going to become, as already stated, a dumping yard for e-waste in the coming years. It is, ergo, also the responsibility of academic institutes to help the state administration in designing a research based comprehensive policy on e-waste Management

Research Methodology:

The state of Jammu & Kashmir, once ‘paradise on earth’ is going to become a dumping yard for e-waste, having serious consequences on general public and environment. It is also a fact that no such research study on e-waste management has been conducted in the state as would underline and recommend a policy framework for the government of the state. This research study, therefore, has explored the basic variables related to e-waste management and hence the research study was exploratory cum conclusive in nature.

Objectives:

1. To study the perception of the stakeholders regarding the health and environmental hazards of e-waste in the sample study area.
2. To study the current disposal practices of e-waste in the sample study area.
3. To study the perception of customers regarding extra payments for management of e-wastes.
4. To give suggestions for policy implication of e-wastes Management in the J&K state.

Sample Inclusiveness:

The sample area for the research study was the summer capital city of Srinagar of the Jammu & Kashmir state which has a huge demographic diversity particularly in the summer season (May to September) which is a must for increasing the representativeness of the Sample. In the sample inclusiveness plan, four major universities in Kashmir region namely Islamic University of Science & Technology (IUST), Central University of Kashmir (CUK), Cluster University of Kashmir (CUOK), Kashmir University (KU) were included. In the public sector, Srinagar Municipal Corporation (SMC), J&K State Pollution Control Board (JKPCB), and in the private sector, two IT-Companies (Lelafe & STC companies), two banks (J&K bank & HDFC Bank) were included in the sample plan. Moreover, the households were also included in the sample (table 1.1). These organizations were selected due to the extensive utilization of electronics products by these organizations, and they are, therefore, the major stakeholders of electronic wastes in the state. In order to collect primary data from the individual respondents from the respective organizations, we designed a comprehensive questionnaire comprising of the following major variables:

1. Customer Knowledge about e-waste.
2. Role of media in e-waste management
3. Health and Environmental Hazards of e-waste
4. Awareness about the Government Regulations
5. Implementation of the rules & Regulation in the state

6. Disposal Practices in the state
7. E-waste management based on Recycle, Reuse, Reduce, Repair, Reselling.
8. Life Cycle of the Product
9. Customer willingness to pay extra for e-waste management.

A well designed questionnaire was used for the collection of primary data (Appendix 1.1) and a total of 850 questionnaires were distributed among the respondents of the respective institutions. However, a total 430 questionnaires were received wherein 411 questionnaires were analyzed by using SPSS-19 software and 19 outlier's questionnaires were rejected.

Table 1.4 Sample plan				
S.NO	Name of the organization	Female	Male	Total
1	IUST	35	29	64
2	Cluster University Kashmir	37	30	67
3	Kashmir University	25	25	50
4	Central University Of Kashmir	32	44	76
5	IT Companies(STC&Lelafe)	18	32	50
6	Srinagar Municipal Corporation (SMC)	7	7	14
7	JK State Pollution Control Board (SPCB)	8	8	16
8	Banks (J&K Bank &HDFC Bank)	21	17	38
9	Households	17	19	36
	Total	200	211	411

In order to make the sample inclusive, the demographic variables male /female, rural/urban, education level, income, employment level were also incorporated proportionately in the sample plan. In the sample inclusiveness, on the basis gender, 51.8 percent male and 48.2 percent female respondents were included in the sample wherein 29.9 percent were married and 70.1 percent were unmarried . Moreover, in the age group, 73.2 percent respondents belong to the age group of 15-30 years and 22.9 percent belong to 31-45 years of age group, respectively. In the family the structure, 37.5 percent were having less than 5 five family members whereas 51.6 percent were having 5-8 members in the family. In the income group, 34.3 percent respondents belonged to below Rs 25,000/- income bracket and 36.3 percent belonged to Rs 26,000-50,000 income bracket whereas other belonged to higher income bracket. In the status segmentation, 44.3 percent belonged to employed class and 42.1 percent were students in the sample wherein 29.4 13 percent and 34.3 percent were graduates and post graduates respectively. In addition to elicit the information detailed Interview was conducted with various administrators of respective institutions mentioned in the sample plan. The normality test was accordingly conducted and the data found normal for the statistical analysis. In the research survey, both primary and secondary data were used. For the collection of data from primary sources, efforts were made to elicit the opinions of almost all key personnel in the respective institutions through observation, personal interviews, questionnaires and schedules. The in-depth interview technique has also been used to increase the reliability of primary data. However, the deficiency of this survey was that we were not able to determine perception of customers from Jammu & Ladakh regions due to deficiency of resources and time.

Analysis of Data

In the research study, it was found that both rural as well as urban concerned about the environment as 93.9 percent respondents mentioned the environmental concern; however, a small marginal population 3.2 percent were not concerned. This reveals that it is good to bring any government interventional based developmental change on environmental issues in the society. Further it was seen that 75.5 percent (urban) and 62.7 (rural) percent respondents were more concerned about their local environmental issues rather than state or central environmental problems, however a marginal proportion of (30 percent) respondents were least concerned about environmental issues which may be due to the lack of specific awareness about e-waste as it was found in the survey that only 17.7 percent (urban) and 19.4 percent (rural) respondents were having full knowledge about the e-wastes whereas 82.3 percent (urban) and 80.6 percent (rural) either have no knowledge about e-waste or even if they have , they surely don't know how it impacts their environment or health. Regarding the e-waste Regulations, it was found that 83.0 percent respondents mentioned lack of knowledge related to the Government regulations on e-waste which is a serious issue as 'law implementation' is directly proportional to 'law awareness'. Moreover, only 1.0 percent respondents claimed that Government regulation related to e-waste are properly implemented whereas 99.0 percent respondents claimed that these regulations are either not implemented at all or exists on paper only. This put a strong question mark on the governance of Government Regulations on e-waste Management in the state. As the research study reveals, the knowledge about e-waste among the general public is abysmally poor; e-waste regulations either are poorly 14 or not implemented properly which needs an immediate strategic intervention from government for effective and efficient e-waste management in the state. When respondents were asked as to why they do not recycle electronic products?, 39.9 percent respondents mentioned that they don't recycle because of non-availability of recycling facility in their vicinity whereas others mentioned that they lack information, time, space or it is useless to recycle the electronic products. In the survey, it was also found that the 28.5 percent respondents mentioned that they dispose the e-waste just like normal trash, whereas small marginal proportion of 10.9 percent respondents mentioned that they do segregation of e-waste before final disposal; In addition, 21.4 percent respondents prefer to donate e- products as charity. Moreover, among the respondents who prefer to segregate the e-waste, it was found that 53.0 use informal system for the final disposal without searching for formal mechanism or using recycling facility which is in consonance with Chinese study where approximately 60 percent of the generated e-wastes are sold to private individual collectors and passed into the informal recycling processes (Liu, et al , 2006). Only 21.0 percent respondents mentioned that they use formal mechanism for disposal of e-waste, this proportion of respondents normally belongs to IT companies. When the respondents were asked whether they knew someone who'd collect e-waste product for recycling, reuse or reselling, 61.8 percent respondents mentioned that they don't have any knowledge about the person (s) or institution that could collect the e-waste for recycling, reuse or reselling whereas 38.2 percent respondents mentioned that they have knowledge about the e-waste collectors. As a result, the movement of e-waste into the informal sector from institutional and individual generators is significant; as a result the health and pollution hazards are significantly high. So, it is the responsibility of Government that they should design a formal mechanism for the disposal of e- wastes and deep penetration of collection centers in the state. It has been found that both rural and urban respondents perceive health risk while dealing with electronic products; however, it was also found that there is a huge variation between rural (38.1 percent) and urban population (62.1 percent) in perceiving the health risks associated with wastes which may be be due to lack of awareness among the rural population. Moreover, 16.1 percent respondents mentioned that it's riskless to deal with electronic products which is due to the lack of information or awareness from different sources among the general masses in the state. Further, it was agreed by 78.8 percent respondents that the electronic product contain toxic 15 component wherein 85.2 percent urban and 65.7 percent rural respondents are also of the same opinion, however, 21.6 percent, a good proportion of respondents are clueless about the toxicity of e-products. When the respondents were asked about he special treatment for toxic or hazardous e-wastes, most of the respondents (69.8 percent) showed positive response whereas 31 percent respondents mentioned the lack of knowledge about the proper disposal of toxic material. It is further mentioned that 52.8 percent respondents mentioned that the negative impact on health is because of e-wastes, whereas 34.8 percent respondents lack knowledge about the same. So, government is supposed to provide awareness related to health hazards of e-wastes, and should also ensure that the producers of these electronic products design a sustained responsible framework. When the respondents were asked about the management of e-waste in the state, both urban (63.2 percent) and rural (50.7 percent) respondents mentioned that the 'Recycling of e-waste' is the best strategy for reducing e-wastes in the state (Agamuthu, & Victor 2011), whereas 26.9 percent rural and 15.9 percent urban respondents mentioned about 'Reusing of old products' as an appropriate option for managing e-wastes. In addition, 12.8 percent and 8.7 percent respondents mentioned that donation

and minimizing the use of e-products in daily life as the best fit for managing e-wastes in the state. Moreover, it was found in the survey that 53 percent respondents are willing to pay extra amount for proper disposal of e-waste which is in contrast to the study done in China, where more than 90 percent of Chinese citizens are reluctant to pay for the recycling of their e-waste as it is due to their traditional understanding that there remained value in these end-of-life products (Liu, et al, 2006). So, government in association with manufactures should design such a strategy where Extended Producers Responsibility (EPR) should neither become a burden for the manufactures nor should the customers feel price psychosis because of additional price. In the research analysis, as the data was following normal distribution pattern (Normality test), the p-value was 0.000, which is less than 0.05, (the assumed level of significance, 95 percent confidence), indicating the rejection of the hypothesis, which depicts that there is a relationship between e-waste management and general awareness level, Government regulation, disposal practices, Hazard level, paying extra amount for its disposal, hence the state policy to be designed accordingly (table:1.2). So, the Government in consultation with industries should design a comprehensive policy mechanism for e-waste management to be adopted and implemented smoothly in the state.

Table1.5: ANOVA between E-waste Management and the different dimensions of e-waste Management

s.no	Dimensions	Sum of squares	Degree of freedom	Mean of squares	F-value	P-Value
1	Knowledge about Govt. Rules & Regulation	1.564	3	.521	2.661	0.48
2	Implementation of Rules & regulation	2.393	2	1.197	6.187	.002
3	Recycling of e-waste Products	17.405	2	2.861	36.195	.000
4	Specialization Knowledge about ewaste	14.664	4	3.666	22.335	.000
5	Presence of toxic components in e-waste	21.45	2	1.754	40.245	.000
6	Perceive any Hazard or Risk with e-waste	18.77	2	1.350	38.477	.000
7	Disposal Practices	35.178	5	7.036	61.771	.000
8	Paying extra amount for e-waste disposal	5.140	2	2.570	13.766	.000
9	Type of media used	2.203	5	.441	2.256	.048
10	Disposal methods for e waste to be adopted	9.391	3	3.130	17.715	.000

Table:1.6: Perception of customers towards e-waste Management

s.no	Dimensions	agree	disagree	Don't know	Total
1	Knowledge of Govt. Regulations towards e-waste	70	230	111	411
		17.0%	56.0%	27.0%	100.0%
2	Implementation of e-waste Rules & Regulations	52	114	245	411
		12.7%	27.7%	59.6%	100.0%

3	Recycling of e-waste Products	73	310	28	411
		17.8%	75.4%	6.8%	100.0%
4	Knowledge about e-waste disposal centre	157	254	0	411
		38.2%	61.8%	0	100.0%
5	Perceive any Hazard or Risk with e-waste	223	66	122	411
		54.3%	16.1%	29.7%	100.0%
6	Presence of toxic components in e-waste	324	30	57	411
		54.3%	16.1%	29.7%	100.0%
7	Special treatment for e-waste	287	47	77	411
		69.8%	11.4%	18.7%	100.0%
8	Negative impact on Health	217	51	143	411
		52.8%	12.4%	34.8%	100.0%
9	Pay extra amount for proper disposal	218	154	39	411
		53.0%	37.5%	9.5%	100.0%
10	Second hand Products for minimizing e-waste	107	304	0	411
		26.0%	74.0%	0	100.0%
11	PLC into consideration before purchasing	278	112	21	411
		67.6%	27.3%	5.1%	100.0%

This research highlights that the hazards of e-wastes needs appropriate Management and Regulations, and calls for clear policies, regulations, systems and institutions for effective management, monitoring and control as these have been found to be the weakest points in the e waste management system currently in the state. Although the legislation for e-waste has been passed by the parliament, but its enforcement seems to be questionable. An analysis of the legislation and management system on e-waste in both industrialized and developing countries reveals that priority should be given to ameliorate the existing legislation system on e-waste management in the developing countries before the e-waste problem itself becomes so worst that it would be very difficult to control the same. Most of the research on e-waste management in the developing countries and in particular India has focused on the survey of environmental pollution, waste management problem and health hazards. This research also contributes to a new knowledge on the effective management of e-waste in the state of Jammu & Kashmir.

Suggestions for Policy Implications:

Based on the research conducted and the conclusions made thereof in case of the present study, the various suggestions are given hereunder and it is recommended that these may be incorporated in the formulation of the effective E-waste Management Policy mechanism in the J&K state:

1. Firstly, to make the e- waste Management a success in its true sense, the planning as well as its implementation should start from general public level planning. It should be followed by block level planning, district level planning and state level planning. Each unit should be managed according to the consumption pattern of the electronic products.
2. We need to create a general awareness about the e-wastes and their impact on health and environment in the state. In this regard, the attitude of the people in general has to be changed and a proper strategy to be formulated for this purpose. An effective media publicity pertaining to “Recycling, Reusing & Reducing” would be an important and a crucial part of this strategy. This is also important for bringing change not only at the societal level but our young

generation will also get sensitized against this menace. This can be done by designing a communication policy in vernacular medium for mass media promotion in the state. It is also important that awareness campaigns, both in the rural and urban areas, should be undertaken with active participation of the self-help groups, NGO's, Academic Institutions etc. as the holistic policy of such nature, be it block level, district level or the state level, can become effective and efficient for the policy implementation in the state

3. In the research study it was found that E-waste is turning out to be a serious issue with huge implications that can create havoc for the future. The current practice for managing e-waste is only through informal services called locally as "kabaddiwalas" in the state. This is the most emerging topic nowadays because we use electronic gadgets at a larger pace and with the advent of new technology; we tend to buy more and more electronic goods. As a result of this, the old electronic gadgets remain lying with us without any use whatsoever and we often forget what effect it would have on the environment and/ or health. The electronic goods are usually thrown out in the open areas. Besides, the components which are present in the electronic gadgets may contain heavy metals and potentially toxic materials like lead, mercury, cadmium and chromium that cause serious damage to the body. These materials mostly cause damage to the peripheral central nervous system. These also get accumulated in kidney/ liver and this could cause some serious carcinogenic diseases. Consequently, the state is obliged to design a formal mechanism for the collection of e-waste across the state where the public at large should also come on their own for the necessary disposal of the e-waste at these centers and be partners in this endeavor.

4. It is important that we do realize that we require a more stringent integrated and strategic e-waste prevention framework to effectively address the wastage-related issues. The government should come up with the e-waste regulations vis-a-viz the need per se and should update each Department about it. It should also keep a check on whether rules are implemented or not and should take corrective steps as and when required, to manage the e-waste so that our health and environment do not suffer. Indeed, it has been seen that as the state neither has a proper system nor a proper method of laws and regulations regarding e-waste management, it has become the most serious obstacle in the e-waste disposal mechanism. It, therefore, follows that both the Municipal Corporations (SMC) of the state & State pollution Control Board (SPCB) should play their proactive roles in this endeavor and should monitor the issues regarding e-waste management. It is incumbent on these bodies, therefore, to design a proper and sound monitoring system which would ensure the effective supervision and the enforcement of the rules and regulations. However, the regional economic differences may pose a problem to formulate a standardized regulation policy for economically backward areas as compared with the more advanced areas but then the policy itself should also include geographical/ income considerations. Moreover, constructing a monitoring system to supervise the enforcement of the regulations could be an effective way to control e-waste. It may be worthwhile to note that by identifying and aligning this function thereof with the administrative function of each department to implement e-waste management laws and regulations, we could achieve a major success in respect of the effective management of e-waste.

5. Integrated management system may improve the implementation of rules and regulation of e-waste management. In this regard, a single principal administrative department would be responsible for e-waste management whereas other departments should only be supportive so that the duplication of administrative functions among different government departments can be avoided. At the block level in the state, effective management of e-waste also needs the collaboration of different administrative departments. Therefore, by developing the state level e-waste management policy specific to the state, it would be quite possible to improve the enforcement of the laws and regulations

6. It is a well-known fact that recycling, reusing and reducing are important dimensions of e-waste management system wherein the consumers can recycle their old electronics, reduce consumption of e-waste and reuse the older electronic product. For this purpose, however, we need to design a proper management system. Besides, we can improve the existing waste management system by introducing additional e-waste management system which can be operated under an additional department. Furthermore, introduction of a payment system as per nature and classification of the e-waste should be developed in the state. By doing so, the private entrepreneurs could easily enter into the business of e-wastes including PPP model (Public Private Partnership). Besides, they would be encouraged to enter into this sector for value addition or value creation at different level of supply chain in the e-waste management system.

7. Collection Centers at appropriate locations can be formed wherein segregation of e-waste can be done for further recycling, repair or reuse of second-hand products. Mobile Vans, or trucks for carrying e-waste from homes, offices, Banks, universities, colleges etc. to collection center can be operated initially by the government and then at a later stage; this activity can pass on to private players and government will only act as regulating-cummonitoring agency

for the benefit of the state. The transport facility should be specified and subsequently provided for according to the areas where the e-wastes are produced and consumed subsequently.

8. A sizable number of waste management units prevalent at the general public level can be run by self-help groups, youth groups or small entrepreneurs. This will help in making the program a self-supportive and sustainable with initial support of seed capital from the 22 financial institutions and/or the state. Moreover, it may not be a burden on the state as well. These groups will create not only awareness in the society but will also create new value to the e-waste if the strategy is based on “Recycle, Reuse, or Reduce” mantra.

9. The state government should pass an order pertaining to the strict e-waste guidelines to the institutions (both Private & Public) as also to the general public at large emphasizing therein the penalty to be imposed in case of the violations of guidelines/rules regulations. This can promote in right earnest the adoption of rules and regulations among the general masses as also with different institutions in the state. All the possible means should be used to make every individual aware of these rules along with the penalty which can be imposed in case of misinterpretation or violation of rules and regulations.

10. The Government should introduce “E-waste Audit” along with IT-audit on yearly basis. The ‘E-waste Audit’ should be based on three pillars of e-waste management i.e. Recycle, Re-use, or Reduce which will also promote green budgeting in the state.

11. In case of the electronic products which can be repaired with the use of new technology or can be upgraded easily (Reuse strategy), the Government should promote “Value Addition Facilitation Centers” in collaboration with the IT companies or technical institutions which can help in repairing or up-gradation of older electronic goods, as otherwise it will go waste and prove as a waste. Indeed, technical training at all levels (General public to state) forms the backbone of a successful e-waste management program.

12. The ‘e-waste management’ can also promote employment generation in the state. This potential needs to be tapped as it is the most pressing problem prevailing in the state now-a-days. The youth possess a good deal of knowledge about the electronic goods especially mobile phones but they need the advancement of technical skills for the development of entrepreneurial ventures in the state. This can also prove to be an effective tool of management for sustainable development.

13. The academic and technical institutions in the state should develop and introduce new skill-based technical courses related to the electronic industry. These courses should also be introduced as open electives in the university / college education system which will help our pass-out degree holders to start the much-needed entrepreneurial ventures in the 23 state. The concept is also promoted by Choice Based Credit System (CBCS) under new curriculum of UGC and the AICTE.

14. It is proposed that an “e-waste management day” be announced in the state so that all the institutes/ departments and the public at large are involved to create mass awareness about this problem as also we could become the first state in the country to celebrate “e-waste management day” based on the concept of the three “R’s” i.e. Recycle, Reuse, & Reduce. Moreover, the collection of e-waste for proper disposal on the same day will act as stimuli for changing the attitude of different stakeholders. The objective of e-waste day should inculcate innovative management practices -creating awareness, minimizing e waste, recycling e-waste, repairing electronic products, reusing electronic products among the general public. It should be a community-based initiative, designed to raise awareness in respect of hazardous nature of electronic waste (e-waste), while offering an easy way for households and schools to dispose of old computers and mobile phones without causing any harm whatsoever to the environment. Indeed, we should make proper utilization of electronic goods and try to save the environment from their harmful effects.

15. The government should promote ‘donation’ as a value system in the society particularly with respect to the electronic product in social programs. It would be far better if we would donate or sell our product to somebody who can use it, if we feel that it is of no use to us and we do not want to keep it any longer. Besides, we can recycle only those components of the device that cannot be repaired. Electronics companies should be encouraged, if possible to manufacture the various components of the product to prolong the life span of electronic equipment. In fact, the Companies should manufacture sustainable products which have longer life. Any product that becomes obsolete for a particular segment of consumers could be donated and used by another segment of consumers.

16. Electronic companies should take the responsibility for the ‘after-life’ of their products. Extended Producer Responsibility (EPR), a popular framework across the world for e waste management wherein the manufacturers of electronic products are responsible for the end-of-life management of their products and this should be followed in true spirit. The electronic products which are no longer viable should be sent to recycling 24 companies. Companies should

initiate the policy of 'take back' or initiate return programs to encourage buyers to resell the products to the same companies they bought it from. In this regard, special guidelines could be issued by the state government to the respective manufacturers of electronic products. It would be much better for us that before we purchase a new gadget at a store, we can ascertain from them if they will buy back our old electronic product as the case is already practiced with inverter batteries in the state.

17. The Companies should refrain from using hazardous materials; they should rather switch to green chemistry to re-invent the ways to make their electronic products and reduce e waste thereof. If we use cleaner, smarter and state-of-the art methods/procedures to create our electronic products, the ill-effects of e-waste would decrease greatly. Instead of worrying about the problem after the products have been made, we should be creating the products which keeps its aftermath in mind. In certain cases of recycling, there may be products that cannot be recycled completely- PVC layers, for example, stay as such for ages and cannot be recycled. It would be better if the manufacturers use recyclable material so that the e-waste is converted into something that can be used again without harming the planet and its inhabitants. Incidentally, one of the major factors, while treating e-waste could be, to compel manufacturers to use green technology. Besides, government should issue guidelines not only on paper but to the respective companies; moreover, it should also implement the same at least in the government purchases.

18. The government should encourage companies to take Corporate Social Responsibility (CSR) in the e-waste sector in the state. Moreover, government should also promote among the customers to buy only from the companies which support "Extended Producer Responsibility (EPR)", "Recycling, Reuse, Reduce" strategy, and "Corporate Social Responsibility (CSR)", as fundamental and core values of their organization.

19. The customers should be encouraged to buy environmental- friendly electronics and should look for products labeled as "Energy Star" or certified by "Electronic Product Environmental Assessment Tool (EPEAT)". The government should assist the electronic companies and encourage them to open up additional recycling and service centers in the state. In fact, by spending on them a meager amount, we can save thousands and it is indeed the best solution for making the full use of electronic goods.

20. We need to design communication strategy with the active collaboration of industries where promotion of 'Do' & 'Do not' of the electronic products should be the consideration for purchasing decision of the customer. This will enable the customer to use minimum products which are useful too. This indeed can define the true character of a welfare state.

21. It would be worthwhile that for the purpose of extending the life span of our electronic gadgets, it is better to buy a cover case as it helps to keep the device clean, saves it from damages and avoids overcharging of the battery etc. It would also help the customer to understand the importance of its value as well as the consumption pattern of the electronic goods.

22. Customer knowledge plays a key role and should be based on the number of things that have to be kept in mind. The consumer should always try to make as much use of the electronics that as he already has. It is better to be a need-based person rather than a want-based person. Though the modern rapid advancement of technology has driven many companies all over the world to come up with new products and thus create an excitement in the customers to buy such products but, nevertheless, one should always control his urge to buy the new electronics products. Infact, when a customer decides to buy an electronic device, he should make sure that he buys something that he really needs and the product comes closest to the specifications that he is looking for. Also, it is worthwhile to buy an electronic device that has the capacity of changing with the technology and is upgradable.

23. In terms of collaboration and in the interest of the good customer relationship, many companies which includes the big and renowned online companies as well, provide monetary rewards for customers who return their old devices when upgrading to a new one ,as for example, giving them a certain amount off on their new product. It would go a long way in mitigating the e-waste production, if this practice is made more universal.

24. E-Waste management should be compulsorily introduced in school curriculum (from 8th standard to 12th standard) in the state, as it will help our young generation to become sensitive at an early age about the negative aspects of e-waste. Besides, e-waste has a 26 direct influence on the environment and hence it is an integral part of Environment Studies.

25. Even though all the electronic devices are usually accompanied with an Instruction Manual which gives instructions as to how to use the product and also gives easy fix-it-yourself guide, but unfortunately, most of the electronic products do not provide information about how to discard the electronic waste after use. In this regard,

Government in consultation with the industries should make it mandatory for all the manufacturers/dealers to introduce e-waste Manual in order to ensure the proper disposal of e-waste.

26. The government needs to create public awareness in maintaining occupational and environmental health. Consumers can also be given more responsibility for e-waste disposal, if resources for proper recycling are made readily available to them.

27. Lastly, all the stakeholders involved in the E-waste Management could learn a lot from how this problem is managed so effectively in Japan, the western countries and other developed nations, who consider it as their top priority and adopt a highly advanced technology and various other means and methods in E-waste Management Strategy of- “Reduce, Reuse & Recycle”.

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