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Challenges of Electronic Waste Management - Tamilnadu in India

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Abstract

The usage of electronic devices is increasing day by day. Developed and developing countries, both are equally responsible for generating E-waste. Technology has short span of life. It has no shelf life. Change in technology takes place quite often; therefore the older one becomes redundant and turns into waste when new version of technology is emerged. This leads to generation of E Waste on a massive scale. In the technical era, every day companies are finding new electronic items and accordingly satisfy consumer needs. Consumers also express their interest in buying the electronic goods immediately after the electronic goods are introduced in the market. To examine the various ways to solve E-Waste problems. To assess the impact of E-Waste management to the local communities. The opinion with high loading on these factors are Companies should devolved Non-Hazardous E-waste, the factors are legal framework for E-waste management, The opinion with high loading on these factors are Increase the life of product, the opinion with high loading on these factors are Companies should make a proper and safe E-waste disposal policy and the opinions with high loading on these factors are Guidelines for the electrical and electronic equipment manufacturers A certain percentage from the price of all such electronic equipment can be directed towards the recycling budget of the government. The government can direct a small part of budget for training E-waste handlers, for public awareness and other related activities. Government must take responsibility to train and monitor the workers. It is necessary to provide them secured livelihood along with life and health insurance.

Keywords: Mandatory provision • Government provision • Sustainability provision • Company policy • Legal provisions

Introduction

In the 21st Century, the information and communication revolution has brought remarkable changes in the way we organize our lives. The development in communication and technology in India has a great impact on our economy, industries and life style of people. Initially, we dealt with record players, radios, VCRs and black-and-white televisions; followed by CD and DVD. Air conditioners, air coolers, cellular phones, refrigerators, computers, laptops, power bank and many other gadgets arrived in the Indian market and in the hands of common man. Electronics have become part of the throw away culture of developed countries. This is not an exception even in the developing countries. Electronic gadgets are meant to make our lives comfortable, happier and simpler, but they contain poisonous toxic substances, their disposal and recycling becomes a health nightmare. These have led to various problems including the problem of huge amount of hazardous waste and other wastes generated from electric products. Over the past two decades, the global market of Electrical and Electronic Equipment (EEE) continues to grow exponentially, while the life span of those products becomes shorter and shorter. Due to Rapid economic growth, urbanization and industrialization, demand for consumer goods, has been increased for both the consumption and the production of EEE. Any improperly disposed electronics can be classified as E-waste. E-waste basically comprises electronic goods that are not fit for their original use.

Need for the Study

The usage of electronic devices is increasing day by day. Developed and developing countries, both are equally responsible for generating E-waste. Technology has short span of life. It has no shelf life. Change in technology takes place quite often; therefore the older one becomes redundant and turns into waste when new version of technology is emerged. This leads to generation of E Waste on a massive scale. The existing management practices related to E-waste in India are poorly managed and have the potential to risk both human health as well as environment. Moreover, the policy level initiatives are not being implemented in an appropriate way. The study on this subject will definitely help in forming solid base for future research and detailed study on the subject. This material will also serve as the source of data for future study. As this is a relatively new research subject, the study conducted on this subject will help in better understanding of this subject and will also play a major role in developing the interest of concerned persons. This study will thus help in formulating appropriate measures for minimizing E-waste volume.

Statement of the Problem

In the technical era, every day companies are finding new electronic items and accordingly satisfy consumer needs. Consumers also express their interest in buying the electronic goods immediately after the electronic goods are introduced in the market. Due to the innovation in electrical and electronic companies, consumers frequently replace their existing equipment with new one. It creates lot of impact to the society in the name of E-waste. The consequences of E-waste are shocking. The nation now dumps between 300 million to 400 million electronic items per year, and less than 20 percent of that E-waste is recycled. The extreme amount of lead in electronics alone causes damage in the central and peripheral nervous systems, the blood and the kidneys. E waste related to computers end up in landfills. Only about two percent of PCs ever find their way to a second user. About 60 million cell phones are replaced worldwide a month and only 10percent are recycled. Flat panel computer monitors and notebooks often contain small amounts of mercury in the bulbs used to light them. Cathode ray tubes in older TVs. All this toxic elements are harmful to human health and environment.

Large volume of E-waste has been sent to countries such as China, India and Kenya, due to lower environmental standards and working conditions makes processing E-waste more profitable. Just 24 States have passed or proposed take-back laws. India is not an exception to E-waste issues. Developed countries are exporting their E-waste to developing countries like India and China. In India, Maharashtra state is leading in E-waste generation

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and Mumbai city of Maharashtra is the leading city among all the cities of India in E-waste generation.

Scope of the Study

The prime focus of the present study is the Consequences of E-Waste on human health and environment. It has further provided information regarding conceptual framework of E-waste. This study also revealed the impact of E-Waste on mankind and providing awareness to companies, its consequences and the suggestions of the public regarding disposal of E-waste in Tamilnadu.

Objectives of the Study

The confined objectives of the present study are:

1. To examine the various ways to solve E-Waste problems.

2. To assess the impact of E-Waste management to the local communities.

3. To offer suggestions for improving the E-Waste management and its business opportunities on the basis of findings of the study.

Research Methodology

Research methodology is a scientific and systematic way to solve research problems. The research methodology deals with research methods and taken into consideration the logic behind the methods. In total, the research methodology of the study includes research design, sampling framework, data collection, framework of analysis and limitations.

Research Design of the Study

Research design is the conceptual structure within which the research is conducted. It is a blue print for the collection, management and analysis of the data. The research design in the present study is descriptive in nature since it describes the phenomena of socio economic implications of E-Waste Management and its Business Opportunities at tamilnadu. Apart from this, the present study has its own objectives and pre-determined methodology. It is purely descriptive in nature.

Sampling Framework of the Study

The sampling framework of the study consists of determination of sample size and sampling procedure of the study.

Factor Analysis

Factor Analysis is a general name denoting a class of procedures primarily used for data reduction and summarization. In research, there may be a large number of variables, most of which are correlated and which must be reduced to a manageable level. Relationships among sets of many interrelated variables are examined and represented in bonus of a few underlying factors. Factor analysis is somewhat similar to multiple regression analysis, in that each variable is expressed as a linear combination of underlying factors. The amount of variance a variable shares with all the other variables included in the analysis is referred to as communality (H 2). Factor loading indicates the level of correlation between the variables associated with the factor. The eigen value represents the level of variance explained by each factor. The factor scores are composite scores estimated for each respondent on the derived factors. The Cunbach Alpha indicates the reliability of the variables in each factor. In the present study, the factor analysis was used for data reduction purpose.

Limitations of the Study

The aspects of harmful E-Waste for the environment, reasons of increasing E-Waste, Useful method of Disposal of E-Waste, ways to solve E-Waste problems and impact of E-Waste management to the local communities have been measured with the help of the variables drawn from previous studies.

Review of Literature

Kumar S Ramachandra M [1] presented a review and assessment of the Electrical & Electronic Equipment used in ship building activities in India vis-à-vis other countries of the world and suggests the way ahead into the Integrated Management of the diverse EEE at their End Of Life (EOL) in an environmentally Sound Manner (ESM) without causing damage of any sort to our Mother Earth. The disposal of Electronic Waste is given the top priority in many countries around the world and thus there is an urgent need for implementation on the regulations on the use of green electronics so that “save A Vital Earth”. It is to be remembered that, Waste, in this paper will connote WEEE (Waste Electrical and Electronic Equipment).

Taye M [2] provided fundamentals regarding the amounts, flows, and handling practices of E-waste in Gaborone, Botswana. A number of relevant stakeholder organizations were interviewed and an in situ waste composition study was conducted. The concentration of E-waste arriving at the municipal landfill is less than 1 weight percent, corresponding to about 1.9 kg/capita/year, far less compared to the estimated 8 weight percent for European Union countries. However, obsolete electronics are in urban storages primarily due to a lack of tapping mechanisms. Among several inadequacies of the current handling practices is the absence of an E-waste management framework. Improvement routes discussed include public sensitization and engagement, capacity building, and future exploitation of potentially suitable end-of-life treatment options including the novel phenomenon of enhanced landfill mining.

Heacock [3] provided an overview of the scale and health risks. They reviewed international efforts concerned with environmental hazards, especially affecting children, as a preface to presenting next steps in addressing health issues stemming from the global E-waste problem. The e-waste problem has been building for decades. The increasingly observed adverse health effects from E-waste sites calls for protecting human health and the environment from E-waste contamination. Even if E-waste exposure intervention and prevention efforts are implemented, legacy contamination will remain, necessitating increased awareness of E-waste as a major environmental health threat. They found that global, national, and local levels efforts must aim to create safe recycling operations that consider broad security issues for people who rely on E-waste processing for survival. Paramount to these efforts is reducing pregnant women and children’s E-waste exposures to mitigate harmful health effects. With human environmental health in mind, novel dismantling methods and remediation technologies, and intervention practices are needed to protect communities [4].

Harmful E-Waste for the Environment

The study has made an attempt to list the important factors with the help of factor analysis on the basis of sixteen harmful E-Waste identified. There are five important factors i. e., Very High Harmful E-waste, Highly Harmful E-waste, Moderately Harmful E-waste, Harmful E-waste and Extremely Harmful E-waste [5]. The Harmful E-Waste included in each important factor is the reliability co-efficient, eigen value and percent of variation explained by each factor are presented in following table 1.

The classified five important factors in the Harmful E-Waste for the environment, to the extent of 71.5 percent. The most important factor is ‘Very High Harmful E-Waste factor’. It consists of five Harmful E-Waste factors with the eigen value of 7.08632. The important Very High Harmful E-Waste in this factor is Brominated flame- proofing agent [6].

The second and third important factors identified by the factor analysis are Highly Harmful E-Waste and Moderately Harmful E-Waste with the eigen values of 1.84940 and 1.54266. Highly Harmful E-Waste factor consists of three harmful E-Wastes for the environment whereas the Moderately Harmful E-Waste factor consists of three Harmful E-Waste for the environment [7]. The most important Harmful E-Waste for the environment among these two factors is Arsenic and PCBs (polychlorinated biphenyls).

Table 1. Rotated Factors Matrix with Communalities.

S.No.	Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1	Brominated flame- proofing agent	**.85357**	.13412	.00634	.16467	-.66093
2	Chrome	**.80049**	.11175	.27208	.10214	.04234
3	Copper	**.65984**	.37561	.37613	.01126	.02800
4	Lead	**.62677**	.16704	.15845	-.36486	-12868
5	Liquid crystal	**.62351**	.24114	.11444	-.03342	-.45620
6	Arsenic	.25987	.59208	.45262	-.02620	.32499
7	Barium	.15562	.51272	-.04745	.23163	.49997
8	Lithium	.41936	.50672	.31567	.00212	-.15609
9	PCBs (polychlorinated biphenyls)	.10700	.07009	.83083	.18716	.11184
10	Selenium	.22271	.22265	.78049	.04927	.01485
11	Silver	.19575	-.00077	.73313	.22480	.00054
12	Cobalt	.6779	.02114	.18849	.84444	-.14042
13	Mercury	.22044	-.18698	.12756	.78971	.09466
14	Nickel	.55182	-.02559	.22602	.55555	.16318
15	Cadmium	-.04464	.17136	.19524	-.13640	**.85159**
16	Zinc	.30089	.31881	.14994	.19733	**.71610**
	Eigen value	7.08632	1.84940	1.54266	1.44426	1.20412
	Percentage of variable	35.4	9.2	7.7	7.2	6.0
	Cumulative percentage	35.4	44.7	52.4	59.6	65.6

Source: Computed data

The fourth and fifth factors are Harmful E-Waste and Extremely Harmful E-Waste factors with the eigen values of 1.44426 and 1.20412 respectively [8]. The Harmful E-Waste factor consists of three Harmful E-Waste for the environment whereas the Extremely Harmful E-Waste factor consists of two Harmful E-Waste for the environment. The most important Harmful E-Waste for the environment in these two factors is Cobalt and Cadmium (Table 2).

The selected five factors are interpreted as follows:

Factor 1: The opinion with high loading on these factors are concerned with Brominated flame- proofing agent

Factor 2: The opinion with high loading on these factors are concerned with Arsenic

Factor 3: The opinion with high loading on these factors are concerned with PCBs (polychlorinated biphenyls)

Factor 4: The opinion with high loading on these factors are concerned with Cobalt

Factor 5: The opinion with high loading on these factors are concerned with Cadmium

The factor analysis has identified five important harmful E-Waste for the environment [9]. The scores of these five important harmful E-Waste for the environment are drawn from the mean of Harmful E-Waste for the environment included in each important Harmful E-Waste for the environment. In order to execute the public opinion on these five important harmful E-Waste for the environment they are shown in the table.

Table 2. Selected Factors and Ratios with Factor Loading.

S.No.	Variables	Factor Loading
Factor 1	Brominated flame- proofing agent	.85357
	Chrome	.80049
	Copper	.65984
	Lead	.62677
	Liquid crystal	.62351
Factor 2	Arsenic	.59208
	Barium	.51272
	Lithium	.50672
Factor 3	PCBs (polychlorinated biphenyls)	.83083
	Selenium	.78049
	Silver	.73313
Factor 4	Cobalt	.84444
	Mercury	.78971
	Nickel	.55555
Factor 5	Cadmium	.85159
	Zinc	.71610

Source: Computed Data

Ways to Solve E-Waste Problems

The study has made an attempt to list the important factors with the help of factor analysis on the basis of nineteen ways to solve E-Waste problems identified. There are five important factors i.e., Mandatory provision, Government provision, Sustainability provision, Company policy and legal provisions and Company responsibility on E-Waste. The various ways to solve E-Waste problems included in each important factor are the reliability co-efficient, eigen value and percent of variation explained by each factor are presented in following table 3.

These five factors indicated explain ways to solve E-Waste problems to the extent of 72.9 percent. The most important factor analysis is mandatory provision (it consists of seven measures with the valuabiling eigen value of 3.30379. The important measures in these factors are Companies should devolved Non-Hazardous E-waste.

The second and third important factors identified by the factors analysis are the government provision and sustainability provision factor with the eigen values of 3.14983 and 2.22503 respectively. These two factors consist of five and two measures respectively. The most important measures in government provision and sustainability provision are legal framework for E-waste management and Increase the life of product.

The fourth and fifth important factors identified by the factor analysis are company policy and legal provisions and company responsibility on E-Waste with the eigen values of 1.63832 and 1.54424 respectively. These

Table 3. Rotated Factor Matrix with Communalities.

S.No.	Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1	Companies should devolved Non-Hazardous E-waste	**.85120**	.13940	-.01671	-.04931	-.16682
2	Environmental Clearances (EC) should be obtained	**.84641**	-.01285	-.04628	-.09429	.47009
3	Liability insurance for pollutant releases, accidents and other emergencies	**.78094**	-.01179	.35988	.01203	.06008
4	An up-to-date, written plan for reporting and responding to exceptional pollutant releases, including emergencies such as accidents, spills, fires, and explosions	**.77986**	.16722	.04754	-.03288	.10028
5	Proper audit program run by government to E-waste management companies	**.76280**	.03008	.11185	.00711	-.12346
6	Companies should promote reuse of E-waste	**.68031**	-.02226	.28086	-.08182	-.12288
7	Extended Producer Responsibility (EPR)	**.53895**	.11849	-.16017	.01556	.12340
8	The legal framework for E-waste management	.01256	**.90691**	.01918	-.03898	-.11643
9	Disposal regulated by government	-.2959	**.77558**	.16230	.17350	-.13313
10	Proper Disposal dismantling, recycling and extraction of E-waste	.02646	**.73804**	.15471	.12004	.05371
11	Export of E-waste	.53383	**.54611**	.01735	.21025	.21225
12	Government should provide tax benefit to those companies	.37837	**.51034**	-.48802	.02211	.08915
13	Increase the life of product	.00284	.42887	**.64600**	-.9535	.02979
14	Proper Treatment of E-waste	.38104	.11214	**.59048**	-.27198	.03113
15	Companies should make a proper and safe E-waste disposal policy	-.20720	.12787	.05562	**.80517**	-.07067
16	Companies should re produce new product from E- waste	-.16916	.47944	-.05424	**.53595**	.07847
17	Legal actions and penalties can do Proper management of E-waste	-.21266	.24902	-.08847	**.50414**	.08448
18	Guidelines for the electrical and electronic equipment manufacturers	.08535	.01873	-.00126	.01014	**.79669**
19	Identify the E-waste composition & hazardous content in E-waste	.00284	.42887	.02979	-.9535	**.64600**
	Eigen value	3.30379	3.14983	2.22503	1.63832	1.54424
	Percentage of variable	14.4	13.7	9.7	7.1	6.7
	Cumulative percentage	14.4	28.1	37.7	44.9	51.6

Table 4. Selected Factors and Ratios with Factor Loading.

Factor	Variables	Factor Loading
Factor 1	Companies should devolved Non-Hazardous E-waste	.85120
	Environmental Clearances (EC) should be obtained	.84641
	Liability insurance for pollutant releases, accidents and other emergencies	.78094
	An up-to-date, written plan for reporting and responding to exceptional pollutant releases, including emergencies such as accidents, spills, fires, and explosions	.77986
	Proper audit program run by government to E-waste management companies	.76280
	Companies should promote reuse of E-waste	.68031
	Extended Producer Responsibility (EPR)	.53895
Factor 2	The legal framework for E-waste management	.90691
	Disposal regulated by government	.77558
	Proper Disposal dismantling, recycling and extraction of E-waste	.73804
	Export of E-waste	.54611
	Government should provide tax benefit to those companies	.51034
Factor 3	Increase the life of product	.64600
	Proper Treatment of E-waste	.59048
Factor 4	Companies should make a proper and safe E-waste disposal policy	.80517
	Companies should re produce new product from E- waste	.53595
	Legal actions and penalties can do Proper management of E-waste	.50414
Factor 5	Guidelines for the electrical and electronic equipment manufacturers	.79669
	Identify the E-waste composition & hazardous content in E-waste	.64600

two factors consist of three and two measures respectively. The most important measures are Companies should make a proper and safe E-waste disposal policy and Guidelines for the electrical and electronic equipment manufacturers.

The selected factors and opinions with factor loading are shown in following table 4.

The selected five factors are interpreted as follows:

Factor 1: The opinion with high loading on these factors are Companies should devolved Non-Hazardous E-waste

Factor 2: The opinion with high loading on these factors is legal framework for E-waste management

Factor 3: The opinion with high loading on these factors are Increase the life of product

Factor 4: The opinion with high loading on these factors is Companies should make a proper and safe E-waste disposal policy

Factor 5: The opinions with high loading on these factors are Guidelines for the electrical and electronic equipment manufacturers

Findings

The opinion with high loading on these factors are Companies should devolved Non-Hazardous E-waste, the factors are legal framework for E-waste management, The opinion with high loading on these factors are Increase the life of product, the opinion with high loading on these factors are Companies should make a proper and safe E-waste disposal policy and the opinions with high loading on these factors are Guidelines for the electrical and electronic equipment manufacturers

Suggestions

1. A certain percentage from the price of all such electronic equipment can be directed towards the recycling budget of the government. The government can direct a small part of budget for training E-waste handlers, for public awareness and other related activities. Government must take responsibility to train and monitor the workers. It is necessary to provide them secured livelihood along with life and health insurance.

2. Government should have consultations with the industry and all stakeholders to recognize a range of EOL (end of life) for all Electronic and electrical products. This classification is essential as consumers in India so that consumers do not need to dispose of products before their actual EOL just because of the rules.

3. Government must encourage research into the development and standard of hazardous waste management, environmental monitoring and the regulation of waste disposal.

4. Government should link “Digital India Scheme” and “Clean India Campaign” which helps to manage E-Waste. Government should open E-Waste collection canter in every smart city.

Conclusion

E-waste or Waste Electrical and Electronic Equipment (WEEE) are loosely discarded, surplus, obsolete, broken, electrical or electronic devices. The flow of E-waste is very rapid causing threats to the human health, environment due to its toxic and hazardous attributes. E-waste is being produced by various sources in the country like Govt. sectors, commercial establishments, institutional sectors, research and developments, household and manufacturing sectors of the country. The lack of public awareness regarding the disposal of electronic goods and inadequacy of policies to handle the issues related to E-waste enhance the problem in India.

Scope for Further Research

The present study was confined only to the consumers and E-Waste management companies in Tamilnadu. An extended research work can be followed to study the marketing problems of e-waste management companies’ employees only. There is a scope of detailed study on scientific and technical aspect of E-waste arising from electrical and electronic products. A Future study can be on functioning of all E waste management companies of India. There is a scope of a comparative study of effective E-Waste practices followed by India and other countries.

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