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**ANALYSIS OF SURVEY DATA IN E- WASTE MANAGEMENT
COMPANIES OF INDIA – A CASE STUDY**

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ABSTRACT

Various researchers, authors, government agencies and international agencies have defined E-waste in simple language. It provides better explanation and understanding regarding E-waste. Some definitions are included in this study to provide better understanding the concept of E-waste. The target population for this study has been selected from Chennai city of the State of Tamilnadu. The prime focus of the present study is the Consequences of E- Waste on human health and environment. 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 a Chennai city and some other cities of Tamilnadu.

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.

Shelton (2015) aimed of study was to improve understanding of electronic waste (E-waste) and the effect on health and the environment on a global scale, documenting the need for change, and suggesting an alternative to the present poor disposal procedures. Performing research on E-waste has provided the means to reflect on the consequences of the lack of proper recycling efforts. If a change is not made on a multi-national scale, pollution rates will increase. The environment will suffer from additional amounts of chemical and hazardous material disposal. Raghupathy (2013) presented options for bridging the gap between the formal and informal divide in E-waste management in India. These options are being developed, implemented and evaluated in the framework of different Indian, European, and bilaterally financed studies and projects focusing on Delhi, Bangalore, Pune and Kolkata. The outcomes of the investigation suggest that the collection, segregation and primary dismantling of non-hazardous fractions of E- waste should be focused in the informal sector while the other higher order recycling processes may be concentrated in the formal sector. They further illustrate elements of the model with several initiatives implemented in India.

Ram Krishna and Saha (2014) approached made towards assessing the present situation of E-waste management globally as well as in India, considering the present regulations and guidelines. It is also a fact that major part of recycling of E- waste is being handled by informal sector that have little/no knowledge about the consequences of exposure to hazardous substances. To address the issue of E-waste management in a sustainable method, the concept of EPR (extended producer responsibility) will be helpful if the regulations incorporate monitoring and penalty clauses. DipankarDey (2014) has tried to identify the challenges in managing E- wastes in India. It also describes few

initiatives taken in recent past to address the challenges and highlights few concerns. A Brief note on the findings: The pilot survey revealed that the main source of E-waste was scrap.

Chatterjee and Kumar (2009) proposed an outsourcing model where equal participation of the formal and non-formal sector is ensured to make the E- waste management business a profitable one. The main motivation for non-formal operators is to extract precious metals (gold, silver) from printed circuit board (PCB) using unscientific and unhygienic methods, which are harmful to the workers and the environment. Victor and Kumar (2010) tried to highlight the particularities of managing waste in different countries, with different levels of economic development and technological sophistication. The comparison and analysis of the management of e-waste in India shows the current state of affairs and highlights the existing e-waste management system (Manju et.al., 2000, Sundar et.al., 2000, Anandan et.al., 2019, Ashok et.al., 2018 & 2019, Vasanthi and Jeganathan 2008 & 2009).

Victor *et.al.*, (2011) explained that growth in the electronics sector and rapid changes in technology mean that more consumers are generating growing volumes of waste electrical and electronic equipment, much of which is still operational. Faced with a limited and fragmented recycling and reuse infrastructure, many consumers are storing old equipment in their homes or discarding it with their regular trash as part of municipal waste. Meenakshisundaram and Sinha (2011) focused on exploring the behaviour of such consumers towards E-waste management and addressing the persistent problems faced by the E-waste recycling industry in UAE. In their research project, they proposed a sustainable working model to bridge the knowledge gap between consumers who generate E-waste and the industry that re-cycles the same E- waste. They found that the awareness amongst consumers has to be increased.

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 industrialisation, 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. The research is undertaken with the following objectives: To analyse the efforts taken by the Hardware manufacturing companies in the State of Tamilnadu in handling of E-waste. To analyse the opinion of general public regarding solution of E -Waste problem and its impact and consequences in human community. To analyse the issues related to E-waste and the initiatives undertaken by the E- waste management companies.

DATA SURVEY ANALYSIS OF E-WASTE MANAGEMENT COMPANIES

1. The study found that 50 percent of the respondents belong to the age category of 35 to 45 years.
2. Majority (70 percent) of the respondents are having post graduate as their educational qualification.
3. Garret ranking method is applied to assess the preference of the E-waste material collected by the companies from their customers. It is found that electronic is ranked as one, electrical is ranked as two, metal is ranked as three and other material is ranked as four and plastic is ranked as five.
4. Through the one sample t test, it is ascertained that eight variables rejected the null hypothesis. That means variables such as financial problem, technical problems, lack of research, non-adoption of scientific process, social problems, non-availability of skilled workers, no awareness and no strong Policy are considered as the problem for handling the E-waste because the p value of the variables is less than 0.05. The variable legal problem is accepted the null hypothesis, because the P value is greater than 0.05.
5. From the mean score analysis, it is found that recycling (4.00) contributed the highest mean score, it means recycling is the best and disposal option for the E-waste , followed by reuse (3.90) which is the higher mean score among the options for treatment of the E-waste. Based on the mean score, the last option is the dumping in the landfills (2.10).

6. From the frequency analysis, the study found that the variable come under the impact of E-waste management to the local communities such as community engagement (40%), protection of human rights and safe and healthy living conditions (40%) were agreed by the respondents. Moreover protection of indigenous rights (30%), reduced pollution (50%) were strongly agreed by the respondents.
7. Through the one sample t test, the study ascertained that the null hypothesis is rejected by the statements of community engagement, protection of indigenous rights, protection of Human rights, reduced pollution, safe and healthy living conditions, socio-economic opportunities, employment opportunities and contribution to national income, because the P value of all the statements is less than the ideal value of 0.05. It means this variable is creating the impact on local communities through E-waste management system.

RESULTS AND DISCUSSION

Demographic Profile of the Respondents-Percentage Analysis

Demographic profile plays a vital role in the social science research. The demographic profile is used for the understanding of the respondents basic background related with the research.

Table 1 AGE OF THE RESPONDENTS

| Sl. No | Particulars | No. of Respondents | Percentage |
|--------|----------------|--------------------|------------|
| 1 | 15 to 25 years | 1 | 10 |
| 2 | 25 to 35 years | 3 | 30 |
| 3 | 35 to 45 years | 5 | 50 |
| 4 | Above 45 years | 1 | 10 |
| Total | | 10 | 100 |

Source: Primary Data

From the table 1, it is clear that, 10 percent of the respondents belongs to the age group of 15 to 35 years, 30 percent of respondents

belongs to the age group of 25 to 35 years, 50 percent of them belongs to the age group of 35 to 45 years and 10 percent of them belongs to the age group of above 45 years. It is found that majority of the respondents belong to the age group of 35 to 45 years.

Table 2 EDUCATIONAL QUALIFICATION OF THE RESPONDENTS

| Sl. No | Particulars | No. of Respondents | Percentage |
|--------|---------------|--------------------|------------|
| 1 | Graduate | 3 | 30 |
| 2 | Post Graduate | 7 | 70 |
| Total | | 10 | 100 |

Source: Primary Data

Table 2 displays the educational qualification of the respondents. 30 percent of them are under graduate and 70 percent of them having post graduate degree as their educational qualification. It is found that, majority (70 percent) of the respondents were post graduate

Garrett's Ranking Methods

Garrett's ranking techniques was used to rank the performance indicated by the respondents on different factors. As per this method, respondents have been asked to assign the rank for all factors and the outcomes of such ranking have been converted into score value with the help of the following formula:

$$\text{Percent position} = 100 (R_{ij} - 0.5) / N_j$$

Where R_{ij} = Rank given for the i^{th} variable by j^{th} respondents N_j = Number of variable ranked by j^{th} respondents

With the help of Garrett's Table, the percent position estimated is converted into scores. Then for each factor, the scores of each individual are added and then total value of scores and garret values of score is calculated. The factors having highest garret value is considered to be the most important factor.

Table.3 PREFERENCE OF THE MATERIAL COLLECTED FROM THE CUSTOMERS

| Sl. No | Materials | Rank | | | | | Total |
|--------------|------------|-----------|-----------|-----------|-----------|-----------|-------|
| | | 1 | 2 | 3 | 4 | 5 | |
| 1 | Metal | 1 | 5 | 1 | 1 | 2 | 10 |
| 2 | Electronic | 5 | 1 | 2 | 1 | 1 | 10 |
| 3 | Plastic | 1 | 1 | 3 | 2 | 3 | 10 |
| 4 | Electrical | 2 | 2 | 1 | 3 | 2 | 10 |
| 5 | Others | 1 | 1 | 3 | 3 | 2 | 10 |
| Total | | 10 | 10 | 10 | 10 | 10 | |

Source: Primary Data

Table 3 explains the preference of the materials collected by the management companies from their customers. There are five types of material have been identified by the researcher and the respondents were asked to rank the preference of the material collected from the customers. Based on the ranks awarded by the respondents, the researcher found out the correct number of respondents placed in each rank. Further, to identify the most important materials collected by the management companies from their customers, the researcher has used the Garret ranking.

Table 4 shows the garret scores. First, the garret ranks are calculated by using garret ranking formula. Based on the garret rank, the garret Table has been framed. As per Table 3, five variables and its scores are multiplied by the respective ranks, in order to record the scores in the Table 4 by using the formula:

$$\text{Percent position} = 100 (R_{ij} - 0.5) / N_j$$

R_{ij} = Rank given for i^{th} variable by j^{th} respondents. N_j = Total rank given by j^{th} respondents.

Table 4 GARRET SCORES

| SI No | Calculation | Calculated value | Garret Table value |
|-------|------------------------|------------------|--------------------|
| 1 | $100(1-0.5)/5 = 50/5$ | 10 | 75 |
| 2 | $100(2-0.5)/5 = 150/5$ | 30 | 60 |
| 3 | $100(3-0.5)/5 = 250/5$ | 50 | 50 |
| 4 | $100(4-0.5)/5 = 350/5$ | 70 | 52 |
| 5 | $100(5-0.5)/5 = 450/5$ | 90 | 24 |

Source: Computed Data

Table 4 shows the Garret scores. Initially the Garret ranks are calculated by using suitable Garret ranking formula. Based on the Garret ranks, the Garret Table value has been ascertained. The Garret Table scores of each factor in Table 3 have been multiplied to record scores in the Table 4 after adding each row, the total Garret scores have been obtained.

In order to identify the which material is having the preference to collected by the management companies from their customers, the respondents are asked to give their opinion by giving ranks to each waste materials and it is further analysed through the garret ranking method.

Table 5 PREFERENCE OF THE MATERIAL COLLECTED FROM THE CUSTOMERS- GARRET RANK

| SI No | Collected materials | Rank | | | | | | |
|-------|---------------------|------|-----|-----|-----|----|--------------|-------------|
| | | 1 | 2 | 3 | 4 | 5 | Garret Score | Garret Rank |
| 1 | Metal | 75 | 300 | 50 | 52 | 48 | 525 | 3 |
| 2 | Electronic | 375 | 60 | 100 | 52 | 24 | 611 | 1 |
| 3 | Plastic | 75 | 60 | 150 | 104 | 72 | 461 | 5 |
| 4 | Electrical | 150 | 120 | 50 | 156 | 48 | 524 | 2 |

Source: Computed Data

Table 5 displays the results of garret rank. Out of the total five wasted materials collected by the management companies from their customers, highest score is awarded to electronic waste, followed by

electrical waste in the second place and metal is the third place and other material having the fourth position. The least and last score is awarded to the plastic. Therefore, it is concluded that electronic waste having the highest importance among the E-waste collected by the management companies.

Table 6 PROBLEMS IN HANDLING THE E-WASTE

| Sl. No | Problems | SA | A | N | DA | SDA | Total |
|--------|-----------------------|-----------|-----------|-----------|-----------|-----------|-------------|
| 1 | Financial Problem | 3 (30) | 3 (30) | 1 (10) | 2 (20) | 1 (10) | 10 (100) |
| 2 | Legal Problems | 3 (30) | 2 (20) | 2 (20) | 2 (20) | 1 (10) | 10 (100) |
| 3 | Technical Problems | 1 (10) | 5 (50) | 2 (20) | 1 (10) | 1 (10) | 10 (100) |
| 4 | Lack of research | 3 (30) | 3 (30) | 1 (10) | 1 (10) | 2 (20) | 10 (100) |
| 5 | No scientific Process | 2 (20) | 4 (40) | 1 (10) | 2 (20) | 1 (10) | 10 (100) |
| 6 | Social Problems | 2 (20) | 4 (40) | 2 (20) | 1 (10) | 1 (10) | 10 (100) |
| 7 | No skilled workers | 1 (10) | 6 (60) | 1 (10) | 1 (10) | 1 (10) | 10 (100) |
| 8 | No awareness | 2 (20) | 4 (40) | 1 (10) | 1 (10) | 2 (20) | 10 (100) |
| 9 | No strong Policy | 4 (40) | 3 (30) | 1 (10) | 1 (10) | 1 (10) | 10 (100) |

Source: Primary Data

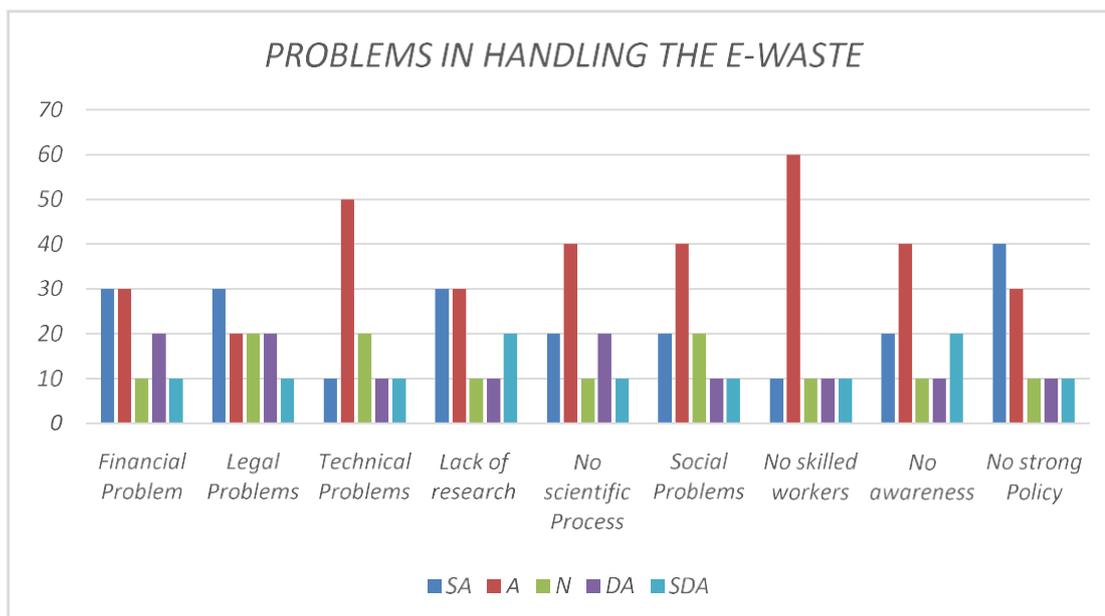


Fig. 1. Problems in handling the E waste

Table 6 explains the E-waste problems faced by the management companies while handling waste. Based on the responses of the respondents all the variables are considered as the problems while they are handling the E-waste.

Table 7 IMPACT OF E-WASTE MANAGEMENT ON LOCAL COMMUNITIES/ SOCIETIES

| SNo | Impact | SA | A | N | DA | SDA | Total |
|-----|------------------------------------|-----------|-----------|-----------|-----------|-----------|-------------|
| 1 | Community engagement | 2 (20) | 4 (40) | 2 (20) | 1 (10) | 1 (10) | 10 (100) |
| 2 | Protection of Indigenous rights | 3 (30) | 2 (20) | 1 (10) | 2 (20) | 2 (20) | 10 (100) |
| 3 | Protection of Human rights | 2 (20) | 5 (50) | 1 (10) | 1 (10) | 1 (10) | 10 (100) |
| 4 | Reduced Pollution | 5 (50) | 1 (10) | 1 (10) | 1 (10) | 2 (20) | 10 (100) |
| 5 | Safe and healthy living conditions | 2 (20) | 4 (40) | 2 (20) | 1 (10) | 1 (10) | 10 (100) |

| | | | | | | | |
|---|---------------------------------|-----------|-----------|-----------|-----------|-----------|-------------|
| 6 | Socio-economic opportunities | 1 (10) | 2 (20) | 4 (40) | 1 (10) | 2 (20) | 10 (100) |
| 7 | Employment Opportunities | 2 (20) | 2 (20) | 1 (10) | 3 (30) | 2 (20) | 10 (100) |
| 8 | Contribution to National Income | 1 (10) | 1 (10) | 5 (50) | 2 (20) | 1 (10) | 10 (100) |

Source: Primary data

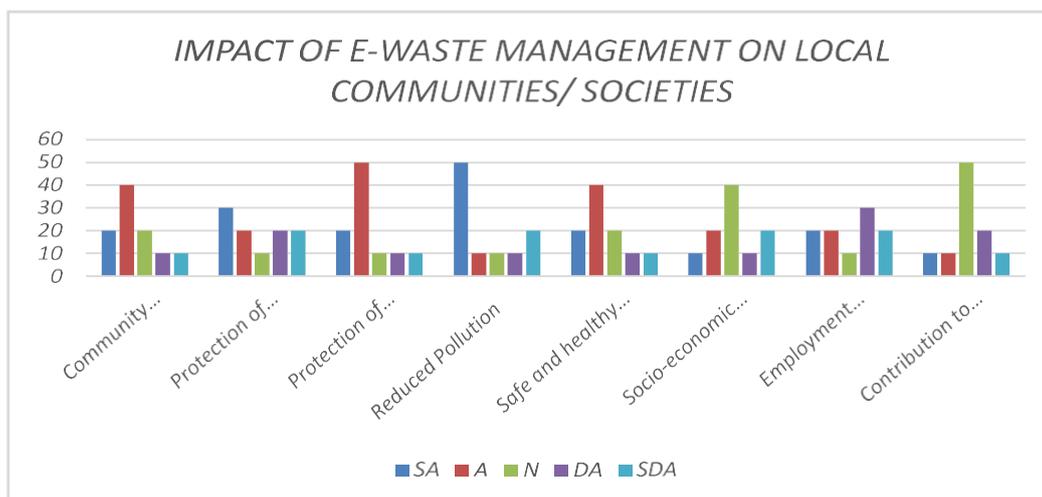


Fig .2 Impact of E-waste management on local communities / societies

Table 7 explains the agreement level of the respondents towards the impact made by E-waste management to the local communities. Community engagement (40%), protection of human rights and safe and healthy living conditions (40%) are agreed by the respondents. Moreover protection of indigenous rights (30%), reduced pollution (50%) are strongly agreed by the respondents. The respondents are agreeing with the impact made by the E-waste management to the local communities.

Heacock, (2015) 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. Okoye and Odoh (2014) ascertained the peoples of the regulation, their mode of disposal of the E-wastes and their awareness of the dangers inherent in improper handling and disposal of wastes. Data for this study were collected through the distribution of 247 well-structured questionnaires. Likert Scale was adopted for the analysis of the respondents. The results revealed that awareness is critically low. Though the respondents have concern for their environment in various degrees, majority dispose their E-waste alongside municipal wastes without knowing the implications. Awareness strategy was designed for sensitization campaign .

Rode (2012) found that the use of electronic goods is growing fast because of innovations, low price and easy to use facilities. Due to higher income, standard of living and professional requirement, people are replacing the electronic goods very fast. Mumbai Municipal Corporation is generating high E-waste in Mumbai Metropolitan Region. In Thane district, Thane Municipal Corporation generates high E-waste but Ulhasnagar Municipal Corporation generates low E-waste. E-waste generation is depending on population, health and education institutions, shops and malls, industrial units etc. E-waste in Municipal Corporations of Metropolitan Region is positively co-related to population growth. People are using different kinds of electronic products in their routine life. The old electronic products are discarded in bins. The market for replacement of electronic products is not well developed. The recycling facility is not well developed in region. The policy of awareness of E-waste to manufacturers, consumers, business houses will bring good result. Similarly buy back and exchange of electronic goods will reduce E-waste at certain extent in region. Municipal Corporations should provide collection, transportation, treatment, storage and disposal service of E-waste. Municipal Corporations should set the goal of E-waste free city. Such policies will help to reduce E-waste.

CONCLUSION

The innovation, dynamism in product design and globalization replacing electrical and electronic equipment in very short duration and made it fast growing waste in the world. The consumer is purchasing more electronic appliances and technologically advanced products such as mobiles, computers, televisions, refrigerators, washing machines and air conditioners. This also means that more and more electronic and electrical appliances are being discarded contributing to electronic waste (or E-waste). 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 above mentioned sectors are free to handover the waste who is going to bid more for it, that may be formal recyclers or informal recyclers or any local E-waste collectors or a Kabadee. Currently, most waste management strategies are largely technical and focused on environmental aspects, leaving out underlying social problems and relevant solutions. 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. While the Government and the industry are unanimous on the view that E-waste needs to be efficiently managed from a social and environmental standpoint, there still is a need for them to mutually arrive at a consensus by understanding the practical and cultural realities on ground. Unless the informal sector is formalized or made to be part of a defined E-waste supply chain, it will automatically defeat the very purpose of what the Government and industry intend to achieve.

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