# KNOWLEDGE AND ATTITUDE OF INDIVIDUAL CONSUMERS TOWARDS E-WASTE MANAGEMENT IN TAMIL NADU

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***Abstract :*** This study has been undertaken to investigate the determinants of e-waste management in Tamil Nadu using structures Questionnaire to collect data from the individual consumers along with attitude and knowledge scale to assess their level of awareness on electronic waste disposal and its management. Data has been collected during the month of April - December 2017. The study concluded that most of the respondents were not aware of e-waste management for which intensive awareness campaign has to be commenced by the government for all the stakeholders especially individual consumers, as this is the need of hour.

***IndexTerms*** **- e-waste, consumers, e-waste management.**

## I. INTRODUCTION

The electronic industry is the world's largest and fastest growing manufacturing industry (Radha, 2002; DIT, 2003). The consequence of its consumer oriented growth combined with rapid product obsolescence and technological advances are a new environmental challenge - the growing menace of "Electronics Waste" or "e waste" that consists of obsolete electronic devices. E-waste from developed countries find an easy way into developing countries in the name of free trade (Toxics Link, 2004) is complicating the problems associated with waste management.

The major issue of concern is that there is no standard definition of WEEE/e-waste. The different countries have given their own definitions, interpretation and usage of the term "e- waste/WEEE". The most widely accepted definition and description of WEEE is as per the European Union directive. EEE means equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields falling under the categories set out in Annex IA and designed for use with a voltage rating not exceeding 1 000 Volt for alternating current and 1 500 Volt for direct current.

### II. Impacts of E-Waste

Electronic wastes can cause widespread environmental damage due to the use of toxic materials in the manufacture of electronic goods (Mehra, 2004). Hazardous materials such as lead, mercury and hexavalent chromium in one form or the other are present in such wastes primarily consisting of Cathode ray tubes (CRTs), Printed board assemblies, Capacitors, Mercury switches and relays, Batteries, Liquid crystal displays (LCDs), Cartridges from photocopying machines, Selenium drums (photocopier) and Electrolytes. Although it is hardly known, e-waste contains toxic substances such as Lead and Cadmium in circuit boards; lead oxide and Cadmium in monitor Cathode Ray Tubes (CRTs); Mercury in switches and flat screen monitors; Cadmium in computer batteries; polychlorinated biphenyls (PCBs) in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and polyvinyl chloride (PVC) cable insulation that releases highly toxic dioxins and furans when burned to retrieve Copper from the wires. All electronic equipments contain printed circuit boards which are hazardous because of their content of lead (in solder), brominated flame retardants (typically 5-10 % by weight) and antimony oxide, which is also present as a flame retardant (typically 1-2% by weight) (Devi et al, 2004).

Landfilling of e wastes can lead to the leaching of lead into the ground water. If the CRT is crushed and burned, it emits toxic fumes into the air (Ramachandra and Saira, 2004). These products contain several rechargeable battery types, all of which contain toxic substances that can contaminate the environment when burned in incinerators or disposed of in landfills. The cadmium from one mobile phone battery is enough to pollute 600 m3 of water (Trick, 2002). The quantity of cadmium in landfill sites is significant, and considerable toxic contamination is caused by the inevitable medium and long-term effects of cadmium leaking into the surrounding soil (Envocare, 2001). Because plastics are highly flammable, the printed wiring board and housings of electronic products contain brominated flame retardants, a number of which are clearly damaging to human health and the environment.

### III. Status of E-Waste in India

India is witnessing a major growth in electronic market. Due to rapid innovation in communication sector a large range of mobiles and communication equipment are available and it is developing rapidly. The computer and peripheral industry is also booming at very fast rate. All these thing leads to increase in e-waste generation in India. India is second largest electronic waste

generator in Asia. Ministry of Environment and Forest (MoEF) 2012 report tell that the e-waste output increases to eight times in last seven years i.e. 8,00,000 tones.

An assessment conducted by the Manufacturers Association of Information Technology (MAIT) Indian hardware Trade Organization state that India produces almost 4, 00,000 tonnes of e-waste each year. Out of the country's total e-waste only 5 percent is recycled and about 40 percent of obsolete and unused computers and electronic products decay in homes and warehouses. Due to faster rate of newer model of electronic entering in the market, the e-waste is growing in Indian market at an alarming rate. Initially about 1, 46,000 tonne of electrical and electronic waste is generated in the country annually, over 80% from households most of which is recycled in non eco friendly manner. In 2007, India generate 3, 80,000 tonnes of e-waste. Only 3% of it recycled in authorised facilities. By 2012, the e-waste generation in the country is expected to cross the 8, 00,000 tonnes mark.

Two billion PCs are expected to invade our homes and India"s mobile subscriber base is expected to touch 450 million by 2015. The significance of e-waste management in India is greater not only due to its own waste but also due to the e-waste particularly computer waste dumped from the developed countries. Due to the absence of any proper disposal system followed in our country, enormous amount of e-waste has been generated in last 60 years. This has leads to the requirement of a proper disposal and recycling system so that the environmental pollution and health hazard is get reduced.

According to the report of UNEP, by 2020, the e-waste from old computer would grow by up to 500% from 2007 levels in India while South Africa and China will witness a 200-400% rise in computer related waste. Due to growth in mobile phone sector in India, the e-waste from discarded phone will grow by eighteen times from 2007 levels, whereas in China it is estimated to see a seven time rise in electronic waste from mobile phones.

**WEE Generating top ten state in India**

| State | WEE tonnes |
|---|---|
| Maharashtra | 20270.59 |
| Tamil Nadu | 13486.24 |
| Andhra Pradesh | 12780.33 |
| Utter Pradesh | 10381.11 |
| West Bengal | 10059.36 |
| Delhi | 9729.15 |
| Karnataka | 9118.74 |
| Gujarat | 8994.33 |
| Madhya Pradesh | 7800.62 |
| Punjab | 6958.46 |

Source : Country level WEEE assessment study by the International Resource Group Systems South Asia Pvt. Ltd (IRGSSA), (m/s IRG Systems South Asia Pvt. Ltd), 2015.

## IV. E-Waste in Tamil Nadu

As there is no separate collection of e-waste in India, there is no clear data on the quantity generated and disposed of each year and the resulting extent of environmental risk. The preferred practice to get rid of obsolete electronic items in India is to get them in exchange from retailers when purchasing a new item. The business sector is estimated to account for 78% of all installed computers in India (Toxics Link, 2003). Obsolete computers from the business sector are sold by auctions. Sometimes educational institutes or charitable institutions receive old computers for reuse. It is estimated that the total number of obsolete personal computers emanating each year from business and individual households in India will be around 1.38 million. According to a report of Confederation of Indian Industries, the total waste generated by obsolete or broken down electronic and electrical equipment in India has been estimated to be 1,46,000 tons per year (CII, 2006).

The results of a field survey conducted in the Chennai, a metroplolitan city of India to assess the average usage and life of the personal computers (PCs), television (TV) and mobile phone showed that the average household usage of the PC ranges from 0.39 to 1.70 depending on the income class (Shobbana Ramesh and Kurian Joseph, 2006). In the case of TV it varied from 1.07 to 1.78 and for mobile phones it varied from 0.88 to 1.70. The low-income households use the PC for 5.94 years, TV for 8.16 years and the mobile phones for 2.34 years while, the upper income class uses the PC for 3.21 years, TV for 5.13 years and mobile phones for 1.63 years. Although the per-capita waste production in India is still relatively small, the total absolute volume of wastes generated will be huge. Further, it is growing at a faster rate. The growth rate of the mobile phones (80%) is very high compared to that of PC (20%) and TV (18%). The public awareness on e-wastes and the willingness of the public to pay for e-waste management as assessed during the study based on an organized questionnaire revealed that about 50% of the public are aware of environmental and health impacts of the electronic items. The willingness of public to pay for e-waste management ranges from 3.57% to 5.92% of the product cost for PC, 3.94 % to 5.95 % for TV and 3.4 % to 5 % for the mobile phones. Additionally considerable quantities of e-waste are reported to be imported (Agarwal, 1998; Toxics Link, 2004). However, no confirmed figures available on how substantial are these transboundary e-waste streams, as most of such trade in e-waste is camouflaged and conducted under the pretext of obtaining 'reusable' equipment or 'donations' from developed nations. The government trade data does not distinguish between imports of new and old computers and peripheral parts and so it is difficult to track what share of imports is used electronic goods.

## V. Legal Framework for e-waste Management in India :

E-Waste management in India is governed by many national and international rules for waste handling in general and specific to e-waste.

- Hazardous Wastes (Management and Handling) Rules, 1989, 2003
- The Municipal Solid Wastes (Management and Handling) Rules, 2000
- Basel Convention 1989
- Lead Acid Battery Rules (MoEF 2002)

- Environmental Protection Act, 1986
- ISO 14001.

**VI. Review of Literature**

Shiv Ratan Agrawal, Divya Mittal (2017) conducted the study with the objective to identify the reasons of the low collection efficiency of household e-waste and to suggest about an organised market with its benefits for proper handling of e-waste that suited to end-users needs. A total of 312 usable responses gathered from household end-users of EEEs of Bhopal (Madhya Pradesh), India. The results of the analysis indicated that the present e-waste management system is needed to change significantly and should adopt an organised online e-waste market that would contribute to our society and the environment.

Borthakur, Anwesha (2015) revealed that the current methods of storage, processing, recycling, and disposal of E-waste have immense potential to harm human health and environment. The findings and conclusions of the article call for an integrated approach in Indian E-waste management scenario including significant considerations such as the identification of diverse range of stakeholders in the E-waste generation and management processes.

Trilochan Pandey et.al. (2014) were of the opinion that the fast pace of innovation both within India and abroad, along with the increasing affordability of electronic goods due to economic growth, has led to the rapid turnover of these consumer goods and thus enormous amounts of electronic waste. In addition to the sheer volume that must be managed, electronics contain highly toxic chemicals that complicate the waste handling process and can be detrimental to human health and the environment.

Anwesha Borthakur and Kunal Sinha (2013) illustrated that the policy level initiatives related to E-waste in India are reasonably recent and inadequate to address the issue. The domination of informal sector in the E-waste recycling business with all its socio-economic, health and environmental implications are dealt with in detail and the dawdling progress of formal recycling units in the country is assessed upon.

Ajeet Saoj (2012) identified Electronic waste or e-waste as one of the rapidly growing problems of the world. In India, e-waste management assumes greater significance not only due to the generation of its own e-waste but also because of the dumping of e-waste from developed countries.

**Need for Research**

The major sources of e-waste in India are the government, private sector, OEMs, retailers and individual households. Of the total e-waste inventory, both the government institutions and the private sector account for about 70 per cent, while the contribution of individuals is about 15 per cent (Sinha and Mahesh, 2007). The treatment of e-waste in India is handled by a very well networked and entrepreneurial informal sector and which replicates a long tradition of waste recycling (Widmer et al., 2005). More recently, several formal e-waste recycling entrepreneurial ventures have also sprung up in parallel with the informal sector in the country. Though e-waste management and disposal continues to be driven by global forces, the specificities will be determined by local conditions. The current e-waste management guidelines issued by the government, promulgates to all the stakeholders down the e-waste for a broad based legislation in the near future, indicating the need of present research.

**V. Research Methodology :**

The researchers adopted Descriptive research design for the present study as they aimed at describing the influential factors relevant to e-waste management. The head of households in Chennai Corporation of Tamil Nadu form the Universe for this study. Multilevel sampling was adopted to identify the respondents for this study - at zone level, purposive sampling was used and 5 zones were selected out of which 50 wards were selected by systematic random sampling and 350 respondents were selected by random sampling method. Primary Data was collected with pretested Questionnaire. Key sources for secondary data included government documents and similar research conducted in India and other countries. Two separate scales were used in the framework of the study. "Environmental Attitude Scale" developed by Kocak (2008) was used to identify student attitudes regarding the environment. The other scale employed in the study is the "Electronic Waste Awareness Survey" developed by Aydin (2011).

**5.1 Statement of the Problem**

Environment pollution is one of the greatest problems that the world is facing today. The seventy-five percent of e-waste that does get disposed of can either be recycled or it can be trashed into landfills or incinerators. For cell phones, EPA (2011) estimates that roughly twenty percent of mobile phones are kept in storage after usage instead of being recycled or thrown away. Out of all the metals used in electronics, cadmium and lead are by far the most toxic. Mercury is a used in electronics as a lighting device to help illuminate flat screens. If released into the environment, mercury can be converted into methyl mercury which can interfere and damage the development of fetuses (Greenpeace). Knowledge, skills and values form the basis for higher levels of understanding. Therefore, the current study aims to investigate the knowledge, awareness and practice of the consumers on electronic waste.

**5.2 Significance of the Study**

E-waste is perceived and managed differently amongst different countries. Therefore understanding the key concepts of e-waste management and the relationships between the economic impact of e-waste and its negative effects on the host community will serve as a base for better environmental and socially friendly practices for e-waste management.

**5.3 Objectives of the study :**

The main objective of the study is to identify the level of awareness of the household consumers on e-waste. The other specific objectives are :

- To portray the relationship of socio-demographic profile of the respondents with their awareness, practice and behavior on e-waste.
- To identify the level of knowledge, awareness, attitude and behaviour of individual consumers on proper e-waste management and its mechanism.

**VI. RESULTS AND DISCUSSION :**

- The majority of the respondents were in age group of 31-35 years representing 48 percent of the sample surveyed. The study covers both the views of men and women - 78 percent of the respondents were men and 22 percent were women.
- The educational qualification included those with higher secondary education, diploma holders, graduates, post graduates and those with professional qualifications 62 per cent came from a nuclear family and 38 per cent were from a joint family.
- High majority (78 percent) of the respondents had 4-6 persons in their families. It is found that 38 per cent had their own accommodation. The respondents were categorized as Housewives, Government employees, business /self employed, private employees and professionals. 44 per cent fell into the category of employees with income Rs.10,001-20,000.
- About 90% to 100% used common electrical goods like fans or televisions. Among the respondents, more than 80 percent own CD players, fluorescent bulbs, washing machines, Over the past 10 years, respondents purchased, on average, 4.3 mobile phones and 2.5 personal computers. Thus, consumers in Chennai purchase a new mobile phone approximately every 2.3 years and a new computer every 4.2 years. In the same timeframe, 2.8 mobile phones and 1.3 computers went unused per person.
- Majority ie. 66 percent of the respondents used to purchase only from the open market which may be due to the longevity of the product.
- Half ie. 50 percent of the respondents used the large electronic appliances for more than 10 years. many people tend to sell or give unused electronic items to a personal contact (35%), or keep these electronics in the home (26%).
- Nearly one third of the respondents ie. 37 percent did not consider unused EEE to be waste, and can either be reused or repaired, or can utilize its parts /source of raw materials.
- About 38 percent of the respondents either did not know any unused electronics collection service. About 58 percent of the respondents did not perceive e-waste as a threat to health or environmental hazards.
- From covered sample, 83% of respondents did not know the meaning of symbol printed on EEE equipments. This shows the alarming level of e-waste problem in general.
- Only 11 percent of the respondents have knowledge about the e-waste collectors indulged in its recycling. This weak awareness level may be an important disruption for the proper disposal of e-waste.
- According to the present data, 20 percent of the respondents thought that the government had the responsible mechanism of proper electronic disposal. This may be due to the fact that the Government is implementing waste management practices including Municipal solid waste management.
- More than half ie. 54 percent of the respondents had rejected the idea of paying the disposal cost by themselves, which may be normal attitude of the consumers in the society.
- About 17 percent of the respondents felt the absence of proper recycling system was the main reason for less disposal rates.
- According to the data gathered, 14 percent of the respondents had no idea about the impact of disposing waste equipments to the environment.
- According to the study, 28 percent of the respondents had no idea about hazardous contents of e-waste and about 29 percent had little awareness on it. This cannot be considered as active level of awareness to make decisions with regard to e-waste and its disposal.
- Nearly half of the respondents ie. 46 percent had no idea about the presence of precious metal in electronic equipments, meaning that half of the total respondents had no awareness about precious metal contents.
- More than half ie.53 percent of the respondents informed that they had purchased their electronic equipment for the first time. Most of the respondents purchased their personal computers and laptops as initial procurement.
- In this study, a majority ie. 62 percent of the respondents used to purchase EEE in new condition and only 38 percent had gone to used products. This may be one of the reasons for increasing the e-wastes in the society.
- About 14 percent of the respondents were used to replace the equipments before one year. This range of people can be considered as top end market which update their electronic products regularly and they may spend more on new features of the products.
- More than half of the respondents ie. 61 percent purchased new electronic items due to a desire for the latest technology, which indicated that they wanted to go for new features and new updates.
- According to the study, 19 percent of the participants disposed their products due to not working.
- A vast majority 88 percent of the respondents had discarded electronic equipments or accessories of one or the other kind,

- A vast majority of the respondents (86 percent) did not segregate e-waste at source and only 14 percent segregated at source. This may be due to lack of policy which does not emphasis strictly on the segregation of e-waste from other wastes.
- Most of the respondents did not have awareness on e-waste, which may affect the attitude of the respondents towards generation, separation and disposal of e-waste and its management.
- A high majority of the respondents had scored low in the attitude scale towards E-waste and its management. most of the respondents were not found to have favourable attitude towards e-waste, which concludes that it is the need of the hour to create awareness as the attitude has the influence on the persons behaviour.
- More than two third of the respondents ie. 68 percent had scored low in the behaviour towards e-waste. It is obvious that it is high time to take further action by Government with the support of other stakeholders in this regard.

**6.1 Testing of Hypothesis :**

- **Hypothesis 1** : there is no significant correlation between socio-demographic profile of the respondents and their perception towards e-waste. chi-square test was used to test the above hypothesis. it is found that there is a significant association between the socio-demographic profile viz. age, religion, type of family, number of persons in the family and occupation of the respondents with their perception towards e-waste
- **Hypothesis 2** : There is no significant difference in attributes of disposal methods with reference to gender aspect of the respondents. 'T' test was used to test the given hypothesis. Since it is significant at 5 percent level, the null hypothesis is rejected indicating that there is a significant difference between gender of respondents and their methods of disposal of e-waste.
- **Hypothesis 3** : There is no significant correlation between the educational qualification of the respondents and their disposal methods of e-waste. Chi-square test is used to test the above hypothesis. The calculated value is 79.4128 and table value at 0.05 confidence level and degree of freedom, value of chi-square is 24.969. Hence it is observed that the calculated value is higher than the table value thus rejecting null hypothesis. The study proves that there is significant correlation between the educational qualification of the respondents and their disposal methods of e-waste.
- **Hypothesis 4** : There is no significant difference between Gender and attitude of the respondents towards E-waste. Student 't' test was used for the above hypothesis. It is also found that Gender does not make any difference in the overall attitude of the respondents which implies that proper e-waste management is not done be it men or women. The table concludes that there is no significant difference between Gender and attitude of the respondents towards E-waste.
- **Hypothesis 5** : There is no significant relationship between the type of house and the knowledge, attitude and behaviour of the respondents towards e-waste. Student 't' test was used to test the above hypothesis. Since the calculated value of attitude 0.005 is less than the table value (P>0.05), the research hypothesis is accepted which proves that the type of house has its own influence in the attitude of the respondents towards e-waste management including its disposal.
- **Hypothesis 6 :** There is no significant association between the educational qualification and Knowledge, Attitude and Behaviour of the respondents towards e-waste. One way ANOVA 'f' test was used to test the above hypothesis. But the knowledge of the respondents is being influenced by their educational qualification. Since the calculated value 0.017 is less than the table value (P>0.05), the research hypothesis is accepted and null hypothesis is rejected which proves that the educational qualification has its own influence in the knowledge of the respondents towards e-waste management including its disposal. Hence there is a significant relationship between the educational qualification and the knowledge of the respondents towards e-waste and there is no significant relationship between the educational qualification and attitude and behaviour of the respondents towards e-waste.

**6.2 Recommendations :**

- The general public needs to be educated about the harmful impacts of e-waste and hence there is a need to develop targeted intensive awareness cum capacity building programmes on issues related to the environmentally sound management (ESM) practices for proper disposal of e-waste and its management.
- Consumer driven approach may be advocated for 'responsible purchasing'. This comes from the idea that if consumers are aware of the environmental impact of their purchases, they will have the opportunity to choose between the manufactures with proper extended producer responsibility.
- Collaborative campaigns are required to sensitize the users and consumers should pay for recycling of electronic goods. The educational campaign may involve educating the consumer during the time of purchase.
- Existing media channels (e.g., radio, television, newspaper) may be used to deliver high level awareness and create awareness on the effects of e-waste. Considering the use of internet and social media network for educating the audiences of the impacts of e-waste is also the need of hour.
- Non Governmental Organizations may also be used in creating awareness to the general public since they have the wider reach to the people at grassroot level.

**6.3 Scope For Further Research :**

The present study identifies the awareness factors contributing to the consumer's knowledge towards e-waste disposal and its management. The researchers in future may examine the correlation among the consumers' awareness factors on e-waste management. In addition, socio-demographic features such as age, gender, income and education play significant role in consumers awareness and e-waste disposal and management. Future researchers may deal with these effects on e-waste

management in detail. The present research covers only Chennai city. It is also necessary to conduct this study in other important cities of India enabling to improve the reliability and validity of the study.

**VII. Conclusion :**

Awareness of Individual consumers plays a key role in proper disposal of e-waste and its management. The present study found that 58.5 percent of the consumers surveyed in Chennai city had awareness on e-waste management. This study makes contributions to both academic field and practical field. From academic view point, it contributes to the literature existing in the area of consumer awareness, e-waste management and disposal. From a managerial view point, the contributions of this study are as follows - The consumer's awareness and preference with regard to the disposal of e-waste is one of the key factors for the future E-waste management. Above, awareness on e-waste management should be taken as a widespread campaign as it is concerned with environment and public health and if left as such, it will be a serious threat in near future like polythene bags.

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