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E-waste management practises among households in Kerala

Meebill C. Mathew[1], Prof. Johnson K. Joice[2]

[1]*Independent Researcher*
[2]*Department of Economics, St. Berchmans College, Changanacherry (Kerala)*

Abstract - *With the advancements in science and technology, the effectiveness of human life has drastically improved with different electronic gadgets manufactured for many different purposes. But at the same time this has led to the emergence of the fastest-growing waste stream all around the world known as "electronic waste" or simply e-waste. E-waste becomes a severe problem because of the very significant health and environmental hazards associated with it. If the electronic goods containing significant quantities of toxic metals and chemicals are left untreated to lie around in landfills or dumps, they leach into the surrounding soil, water and the atmosphere, thereby generating obvious adverse effects for human health and ecology. Many elements of the waste are hazardous, as the circuit boards, cathode ray tubes, connectors and other elements that are essential for most such goods almost always contain poisonous substances such as lead, tin, mercury, cadmium and barium. Among the states in India, the problem of e-waste is very severe in Kerala. The emergence of this problem to a great extent is consequential to the nature of its economic development, fuelled by high consumerism. This paper studies about the nature and sources of e-waste, the various methods of disposal adopted and issues related to it.*

Keywords*-e-waste; e-waste management; electrical and electronic equipment (EEE); waste electrical and electronic equipments (WEEE); hazardous; disposal*

I. INTRODUCTION

The technological advancements of the 21st century has given remarkable breakthroughs to the lives of people. These spectacular developments have undoubtedly brought ease and comfort to every aspect of our daily lives. But the people discard these electronic equipment to upgrade to the latest ones at the slightest inconvenience. This leads to the generation of e-waste at alarming rates all over the world. A 2015 report by the United Nations University (UNU) estimated that 41.8 million tonnes of e-waste was generated in 2014, almost 25% more than the 2010 figure of 33.8 million tonnes. (Website, United Nations University). The e-waste generation has increased to 44.7 million tonnes in 2016 as per the United Nations Report in 2017. Estimated annual generation in the coming years are as high as 50 Mt in 2018. According to a report released by Platform for Accelerating the Circular Economy (PACE) and the UN E-Waste Coalition in 2019, the amount of waste will more than **double by 2050**, to 120 million tonnes annually if the current trends continue. Most e-waste in the world in 2014 was generated in Asia at 16 million tonnes or 3.7 kg per inhabitant. The top three Asian nations with the highest e-waste generation in absolute quantities are China (6.0 million tonnes), Japan (2.2 million tonnes) and India (1.7 million tonnes). **India is the fifth biggest producer of e-waste in the world**, discarding 1.85 million tonnes (million tonnes) of electronic and electrical equipment in 2016. India is behind the U.S., China, Japan and Germany (The Hindu, October 18, 2016).

"E-waste" is a term used to cover all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of reuse. (The Global E-waste Monitor, 2017). The broad range of electronic products includes computers, television sets, music systems, CD players, mobiles, laptops, VCRs, refrigerators, photographic devices, video games and all other household electronic equipments. The growing quantity of e-waste is consequential to economic growth and accompanied changes. Rapid economic growth coupled with urbanization and a growing demand for consumer goods has increased both the consumption and production of EEE. With innovations in technology, the devices of yesterday as they become obsolete end up in the heap of electronic or electrical or e-waste. The electronic industry also has been growing in rapid pace due to dynamic nature of technology in electronic and communication sector. The consumers thus shift from low capacity, less featured products to the advanced ones which offer tremendous functions in lesser sizes and attractive aesthetics. As the products are made available at affordable prices, the replacement rate increases with the speed of technological innovation. Thus, the old obsolete products are discarded at an alarming rate. The problem is not only about its compilation but the complexity at its collection and management.The increasing quantity of e-wastehas posed a significant challenge to waste management in both the developed and developing countries.The impact is however worse in developing countries, where people often live in close proximity to dumps or landfills of untreated e-waste. Given the high health hazards involved in e-waste the development of strategies for its management is highly warranted in any country.

II. PURPOSE OF THE STUDY

The primary materials and components produced thereof, which are assembled to produce "Electrical and Electronic Equipment" include metal, motor/ compressor, cooling, plastic, insulation, glass, LCD, rubber, wiring/ electrical, concrete, transformer, magnetron, textile, circuit board, fluorescent lamp, incandescent lamp, heating element, thermostat, FR/BFR-containing plastic, batteries, CFC/HCFC/HFC/HC, external electric cables, refractory ceramic fibres, radioactive substances and electrolyte capacitors (over L/D 25 mm). The composition of these components is very diverse and may contain many different substances which fall under "hazardous" and "non-hazardous" categories. These consist of ferrous and nonferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete and ceramics, rubber and other items. According to the national level e-waste assessment study conducted in 2007, 95% of the e-waste is recycled by the unorganized sector. They follow crude dismantling operations using tools like hammer, chisel, screw driver including open burning of wires to extract precious metals like copper, gold, platinum, silver etc. Such unchecked activities carried out without proper protection to workers is hazardous not only to labourers involved but also to the environment. In addition, the country loses out on precious metal recovery as the unorganized sector is able to recover only 25% of metal as against possible efficiencies of over 95-99% in the organized sector.

The State of Kerala has a continuing problem with waste management with its high population density and land constraints in its pursuit to promote economic development (Nair, K.N., & Sridhar, R. 2005). The state experiences rapid urbanization in the last three decades and evidently the trend continues through the current decade. The rural – urban divide is not sharp in Kerala. With an urban population share of nearly 48 per cent, Kerala comes close to the global rate. The state is ahead of all other states in consumerism and accounts for 10% of the total consumption (Nithya,N.R.2013). Consequently, consumer waste in different forms increased in Kerala over the years.

As per the data on Municipal solid waste generation in different states in India, Kerala is among the top waste generating states (Kumar, S.et. al., 2017). The Malinya Mukta Keralam Action plan (2007) estimated that households contributed 49% and formed the prime source of solid wastes. In India, plastic waste accounts for only 0.6% of municipal solid waste, whereas in urban areas of Kerala, it is as high as 4 – 6% almost at par with any developed economies (Varma,A.K.2006). Along with plastic, e-wastes are fast becoming a major component in the waste stream of state. Kerala has 20.4% computer connectivity as against the national average of 18.7%. According to the 2011 census around 32.6% of the households in Kerala have both landline and mobile phone connectivity, while the nationalaverage is only 11.87% (G.O.01/2014). Also, Compact Fluorescent Lamps (CFL) & Fluorescent Tube Lamps (FTL) being dumped into Municipal waste sites very carelessly by the public endangers public health.

Kerala is one of the few states in the country that took some measures to address the solid waste management issue by launching an initiative called Clean Kerala Mission in 2003. The objective of the mission was to create a garbage free Kerala (Nair K.N.,Sridhar, R. 2005). In 2008, Government integrated the Clean Kerala Mission with Kerala Total Sanitation and Health mission and renamed it asSuchitwa Mission. There were efforts to achieve the goal with the participation of NGOs, Community organizations such as Kudumbasrees across Kerala (Dhanalakshmi, T.2014, Siji,S.R. 2014). Further, Kerala started a company called Clean Kerala Company under the Kerala Local Self Government department for waste management. This company has a special division to collect e-waste and is revealed 823 tonnes of e-waste has been collected so far by the company.(Website, Clean Kerala Company). A project for collecting e-waste from schools and other educational institutions was initiated by IT school with the help of Clean Kerala Company. Around 10,000 schools and educational offices in the state will be able to dispose of e-waste accumulated over the years through this project. (Indian Express, April 6, 2018).

In spite of this, there is a serious crisis in waste management in the state. That is manifested in the gap between accepted standards in solid waste management and their achievement. When it comes to e-waste the situation is severe. The management of it in the state is highly inadequate and unsatisfactory. Its effective management, however, is crucial given the fact that e-waste is much more hazardous than any other municipal waste. It contains thousands of components which are made up of highly toxic chemicals and elements like lead, cadmium, chromium, mercury, PVC (polyvinyl chlorides), antimony, arsenic, BFRs (brominated flame retardants), beryllium, antimony and phthalates causing serious health impacts. The improper treatment of e-waste prior to disposal also causes several environmental problems. On the other hand, if we reuse and recycle e-waste is one of the most precious wastes also known as '**the gold of waste**' but the present informal practices cause severe health hazards to the workers associated with it.

Given the environmental and health hazards of e-waste, proper policies and mechanisms are to be evolved to manage it. For evolving appropriate policies micro level studies analysing the magnitude, nature and causes of e-waste is highly needed. The present study is a modest attempt on that line. It addresses questions like-

- What is the quantum of e-waste generated across households?
- How do peopledispose of e-waste generated within the households?
- Whether people are aware of the initiatives made by the government in e- waste management?
- What are the challenges that arise in the e-waste management?

III. OBJECTIVES OF THE STUDY

1. To determine the magnitude and composition of e-waste generated within the households.
2. To analyse the mode of disposal of e-waste
3. To understand the level of awareness among the public regarding the hazardous nature of e-waste .

IV. RESEARCH METHODOLOGY

The study is both descriptive and analytical in nature. Primary data as well as secondary data are used for the present study. The secondary data is collected from the official reports of the United Nations University, the Global E-waste Monitor, status reports on Municipal Solid Waste Management, Central Pollution Control Board, Ministry of Environment & Forests, e-journals, newspapers etc. For primary data of the study on e-waste management, a survey was conducted using a structured questionnaire. The questionnaire consisted of two sections, A and B. Section A collected information on the respondents' socio-economic characteristics and Section B included several items to measure the respondents' perceptions, awareness, and attitudes towards e-waste and recycling behaviour. The households list was collected from Changanacherry municipality. Using this, a sample of 100 households was selected using a simple random sampling method. Simple statistical tools like ratios, percentages, averages, pie charts, etc. are used to analyse the data. Chi square tests were used to check the association between variables.

V. C OMPOSITION, SOURCES AND HEALTH AND ENVIRONMENTAL IMPLICATIONS

Internationally, the most accepted definition of e-waste is the definition as per the WEEE Directive which defines electronic waste, "e-waste" or "Waste Electrical and Electronic Equipment" ("WEEE") as the waste material consisting of any broken or unwanted electrical or electronic appliances. According to the WEEE Directive 2012/19/EC (European Union) WEEE are defined as a category of waste, consisting of equipment at the end-of-life, powered by electricity or through electromagnetic fields and designed for use in a voltage typically not exceeding 1000V AC and 1500V DC.(Chagnes, Cote, Ekberg, Nilsson, &Retegan, 2016) .

They are presently divided into the ten following categories:

1. Large household appliances
2. Small household appliances
3. Information technology and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large scale stationary industrial tools)
7. Toys, leisure and sports equipment
8. Medical devices (with the exception of all implanted and infected products)
9. Monitoring and control instruments
10. Automatic dispensors

However, these ten categories are now regrouped into the six following categories:

1. Temperature exchange equipment (refrigerators, freezers, air conditioning equipment, etc.)
2. Screens, monitors and equipment containing screen having a surface greater than 100 cm^2.(televisions, LCD photoframes, laptops, notebooks, etc)
3. Lamps (fluorescent lamps, sodium lamps, LED, etc)
4. Large equipment, that is, any external dimension more than 50cm (washing maching, dish washing, cookers, copying equipment, photovoltaic panels, etc)
5. Small equipment, that is, no external dimension more than 50cm (vacuum cleaners, caper sweepers, Hi-fi equipment, musical instrument, etc)
6. Small information technology and telecommunication equipment (mobile phones, GPS, project calculators, routers, telephones, etc)

5.1. Components and composition of e-waste.

A rough break-up of e-waste by its components is given in the figure below.

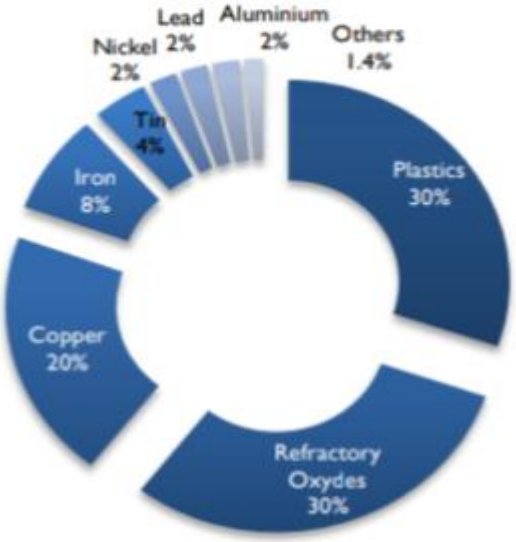

Figure 1. Components of e-waste
International Journal of Environmental Sciences Volume 3 No.1,2012

5.2. Major sources of e-waste

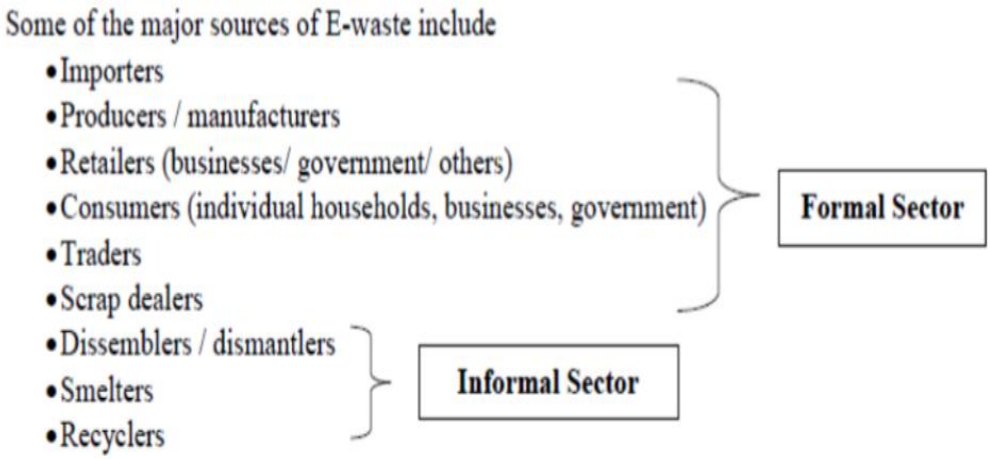

Figure 2. Sources of e-waste
International Journal of Environmental Sciences Volume 3 No.1,2012

5.3. Health and Environmental Implications

Electronic wastes that are landfilled produces contaminated leachates which eventually pollute the groundwater. Acids and sludge obtained from melting computer chips, if disposed on the ground causes acidification of soil. Mercury leaches when certain electronic devices, such as circuit breakers are destroyed. The same is true for polychlorinated biphenyls (PCBs) from condensers. When brominated flame retardant plastic or cadmium containing plastics are landfilled, both polybrominated diphenyl ethers (PBDE) and cadmium may leach into the soil and groundwater. It has been found that significant amounts of lead ion are dissolved from broken lead containing glass, such as the cone glass of cathode ray tubes, gets mixed with acid waters and are a common occurrence in landfills. In addition, uncontrolled fires may arise at landfills and this could be a frequent occurrence in many countries. When exposed to fire, metals and other chemical substances, such as the extremely toxic dioxins and furans (TCDD tetrachlorodibenzo-dioxin, PCDDspolychlorinated dibenzodioxins. PBDDs-polybrominated dibenzo-dioxin and PCDFs-poly chlorinated dibenzo furans) from halogenated flame retardant products can be emitted. The most dangerous form of burning E-waste is the open-air burning of plastics in order to recover copper and other metals. The toxic fall-out from open air burning affects the local environment and broader global air currents, depositing highly toxic byproducts in many places throughout the world. Incineration of E-waste possesses another threat. It can emit toxic fumes and gases, thereby polluting the surrounding air.

VI. RESULTS AND DISCUSSION

- The mean e-waste generated per household was found to be 81.29 kg with a standard deviation of 59.81kgwith a minimum amount of **5.6 kg** and a maximum quantity of **301.23 kg.**
- Out of the total e-waste generated the largest share belongs to Screens and Monitors (29%). The share of Temperature exchange equipment, and large equipment were 22% and 21% respectively. Small equipment contributed 20%. The remaining two categories, Lamps and Small IT & Telecommunication constitute a relatively smaller part, (6%) and (2%) of the total-waste generated.
- The electronic equipments were disposed mainly if they are- a) beyond repair b) high expense of repair or c) as new equipments with advanced features are available. It is inferred from the survey that the Refrigerators, TV and Mobile Phones are being discarded as most of the consumers want to have gadgets with better features while most of the consumers discard the Washing Machines and Mixers due to the high expense of repair.
- The most widely adopted modes of disposal of e-wastes are - a)exchanged for other goods b) sold it to scrap dealers c) gave it to friends or family d) threw away along with other waste e)lying in the house or backyard. The **temperature exchange equipment** and **large equipment** are mostly found to be exchanged for other goods. With regard to - **lamps, small equipment** and **small IT and telecommunication equipments** were mostly abandoned in the house or backyard.
- The majority of the consumers choose to use the products until beyond repair regardless of the category of electronic equipment to which they belong. The electronic products which are increasingly being repaired and used again by the households in the Refrigerators, Television, Desktop, Mixer and Mobile Phones.
- Only (28%) of the households are aware of the toxic components in the electronic devices
- There exists an association between educational qualification and awareness of toxic components (Chi-Square(3,N=100)+9.738,p=0.021) Even among the highly qualified group (PG or Professional degree holders), 50% were unaware about the toxicity of e-wastes. Within the gruaduates 69.24% are unaware and within those who possess only matriculation or below, only 0.1% have awareness about the toxicity of e-waste.
- The survey conducted also showed that (65%) of the households are willing to pay for the disposal of e-waste. Among them the majority (60%) are ready to pay upto 5% of the value of the product for an environment friendly e-waste management process. To pay (6-10%) or (11-20%) a very small portion of the total users are willing.

VII. CONCLUSION

The management of e-waste is a global problem and particularly challenging. This study has made an attempt to analyze the factors and their contribution to total e-waste generations, its quantification and total management and it was found that not a single unit or area is responsible but a series of uncontrollable practices led to piling up of this problem. It is found that the increase in purchasing power (household income) is strongly related to the quantity of e-waste generated. And there is an urgent need of generating awareness among the people about the best practices for collection mechanism of e-waste, to channelize the waste through standard methods of e-waste disposal management. Thus, the need of having a comprehensive strategy for **sustainable electronic product design**, **production** and **e-waste management** is highlighted in the study. The development of more effective technologically sound policies and strict enforcement of regulations will definitely check the faster growth of e-waste in the state.

VIII. REFERENCE

[1] Subrahmanian,K.K.(1990)Development Paradox of Kerala .Analysis of Industrial Stagnation. Economic and Political Weekly pp Sep.15,2053-2055.
[2] PTI, “India fifth largest producer of e-waste : study”. *The Hindu.* 18.October.2016.
[3] Kurian, M.V.,&John,R. (2014).Kerala Economy and its Emerging Issues,SahityaPravarthaka Co-operative Society Ltd, Kottayam.
[4] Nair K.N., Sridhar, R. (2005) Cleaning up Kerala submitted to Kerala Research Programmeon Local Level Development by Centre for Environment and Development December 2004.
[5] Nithya,N.R.(2013) Changing Trend of Consumerism in Kerala,*International Journal of Current Research* Vol. 5, November Issue, 11, pp. 3520-3523 .
[6] Koshy, Jacob. “What is India doing with its 2 million tonnes of e-waste every year?”. *The Hindu*. 14.January2018.
[7] Nair K.N.,Sridhar, R .(2005) Cleaning up Kerala submitted to Kerala Research Programme on Local Level Development by Centre for Environment and Development December 2004.
[8] Sunil Kumar, StephenR. Smith, Geoff Fowler, Costas Velis, S.Jyoti Kumar, Shashi Arya, Rena, Rakesh Kumar, Chris topher Cheeseman (2017) Challenges and opportunities associated with waste management in India. Royal Society,Open Science.
[9] Varma, A.R. (2006) Status of Municipal solid waste Generation in Kerala and their characteristics.
[10] CPCB(2012)Status report on Municipal Solid Waste Management .Central Pollution Control Board, Ministry of Environment& Forests .
[11] https://unu.edu/news/news/ewaste-2014-unu-report.html

[12] Government of India Environment Department-Electronic Wastes-Collection and Disposal-Orders Issued G.O.01/2014,Thiruvanathapuram,1stJanuary 2014

[13] DhanalakshmiT(2014), Impact of waste management technology on women waste workers in Composting – A case study of Ernakulum, *International Journal of Business and Administration Research Review*. Vol .I, Issue No.2, Nov-Jan2014.

[14] Siji, S. R.(2014).*Role of Kudumbasree in waste management a study of Ernakulum district.*Unpublished doctoral dissertation, Mahatma Gandhi University,Kottayam.

[15] Zoeteman, Bastiaan C. J., Harold R. Krikke, and Jan Venselaar. "Handling WEEE Waste Flows: On the Effectiveness of Producer Responsibility in a Globalizing World." *The International Journal of Advanced Manufacturing Technology* 47, no. 5–8 (March 2010): 415–36. https://doi.org/10.1007/s00170-009-2358-3

[16] Hilty, Lorenz M. "Electronic Waste—an Emerging Risk?" Environmental Impact Assessment Review 25, no. 5 (July 2005): 431–35. https://doi.org/10.1016/j.eiar.2005.04.002.

[17] Needhidasan, Santhanam, Melvin Samuel, and Ramalingam Chidambaram. "Electronic Waste – an Emerging Threat to the Environment of Urban India." Journal of Environmental Health Science and Engineering 12 (January 20, 2014): 36. https://doi.org/10.1186/2052-336X-12-36.

