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E-waste management: "A Case Study at the College of Science and Technology, Bhutan"

Jigme Zangpo[1], Karma Gayley[2], Karma Wangzom[3] and Karma Kelzang Eudon[4]

[1,2,3,4] Department of Electronics and Communication,
Royal University of Bhutan/College of Science and Technology,
Phuntsholing, Bhutan

Abstract

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. In this paper, it investigates the behavior of people towards e-waste, how they are segregating or managing e-waste among other household waste. The mobile phone waste (m-waste) has been found to be the highest number of mobile waste generation owing to its rapid change in technologies. With this goal in mind, questionnaire survey was performed in the campus of college of science and technology where it includes students from different family background and households which includes lecturers, cooks, security guards and sweeper.

Keywords: *Electrical and Electronic Equipment, M-waste.*

1. Introduction

E-waste or waste electrical and electronic equipment is the major problem in all developed and developing countries as it has given significant challenge towards waste management system. Owing to the rapid development of technologies, marketing and compatibility issues, the lifespan of electrical and electronic goods become considerably shortened, become waste electrical and electronics equipment (WEEE), which is referred to as Electronic waste or E-waste. E-waste has become serious issues which is an emerging global and local concern today due to the increasing amount of it.

Electrical and electronic equipment are being developed, applied and consumed in very large quantities worldwide [1]. [2] Stated that the electronics industry is the world's largest and fastest growing manufacturing industry. This situation has been partly attributed to the increasing affordability of electronic equipment, rapid innovation in technology and design, market expansion, increased consumer demand for newer electronic products, global population growth, rapid economic (GDP) growth, short innovation cycles, and the fact that global markets are far from saturation point [3], [4]. On the other hand, the fast replacement process means that large numbers of appliances are becoming old-fashioned despite the fact they are often times still quite functional. [5] Calculated the global production of e-waste to be between 20-50 million tons per year. A large amount of this is generated in countries of the OECD (organization for economic co-operation and development) such as Europe, the USA and Australia [6].Though per capita e-waste generation in Bhutan would be relatively low compared with OECD countries.

Now a day's mobile phone waste or m-waste has become one of the growing components in the e-waste as mobile phone is one of the necessary equipment without which it causes challenges for survival with other people in society or community. The production of mobile phones has reached 1.13 billion units, accounting for 70.6% of the global production. Mobile phones wastes are a part of WEEE (Waste Electrical and Electronic Equipment). Recent data shows an almost exponential growth in these values. The International Telecommunication Union's (ITU) latest reports estimates that more than 7 billion mobile phone subscriptions will be there globally by the end of 2015, with a population-wise penetration rate of 97% (ICT Facts and Figures, 2015).

The fast advancement in the technology, providing better models regularly forces the consumer to change their phones more frequently. This in turn results in very short service life of mobile phones and thereby generating large amount of waste streams

This paper starts off by reviewing current e-waste management and practices in College of Science and Technology. It then goes on to discuss the critical analysis and how E-waste management strategies can be implemented in and around the country, Bhutan and help overcome some of the barriers encountered at present.

Like other part of the world, Bhutan may also face serious problem due to the growing generation of e-waste, In the recent years it was observed that large quantity of e-waste has been exported from western countries to Asian countries for disposal. The main challenge is to create awareness of the environmental among the public, consumers, producers, institutions. So, Sustainable and safe use of technology is a big challenge for Bhutan. According to the respondents of the survey, people consume and dump the useless products without any consideration of environmental damages and sustainability

2. E-waste Management and Current Scenario

The e-waste or waste electrical and electronic equipment has posed a significant challenge towards waste management system as the number of population increases. When population increases, the use of electrical and electronic equipment increases which results in increased production of WEEE. According to the Global e-waste monitor report 2014 "The population of the world in the year 2010 is assumed to be 6.8 billion and 33.8 metric tons of e-waste is produced and in 2018 it is expected that population to be 7.1 billion and volume of e-waste to be 49.8 metric tons with an annual growth rate of 4 to 5 percent" [7]. From this we could derive the directly proportional relationship between e-waste production and increment in population. As per the Population and Housing census report of Bhutan 2005 (PHCB 2005) "The population of Bhutan was 634,982 in 2005 which is projected to grow to around 887,000 in 2030, an increase of 40% within the next 25 years" So can conclude that we cannot escape from such an alarming growing rate of e- waste production.

Most of the peoples in our country are unaware as laws related to e-waste is not strict. Currently, e-waste generated by the government(Bhutan) is dumped at the warehouse of the Department of National Properties (DNP) located in Chagzamtog and it is stated that the Waste Prevention and Management Regulation 2012 requires that government agencies bring their e-waste to the DNP, which is then permitted to auction them to e-waste management entities or any other entities deemed appropriate by the DITT [8].It is not known whether these scrap dealers handle and dispose of these e-waste in an environmentally friendly way in India and moreover the Waste Prevention and Management Regulation 2012 also requires that the e-waste management entity besides being collected, transported, sorted and recycled in an environmentally sound way, also ensure the occupational health and safety of personnel handling e-waste. However it is mentioned in Department of Information Technology and Telecom (DITT) report that Bhutan will handle and dispose of its e-waste in an environmentally friendly way from the fiscal year 2016-2017. We could conclude that main reason for letting room for e-waste to grow at an alarming rate is the poor implementation of rules and regulations that are in place.

From the most common e-waste generated in our country, mobile phone had become one of the most abundant electronic product and fastest growing e-waste item. The rapid technology with better functions and models encouraged the customers to change mobile phones more frequently, which leads to the short lifetime of cell phone. According to the Bhutan Living Standard Survey (BLSS) 2012, " 90.7 percent of household from total respondents in rural areas has mobile phone and 96.7 percent of household in urban area has mobile phone" which is comparatively higher than other household electronic items [9].

3. Research Methodology

3.1 Overview of Study Area

Our case study of e-waste covers the campus of College of Science and Technology, CST, where we are currently studying. Literature review was conducted on major areas of electronic waste management and available strategies for managing electronic waste especially in developing countries, to appraise existing electronic waste management practices system and moreover to bring changes in practiced system by proposing new management system in our college and country as whole. We had concentrated our study in two areas that is households and student. So in order to get required data, two different survey questionnaires were set up for students and households. The reason behind for collecting data from the students is that, student of our college comprises of diverse family background and from diverse region. From different e-waste component, we

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had focused more on mobile phone waste (m-waste) generation toward student as students keeps update on state-of-art technology, we thought that we could get correct information. We carried out survey for household because they use most of the electrical and electronic appliances, so form them we could see the increment of e-waste production, behavior towards e-waste management and current disposal strategies.

3.2 Sampling Method

The survey was targeted to cover 71% from households and 65% from students. 50 samples from household and 500 samples from student. Information was gathered from face to face interview rather than gathering all data by distributing question papers every hotels for students. There are 344 rooms in 7 blocks and collected 344 samples. The remaining 156 divided among 7 blocks and 20 samples are being collected from 6 blocks and 36 samples from block having 96 rooms. The total of 500 samples is collected.
In regards to household, 50 data samples were being collected. The collection of data was done by face to face interview from illiterate head of household and provided survey questionnaires to educated household head.

3.3 Data Analysis

The available tools for Data Analysis are SAS (State of the art Statistical Analysis Software), R (R Project for Statistical Computing), Stata (Data Analysis and Statistical Software) and SPSS (Statistical Package for the Social Science). Among the software, SPSS emerge to be easy and accurate software to use in this data analysis owing to its simplicity in use and analysis.

4. Results and Discussion

4.1 Hostel Occupants (Students)

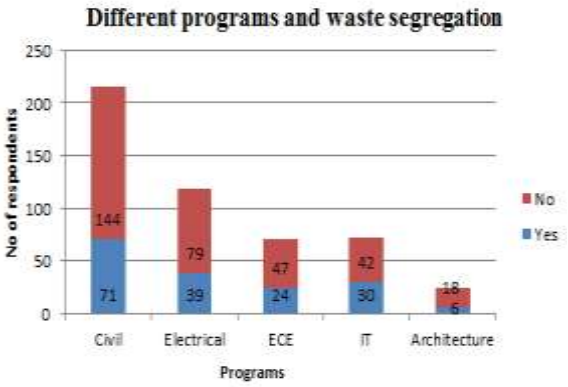

Fig 1: Different programs and waste segregation

From this graphical data, it shows different programs and waste segregation among programs.

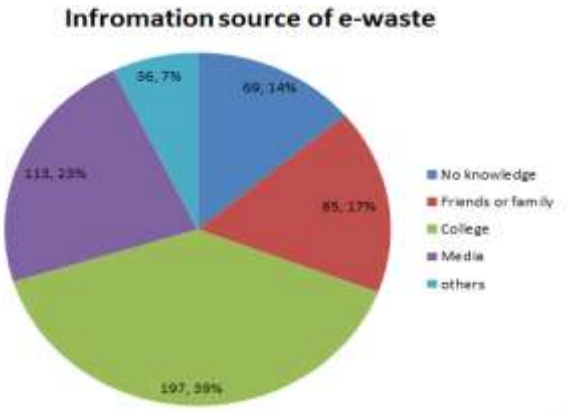

Fig 2: Information source of e-waste

The above figure shows source of information of e-waste.
Above pie chart shows the information source of e-waste. Out of 500 respondents, 39% which corresponds to 197 from 500 had given information as they got information from college which is highest as compared to other sources and we could also show that college plays an important role in giving awareness to students. To our surprise there is also student who doesn't have knowledge of e-waste and it is 14% of total.

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Fig 3: M-waste disposal strategies

The above figure shows the disposal strategies of Mobile Phone waste (M-waste) as per the respondents. Most of the respondents (224) had end-of-use mobile phone at home.177 respondents gave away to another person, whereas 32 of respondents dumped with the municipal wastes. Based on the above data, it shows that there is no concrete disposal strategies. The option like "Gave away, Stored at home, Sold to another person and Dumped it in the garbage" respondents is more. From this, it clearly say there is no disposal strategies of e-waste in place. In the other option "Others" the respondents had specified what they did with their M-waste. There are few respondents who segregate m-waste from other waste.

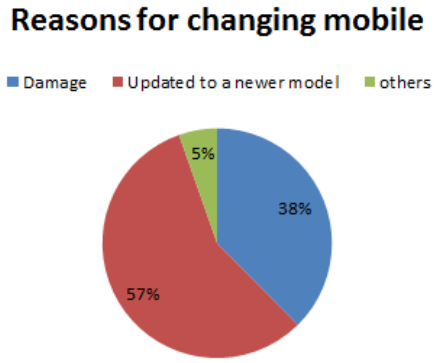


Fig 4: Reasons for changing Mobile phone

From the aforementioned pie chart it show that 57 % respondent updated to a newer model which contributes to more amount of the waste generation. Therefore, it shows that the fast advancement in the technology, providing better models regularly forces the consumer to change their phones more frequently. This in turn results in very short service life of mobile phones and thereby contributes to generation large amount of waste streams.

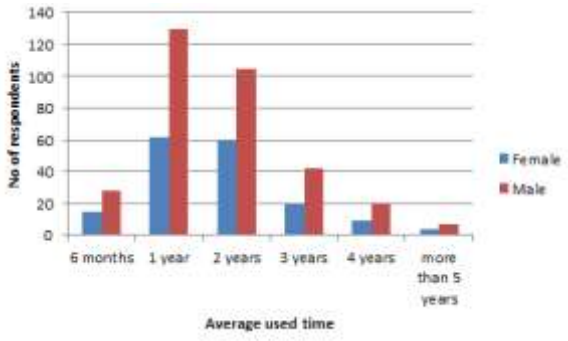
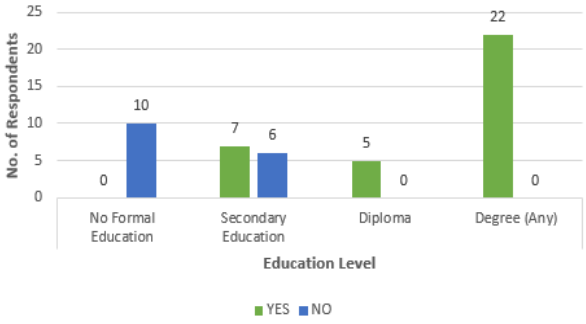


Fig 5:Frequency of mobile phone use

The above figure shows the average use of the mobile phone by the survey respondents. It shows that majority of respondents uses mobile phone for 1 year or 2 years which depicts that the contribution towards the generation of e-waste increases.



4.2 Household Data

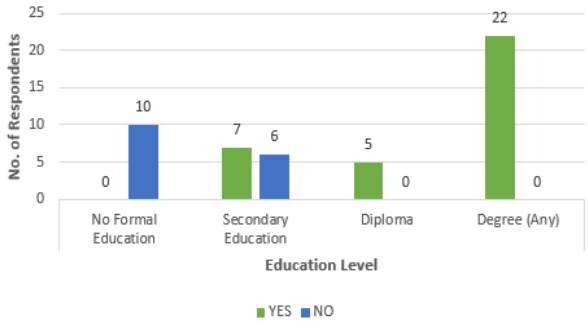


Fig 6: Awareness level of households

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Above graph shows the awareness level about the e-waste among the people with different level of education. Respondents with highest education level, Degree know more about e-waste than respondents with no formal education. 58.33% of respondent with Degree know what e-waste is and 57.14% of respondents with no education don't know what e-waste is. It is therefore educated people to educate what is e-waste and how harmful the e-waste is to illiterate people. Now let us look at from where information about e-waste is being informed to people in below pie diagram.

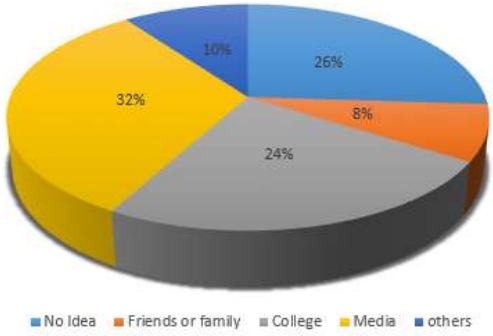

Fig 7: Information source about e-waste

Above pie diagram shows the where information about e-waste is being informed to the people. 16.32% of information about e-waste is from media and followed by other and college with 13.26% and 12.24% respectively. Since media and college play vital role in informing the information about e-waste, media department and college management should take measure to campaign about the e-waste.

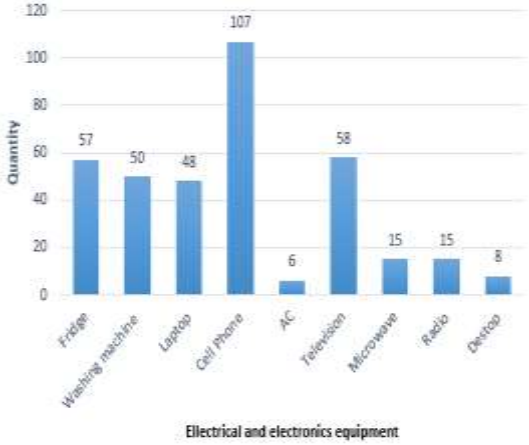

Fig 8: Quantities of the electrical and electronics equipment (EEE)

Above figure shows the quantities of the electrical and electronics equipment (EEQ) used by 50 household. Among the EEQ, cell phone was highest with 107 numbers and followed by television with 58. Every household has televisions and cellphones. Which means television and cellphone contributes more in generating e-waste than any other EEQ. We will look at how frequently respondent change their cellphone.

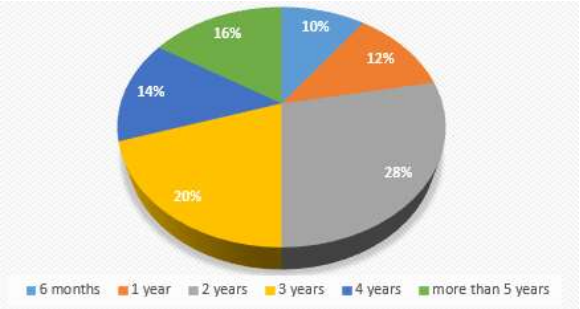

Fig 9: Pie chart showing how many years respondents use cellphone

There are respondent who use cellphone for 6 months or more than 5 years. But respondents with cellphone using for 2 years is 28% followed by respondents using for 3 year with 20%. It is clearly indicating the cellphone contribute in generating e-waste since cellphone are used for minimum years by respondents.

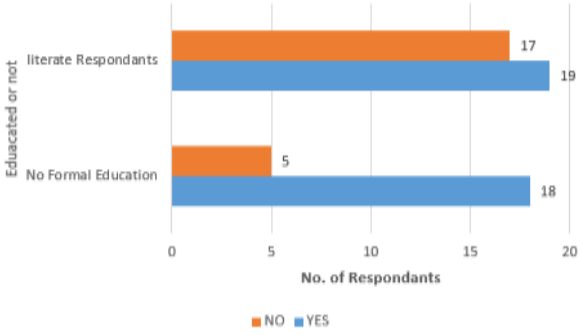

Fig 10: Respondents dumping e-waste with household waste

Above graph shows the relationship between the education level and caring of e-waste. It clearly shows that people with no formal education tend to dump e-waste with household waste more than educated people. People with Degree level of education care about e-waste and segregate e-waste from household waste.

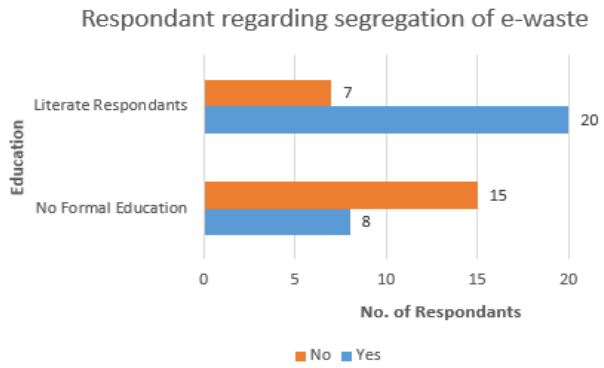

Fig 11: Respondents segregation of e-waste from other waste

Above figure shows the relationship between the education level and segregation of e-waste. The figure clearly shows people with no formal education don't segregate e-waste is more than people who are educated. Educated people segregation of e-waste is more than people with no education.

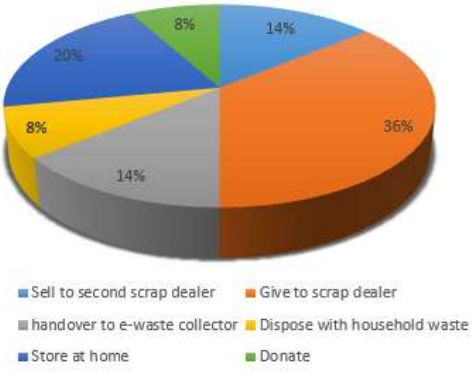

Fig 12: Disposal strategies of electrical and electronics appliances

The above figure shows the disposal strategies of electrical appliances. There is no concrete disposal strategy. There should be take back system or extended producer responsibility. Take back system and extended producer responsibility are similar. It has implemented in develop country like Japan, Thailand and so on. In that system the brand who sold the Electrical and Electronics Equipment should take the same when it became outdated.

6. Conclusions

E-waste in Bhutan has become major problem owing to no appropriate disposal in place. The increasing number of Mobile phone usage and changing mobile phone within few years contribute in generating e-waste. As per the Bhutan Waste Prevention and Management Regulation 2012, Department of Information Technology and Telecom (DITT) is fully responsible for e-waste management.

The only data about Electrical and Electronics Equipment in Bhutan can be seen in National Statistics Bureau website, http://www.nsb.gov.bt/. They conduct Bhutan Living Standard Survey (BLSS) every four years and include small portion about Electrical and Electronics Equipment use in household.

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