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SRI LANKAN CONSUMER PERCEPTIONS ON E-WASTE RECYCLING

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ABSTRACT

Sri Lanka has the potential to support the national circular economy, though Sri Lanka suffers from the problem of rapid generation of E-Waste. E-Waste generation is inevitable in the constantly developing technology industry and has usually been treated as a burden per the perception. Reusing and recycling E-Waste can positively impact the circular economy because E-Waste is recyclable and is beneficial in recovering valuable metal components that are rapidly depleting. The public's perception of reusing electronic waste and its challenges and limitations as a new business model have all been thoroughly examined. The study's findings can be used to establish a sustainable business model to effectively assess managing E-Waste by demonstrating how consumers' perceptions can effectively be examined.

Key Words: E-Waste, Recycling, WTP, EEE

1. Introduction

Due to the expansion of the economy, increasing living standards, rapid urbanization, innovation, and the influence of western culture, the generation of electronic waste (E-Waste) has become a significant global issue. These factors have a direct impact on the usage rate of electrical and electronic equipment (EEE) (Arain et al., 2020; Yin et al., 2014). The amount of E-Waste, generated in 2016 was estimated at 44.7 million metric tons (Mt) (Cai et al., 2020). By 2019, there were 53.6 million tons of electronic waste generated worldwide, with the United States contributing roughly 10 million tons and Europe about 8.3 million tons (Miner et al., 2020)(Table 1). Developed countries export their electronic waste to developing countries, which receive payment as a result and it increases the improper handling of E-Waste (Abalansa et al 2021).

E-Waste contains different chemicals and the majority of them are toxic and dangerous metals, which affect human health and the environment (Peluola, 2016). Toxic metals like lead (Pb), mercury (Hg), and cadmium (Cd) are the chemicals that are most frequently reported (Akhtar et al., 2014; Kiddee et al., 2013; Ben-Enukora et al., 2017; Lu et al., 2006). India has recycled between 5 and 10 percent of such waste sustainably in the formal sector (Sengupta et al., 2022). Value recovery and E-Waste treatment are dominated by the informal sector in India. Thus, India must develop a sustainable E-Waste business (Sengupta et al., 2022).

Table 1: Global Generation of E-Waste in 2019

Region	Amount	Properly recycled amount
Asia	24.9Mt	11.7%
America	13.1Mt	9.4%
Europe	12Mt	42.5%
Africa	2.9Mt	0.9%
Australia	0.7Mt	8.8%

China also struggles with informal E-Waste recycling, and they have implemented formal laws and regulations to ensure proper handling of E-Waste. (Cai et al., 2020).

Reasons for expansion in E-Waste production in Sri Lanka have increased usage of information technology equipment, and consumption of large household appliances (Samarakoon.M.B, 2014). In 2008 30% of imported EEE was secondhand in Sri Lanka. The downside of second-hand equipment is that they have a shorter lifespan, and quickly turns into E-Waste (Auditor General's Department, 2015). But Sri Lanka has adopted the Basel Convention, which places restrictions on the export of E-Waste. The contributors to E-Waste in Sri Lanka have been recognized as households, commercial sectors, and industries (Ranasinghe & Athapattu, 2019)

Import-export laws and tax policies must be implemented and the government should implement the necessary infrastructure for waste disposal, collection, storage and transportation. Awareness campaigns on the harmful effects can be implemented to change people's perceptions and behaviors toward proper E-Waste recycling. There was no proper research done in Sri Lanka which identify the value of E-Waste as a business

opportunity. Our research aims to understand how public opinion affects E-Waste management and recycling in Sri Lanka. Using survey data, this study examines how the Sri Lankan public perception can influence E-Waste management and recycling in Sri Lanka. The study's findings can be used to establish a sustainable business model that can be successfully used to manage E-Waste by demonstrating how people's perceptions can be evaluated.

Background

Sri Lankan perception of E-Waste management

Age, income, gender, region, and education are some of the demographic factors that might directly affect a customer's recycling practices. These factors can influence people's perceptions. Sri Lanka is a developing nation with a lower per capita income. As a result, consumers may not be as interested in paying for recycling if they don't have enough money. Additionally, by selling E-Waste to improper waste collectors, they can make money and it is convenient because the vendors visit the households. People's levels of education are also generally poor, particularly in rural communities. Thus, there is a low probability that people will comprehend the harmful effects and substances even if awareness initiatives are implemented. When cultural factors are taken into account, Sri Lankans are reluctant to discard EEE, even if they are no longer functional. They prefer to keep EEE at home in the event that it has to be repaired or in the event that some of the equipment's components might still be functional. The majority of developing nations experience this problem. A prior study suggested that the cause may be a lack of knowledge and education (Gunarathne et al., 2020).

With Sri Lanka's adoption of a free market economy, usage and demand for the electronic equipment that is utilized for daily tasks have risen significantly. Additionally, between 22.5 to 23.5 percent of households now own computers, rising from 22.5 percent in 2016. Only a relatively small amount of electronic equipment was produced domestically; approximately 95% of it was imported. According to a Census survey on computer literacy (Auditor General's Department, 2015), about 25% of households in the country own a computer. Sri Lanka lacks sophisticated strategies aside from a few forms of equipment like CFL bulbs, mobile phones, computers, etc (ELECTRONIC WASTE MANAGEMENT IN SRI LANKA, n.d). People are obliged to store their broken equipment in their homes or dispose it because they have no other choice. Studies conducted in Sri Lanka in the past have classified several types of E-Waste. According to one survey, the top three sources of E-Waste are lighting equipment, IT and telecommunications equipment, and household appliances (Mallawarachchi & Karunasena, 2012).

Even educated people in Sri Lanka are unaware about the proper methods of E-Waste disposal and therefore general public frequently uses informal waste disposal methods without considering the consequences (Ranasinghe & Athapattu, 2019). Since proper recycling behavior can be directly impacted by the adverse effects of E-Waste, the government must inform individuals about these effects. E-Waste recycling management is the responsibility of both the public and the manufacturing industry. Manufacturing industries can also adopt E-Waste recycling techniques, which will at the very least mitigate improper E-Waste disposal and decrease environmental pollution.

The mass media and telecommunications industries must raise the level of awareness of all E-Waste stakeholders.

2. Literature Review

E-Waste disposal methods have a severe impact on both human health and the environment. Using improper disposal methods can cause adverse effects like environmental pollution and many health problems like cancers, lung diseases, and DNA damage (Forti et al., 2020). Because of the lack of efficient E-Waste management systems, women who live near informal recycling plants face stillbirths and premature births problems. Further, there are more poor people who contribute to E-Waste handling, and they suffer from various diseases. Such as itchy eyes, skin irritations, burns, and stress (Abalansa et al., 2021). As a result of improper management of E-Waste, global warming, water pollution, and soil pollution increase. Also, through foods, these hazardous substances can enter the human body as well (Ranasinghe & Athapattu, 2019).

A study done in Bangladesh (Ananno et al., 2021) discovered that people are not aware of E-Waste recycling and what it means, the adverse effect of improper recycling, the difference between formal and informal recycling, and most importantly not aware about E-Waste related laws and regulations in effect within the country. Logistic regression analysis was conducted to determine the factors influencing willingness to pay. The result shows that environmental awareness and purchasing power have an influence on willingness to pay (WTP) and the region does not have any influence on WTP (Ananno et al., 2021). USA study (Arain et al., 2020) has done using university students and lecturers as the target group and it shows that having a certain level of education is not alone sufficient and they should also focus on consumer beliefs about their responsibilities and minimizing the individual recycling cost. They have used one-way ANOVA and chi-square to show that increasing consumer knowledge about E-Waste and proper E-Waste recycling practices has a positive impact on consumer behavior toward E-Waste (Arain et al., 2020).

China (Cai et al., 2020) has done a research to determine the factors affecting WTP. Results show that monthly income and respondent's environmental consideration are highly influential on WTP. But the level of education does not have an influence on WTP. Findings stated that it can be because, educated people expect that the recycling cost is the responsibility of manufacturers and governments rather than themselves.

There are limitations also when doing research such as not enough studies have been done focusing on sufficient incentivization from the consumer perspective. Not enough studies have been done focusing on understanding the differences in socioeconomic predictors of E-Waste recycling behaviors. Limitations in implementation of data collection methods (self-selection bias respondents, unable to collect responses from community members, etc.) (Arain et al., 2020). The lack of respondents and data sources are the main limitations of the research. And also, there are limitations in contacting the stakeholders related to the E-Waste recycling industry. Further, as they have used a quantitative approach, the generalizing of findings is limited (Gunarathne et al., 2020). A simple random sampling method was used in the descriptive study, therefore unable to denote the entire community of the E-Waste management stream

accurately. Bias answers by respondents as some respondents over-report their knowledge to be viewed as good by data collectors (Uhunamure et al., 2021).

3. Methodology

Survey Design and Methodology

The preliminary investigation for this emerging E-Waste management business was initiated through informal interviews and online questionnaires. We employed online platforms and designed these interviews and questionnaires in Sinhala, Tamil, and English to reach a broader audience in Sri Lanka. Also, the informal interviews were conducted in public places. The sample population of the study is 727 and convenient sampling was used as the sampling technique. Past studies have categorized survey questions based on multiple sets of criteria such as socio-economic characteristics, knowledge & perceptions, awareness, attitude towards E-Waste recycling behavior, willingness to pay, demographic characteristics, motives for changing electronic merchandise, and environmental problems aligned with E-Waste management (Akhtar et al., 2014; Ananno et al., 2021; Uhunamure et al., 2021). The questionnaires were developed to holistically include four categories: Demographics, Awareness, Behavior, Perception, and Attitudes. The questionnaire has been published within the time period between January to March of 2022. Participation in the questionnaire is entirely based on the respondent's willingness. The questionnaire entails a few Likert scale-type questions also. The labels are as follows for the questions under the section of perception & attitudes; "Strongly disagree", "disagree", "agree to some extent", "agree", and "strongly agree". There is another question under that section which has labeled as below; "Does not care", "Is somewhat concerned", "Usually concerned", "Is concerned", and "Definitely care". Another question that has Likert scales is also there and it is about the satisfaction of the current E-Waste recycling and management. "Strongly dissatisfied", "dissatisfied", "normal", "satisfied", and "strongly satisfied" are the labels for that question.

To achieve the research objectives, gathered information was organized by using Microsoft excel and python. After completing the organization phase, we visualized the data in Power BI and then the analysis phase originated. Dummy variables and coded variables were used to convert the categorical variables into quantitative variables. Due to PCA capturing the variables that have the highest variance, we identified the variables as age, income, belief about the adverse effect of E-Waste on human health and the environment, expected lifetime for small EEE, satisfaction about current E-Waste management, caring convenience when disposing E-Waste. Then, we applied the Decision Tree method as a machine learning technique, and to optimize the tree we used pruning methods in order to achieve the research objectives.

4. Results

According to the survey data, 68% of the respondents are aware about E-Waste. Though the majority are aware of E-Waste, most of them (nearly 80%) do not know about E-Waste laws and policies [Figure 1]. Moreover, 47% of the respondents in Sri Lanka are not aware whether there is a nearby E-Waste collection center. According to the Figure

2, In western province also approximately 55% in Gampaha and 50% in Colombo do not have any idea about the nearby E-Waste collection center. But, in Kalutara majority (48%) tells that they do not have a nearby E-Waste collection center and 42% are not aware about the E-Waste collection center. Therefore, there is a shortage of the availability of E-Waste collection centers around the country. And the awareness about E-Waste among the people should be increased to establish a sustainable E-Waste management system.

Consumers discard EEE from use because the usable time period is over, technological obsolescence, high repair cost, and inability to repair. Hence, the manufacturers or sellers can implement a system to collect EEE from consumers at the end of the usable time period and offer an incentive such as a discount. Then consumers also tend to hand over their E-Waste to the manufacturers due to the incentive, then the E-Waste collection system also will be more systematic. Further, nearly 80% of the respondents do not prefer to take their E-Waste to recycling centers due to some circumstances such as not having proper transportation facilities. Thus, building E-Waste recycling centers without a proper transportation system would not be a solution for the proper disposal of E-Waste. As per the survey results, nearly 70% of the respondents prefer a system where collectors come and carry their E-Waste. Thus, E-Waste recycling centers should have proper waste collection methods. According to questionnaire results, 10.97% of people transfer their E-Waste to recycling centers, and also, most of the people prefer to repair their broken equipment by a technician (26.39%). The third most preferred option is, storing at home which is 13.3%. This may happen because some people do not throw EEE due to they know the adverse effect of E-Waste or some of them may have space in their houses and it would not be a burden for them. Although some people are aware of the adverse effect of E-Waste, they would end up throwing broken equipment because it would become a burden for them in the last and this can happen due to the unawareness of E-Waste as well. People prefer selling E-Waste to scrap metal collectors, disposal as general waste, or outdoor combustion as well [Figure 3]. Therefore, transferring E-Waste to recycling centers represents the minimum preference among the other options. But, to lay the foundation for the emerging E-Waste management business, we have to develop this sector.

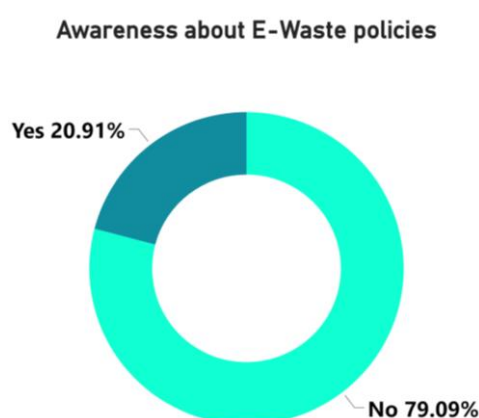


Figure 1. Awareness about E-Waste Policies

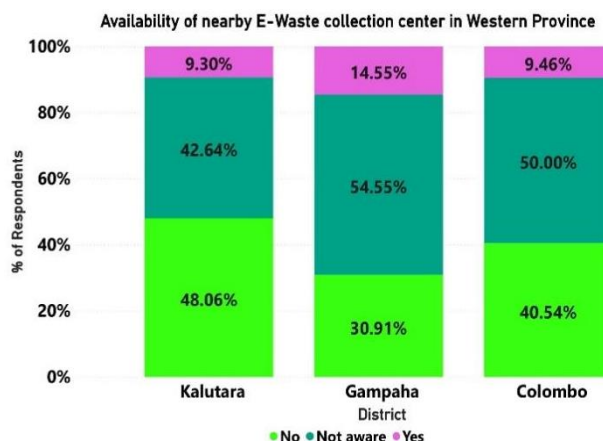


Figure 2. Availability of nearby E-Waste collection center

The questionnaire also gathered data regarding the perceived durability of some electronic equipment. We have chosen six pieces of equipment based on the categorization of electrical and electronic equipment. Equipment used for temperature exchange includes air conditioners. 77% from the survey participants have been using air conditioners for over four years and 70% of the respondents have been using laptops also for over four years, which have been classified as screens and monitors. Mobile phones are categorized as small IT and telecommunication equipment that is often utilized for longer than four years by 65% of the respondents. Calculators also come under small equipment that is frequently used for four years or longer by 53%. The lamps including LED bulbs, which are typically used for just one to two years by nearly 70% of the respondents. 83.4% of the respondents have used washing machines for more than four years among other appliances. It belongs to the category of heavy equipment. These responses indicate that consumers believe electronic equipment, excluding lamps, has a lifespan of at least four years. Figure 4 shows the reasons for why people are refusing to pay for a proper E-Waste management system. The highest number of people (32.3%) are refusing to pay because of not having enough income. As a developing country with a low per capita income, insufficient income can have a significant impact on initiating proper recycling practices. Some people are refusing to pay due to a lack of information available regarding the E-Waste recycling process (17.49%). 11.5% of people think that the government should pay for proper E-Waste recycling while 9.9% think manufacturing companies should be responsible for proper E-Waste recycling.

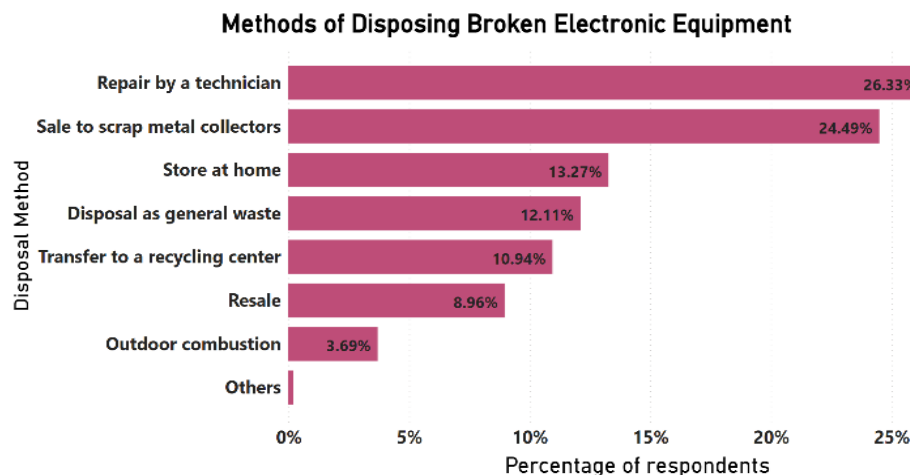


Figure 3. Disposal Methods of Broken EEE

Fewer respondents (29 respondents) believe that the responsibility of proper management of E-Waste should be undertaken only by the manufacturers. The majority (292 respondents) believe that consumers are solely responsible for managing and recycling E-Waste. This is followed by another large group of respondents (221 respondents) supporting the idea that E-Waste management and recycling should be handled jointly by consumers, government and manufacturers [Figure 5 – Responsible Parties for E-Waste Management]. Figure 5 (Willingness to Pay for Recycling) demonstrates that majority is willing to pay for a proper E-Waste management system and it is near to 60% from the total respondents.

According to the decision tree, the root node represents how customers care about their convenience when disposing of E-Waste and their satisfaction towards current E-Waste management system. The other nodes represent how people believe about the adverse effect of E-Waste on human health and the environment, customer age, and expected lifetime for mobile phones, calculators, and LED bulbs. Therefore, consumers' convenience is more influential on E-Waste perception regarding Willingness to Pay. They will prefer if proper E-Waste collectors come home and collect their E-Waste. And also, customers should have a positive mindset regarding the current E-Waste management system. Then only the responsible parties can persuade consumers to the willingness to pay method. The system should focus more on the lifetime of small EEE due to most people use small EEE. Therefore, as an emerging business, focusing on each individual person will be more effective as almost every individual uses a mobile phone, laptop, calculator, etc. In addition to that, when we compare the organizational level and household level, there will be a huge generation of E-Waste from the organizational level than households because at the present most organizations utilize computers, phones, air-conditioners, fans, and printing machines, etc. As another node of the decision tree entails the belief about the adverse effect of E-Waste on human health and the environment. To this end enhancing awareness about E-Waste among school children and young people will be more efficient when developing a sustainable E-Waste management system. School children and young people are more significant due to they are the ones who are going to be the customers of the emerging E-Waste management business.

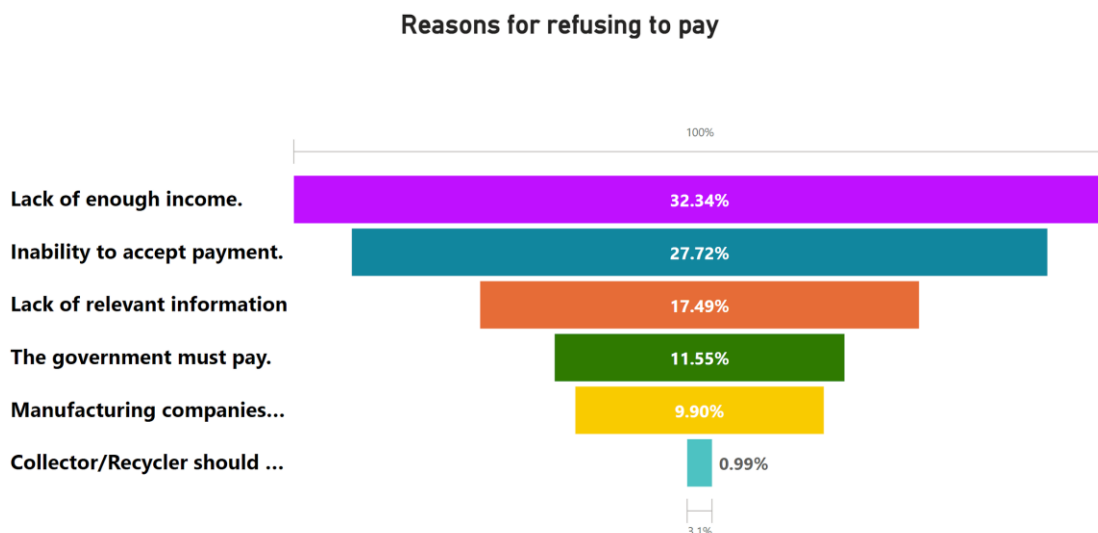


Figure 4. Reasons for not Willing to Pay for a Proper E-Waste Management System

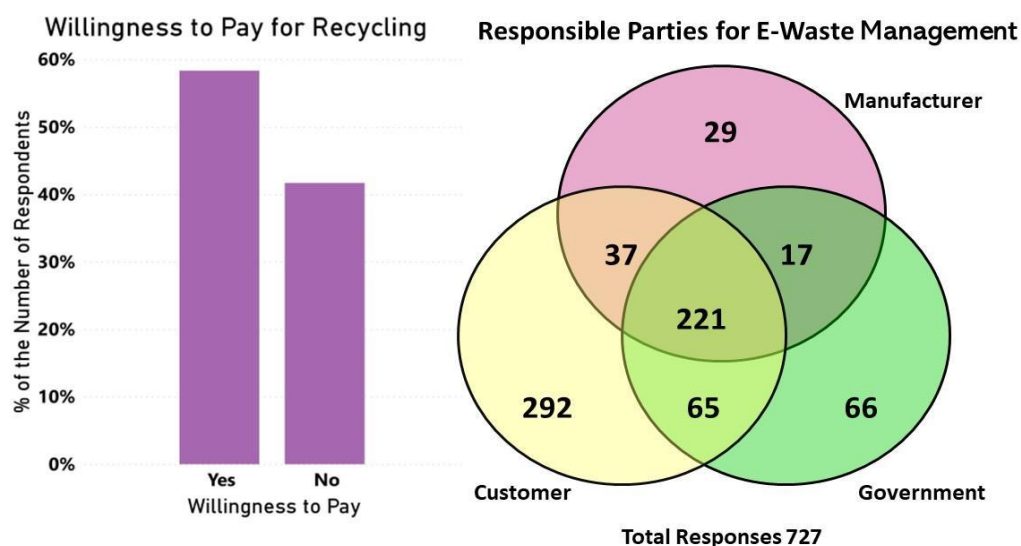


Figure 5. WTP for Proper E-Waste Recycling & Responsible Parties for Proper E-Waste Management

5. Conclusion

Sri Lanka needs a proper E-Waste management system to manage E-Waste sustainably. To this end, Sri Lanka can make a strategy to collect, extract, and recycle E-Waste by integrating the government and the manufacturers. According to our study, people care a lot about their convenience when they discard E-Waste. Therefore, if the responsible parties can implement a method to collect E-Waste at the village level, then the people will tend to discard E-Waste properly. Moreover, though most people are aware of the adverse effects of E-Waste on human health and the environment, they dispose E-Waste without considering hazardous substances, diseases caused by E-Waste, and proper E-Waste management methods. Therefore, launching awareness programs to educate people regarding E-Waste, will be more helpful in developing a sustainable E-Waste management system. In addition to that, our research reveals that most of consumers use small electrical equipment such as mobile phones, calculators, LED bulbs, etc.

Therefore, it would be more effective if manufacturers or sellers could provide a way to collect EEE at the end of their life when people purchase it. Even though Sri Lanka has few policies to mitigate the E-Waste problem, still those policies have not been able to cover the entire E-Waste industry. Thus, if some legislative changes can be done to the existing laws and regulations, the policies will be strengthened. Considering the above factors will be more effective when Sri Lanka develops a sustainable E-Waste management system as an emerging business.

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