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Public Opinion on Waste Electrical and Electronic Equipment (WEEE) Management in Colombo, Gampaha, Galle, Kandy, and Matara (Sri Lanka): A Case Study

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***Abstract*—The significant issue at hand is the alarming surge in waste resulting from the use of Electrical and Electronic Equipment (EEE), which, due to its non-biodegradable nature, poses a substantial threat to society. In light of this, this study aimed to assess the level of public awareness regarding e-waste management. A survey employing a questionnaire was carried out to collect data regarding public opinion on the management of WEEE. The survey involved 99 respondents from five different districts. The research findings indicate that 70% of Matara respondents are informed about E-waste management policies. Furthermore, 61% of respondents in Galle, 50% in Colombo, 43% in Gampaha, 35% in Kandy, and 34% in Matara are aware of the potential risks linked to WEEE. The results reveal that 53.8% of respondents practice E-waste segregation, while 50% in Colombo and Gampaha resort to burying E-waste at their residences. Notably, 19% of respondents in Galle opt for compost bins, and 25% in Kandy and Matara choose to sell electronic waste to collectors. Environmental and human health impacts of WEEE are known by just 50% of the respondents from Colombo, 43% in Gampaha, 61% in Galle, 35% in Kandy, and a mere 34% of the respondents in Matara. While all respondents in Colombo are knowledgeable about businesses that collect recyclable materials, a larger segment of the respondents in Gampaha (68%), Galle (53%), Kandy (85%), and Matara (65%) seem to be unaware of such services. A comprehensive approach is essential for addressing environmental challenges associated with WEEE.**

Keywords—Waste management, electrical and electronic equipment, e-waste, regulations

I. INTRODUCTION

The continual development of technology leads to shorter product lifecycles and an ever-increasing pile of electronic garbage (e-waste), which is created. Metals, polymers, glass, and chemicals, which are hazardous and not biodegradable, are among the diverse materials in these gadgets. Due to the seeping of harmful compounds into soil and water sources, improper disposal, which frequently ends up in landfills or incinerators, can cause environmental degradation and health concerns. Waste management is a critical global challenge, and Sri Lanka [1, 2] is currently grappling with the emergence of electronic waste (e-waste) as a significant component of its waste stream. Waste management is a critical global challenge, and Sri Lanka is currently grappling with the emergence of e-waste as a significant component of its waste stream [5].

In 2016, e-waste accounted for approximately 0.2% of municipal solid waste (MSW), and it was projected to increase due to the growth of urbanization and improvements in the quality of life [3]. E-waste is categorized into two main groups: white goods, such as refrigerators, washing machines, air conditioners, electric ovens, and toys, which consist of materials that can be readily recycled locally and contain fewer hazardous components; and non-white goods, including computers, televisions, printers, and mobile phones, which contain significant amounts of hazardous materials, as identified by EML in 2016 [4].

Moreover, according to the "global overview report for digital 2022," device ownership figures indicate the following: 96.6% use some form of mobile phone, 96.2% use a smartphone, 8.8% use a feature phone, 63.1% use a laptop or desktop computer, 34.8% use a tablet device, 20.3% use a gaming console, 27.4% use a smartwatch or smart wristband,

15.5% use a TV streaming device, 14.1% use a smart home device, and 4.8% use a virtual reality device. Consequently, electronic waste is increasingly becoming a major concern in Sri Lanka [6].

To comprehensively understand the intricate aspects of household e-waste management, this research delves into the drivers of behavior within communities and the obstacles they face. Promoting sustainable practices, enhancing e-waste recycling rates, and mitigating the environmental repercussions resulting from household e-waste mismanagement are of paramount importance. Furthermore, gaining a deeper understanding of these trends is crucial for devising well-informed and effective solutions. Therefore, the driving force behind this research is our commitment to acquiring a comprehensive understanding of these critical aspects, primarily driven by the need to gauge public opinions on Waste Electrical and Electronic Equipment (WEEE) management in Sri Lanka. As e-waste continues to accumulate, our study seeks to explore the broader landscape of e-waste collection in the country. Specifically, we aimed to assess the level of public awareness about e-waste, the knowledge of proper e-waste disposal procedures, and the quantification of annual e-waste collections.

II. Materials and Methods

A questionnaire-based survey was conducted to collect data on public opinion on WEEE management, using a population of 99 respondents that was selected based on convenience sampling. For the survey, five districts were selected. These selected districts were Colombo, Gampaha, Galle, Kandy, and Matara (Fig. 1).

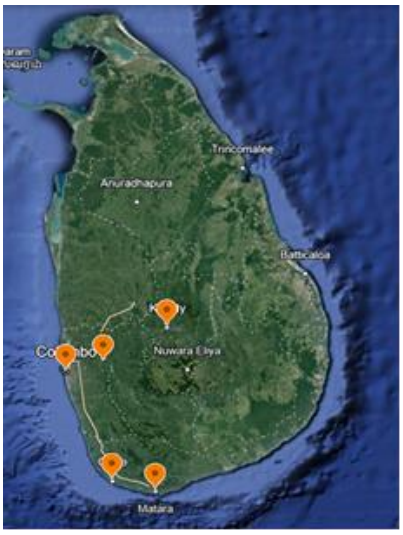

Fig. 1: Study area (Ref: Google Earth)

The survey was conducted using various electronic methods, such as email, Facebook, and WhatsApp, supplemented by personal phone calls over two months in September and October 2023. Additionally, in-person face-to-face interviews were also conducted. The questionnaire comprised with 35 questions; a mixture of Likert scale, multiple-choice, and open-ended questions. The 35 questions included personal information (Q1 - Q7), how they separate their garbage (Q8 - Q12), dispose of WEEE (Q13), factors to consider when purchasing (EEE) and do they separate (WEEE) (Q14 - Q19), one of the most important factors taken into consideration when WEEE dispose/collection,(Q20) Awareness on discarded e-waste re-cycling (Q21-Q22), Opinion of WEEE collection for dispose responsibility (Q23), awareness of hazards present in electronic products(Q24-Q26), source of information to dispose WEEE (Q27), like to participate E-Waste related collection or awareness programs (Q28-Q29), most important way to control WEEE pollution(Q30), awareness of e-waste management policy(Q31), If green products are available are they willing to pay additional for EEE(Q32-Q33), If the government wants to develop a good E-waste system, are they willing to pay a reasonable amount of disposal fee (Q34), Comments for improvement of WEE management in their area(Q35). Ethical clearance was obtained prior to the research due to the participation of human subjects in the study. Their demographic details and responses to the questions were collected only for the purpose of the study, and the respondents were informed about this at the beginning of the survey. All the respondents participated in the survey as volunteers. The respondents' consent was secured for their voluntary participation in the survey after informing the respondents about the purpose of the study and the potential dissemination of the outcome prior to the survey.

III. Results and Discussion

A. *Demographic Characteristics*

The age range of the test population was between 17 to 60 years. The majority of respondents (79.04%) were 20 - 30 years old. Nearly 8% and 13% of the respondents represented the age groups of 17-20 years and 30-60 years, respectively. Among the respondents, a majority were graduates and above level (32.1%), while 27.4%, 20.8%, and 9.4% were up to A/L, diploma & other, and professional degree, respectively. Furthermore, the majority of respondents (76.4%) had one family. The others are single-member families (14.2%) and extended families (9.4%). Considering the overall demographic characteristics, the test population is relatively young, well-educated, and has a variety of family structures.

B. Amount of Household Waste Generation

According to the research details, household wastes could be separated as kitchen waste (food/preparation waste), plastic and polythene, paper and cardboard, garden sweeping (leaves), Metal (Ion, Aluminium), glass and bottles, cloths and textiles, rubber/leather, other. According to the analysis results, most of the generated waste is less than 1 kg per day. Tab. 1 depicts the summary of the respondents' analysis for the quantity of household waste generation.

TABLE 1: SUMMARY OF QUANTITY WASTE GENERATION CAPACITY OF HOUSEHOLDS PER DAY

Type of Waste	**Percentage of Respondents (%)**			
Kitchen waste	<1kg/day	2-4kg/day	4-6kg/day	>6kg/day
Plastic, Polythene	44.44	39.39	15.15	1.01
Paper and cardboard	79.80	15.15	2.02	3.03

Garden sweeping	82.83	8.08	8.08	1.01
Metal	50.51	34.34	13.13	2.02
Glass and bottles	79.80	14.14	5.05	1.01
Cloths/old textiles	81.82	9.09	7.07	2.02
Rubber/leather	83.84	10.10	5.05	1.01
Other	81.82	14.14	3.03	0.00
Kitchen waste	79.80	14.14	4.04	2.02

C. WEEE Separation and Disposal

According to data collected from the respondent population on WEEE disposal, 53.8% of the population actively engaged in the separation of e-waste from other waste materials, demonstrating a notable commitment to responsible waste management. Meanwhile, 24.5% occasionally separate e-waste, and 17.9% do not engage in any form of e-waste separation at all, as illustrated in Fig. 2.

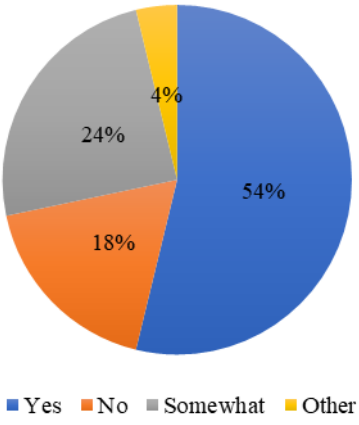

Fig. 2: Status of e-waste separation

Furthermore, according to the conducted research, respondents had prioritized certain key factors when selecting an electronic waste collector. Notably, 33% emphasize the convenience of accessing e-waste collectors, while 30.2% consider the collector's capacity for proper treatment and recycling, favoring formalized treatment processes. Additionally, 11.3% take into account any incentives provided by the collector, such as compensation or incentives, and 11% consider the price offered for their e-waste. Interestingly, a substantial portion of the respondents demonstrate limited awareness of electronic waste collection and recycling organizations. They largely attribute the primary responsibility for WEEE collection and disposal to local authorities (39.6%) and central government bodies (34.9%). Fig. 3 depicts the summary of factors that should be considered when selecting a suitable WEEE collector according to public opinion.

The study explores e-waste management behaviors and preferences among the surveyed population, revealing a growing environmental consciousness. Factors such as accessibility, responsible treatment, recycling capabilities, and incentives influence the selection of e-waste collectors. However, a knowledge gap exists regarding organizations involved in e-waste management and the role of government initiatives in promoting sustainable practices.

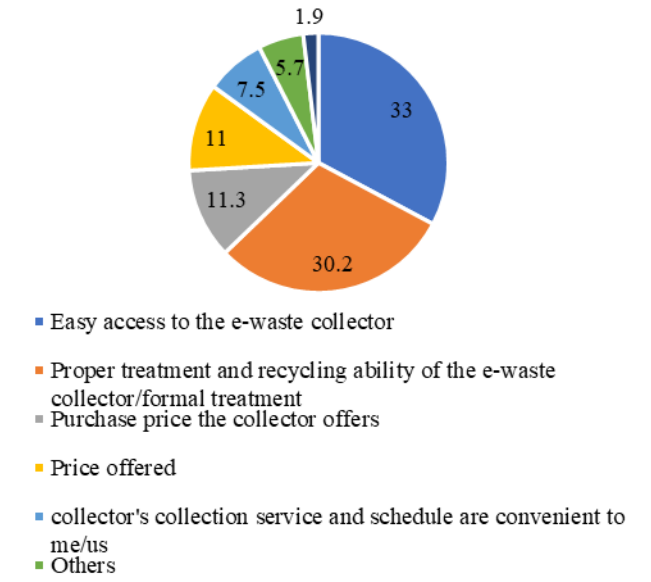

Fig. 3: Summary of public opinion regarding the WEEE collector selection

D. Waste Electrical and Electronic Equipment Disposal and Public Awareness About E-Waste Collection Companies

When considering the WEEE disposal methods, a significant number of respondents in Colombo and Gampaha (50%) indicated that they bury their e-waste in a pit at home. In contrast, 19% of respondents in Galle mentioned using a compost bin, while 25% of respondents in Kandy and Matara reported selling their electronic waste to collectors who visit their homes. However, the practice of burying electronic waste in a pit at home emerged as the most popular method. It is important to note that improper e-waste disposal practices, such as burying it at home, can lead to soil and water pollution, which has adverse effects on human health. Hence it is important to recycle the E-Waste and public awareness about those companies.

Interestingly, in Colombo, all respondents are well-informed about businesses that collect recyclable materials. However, in the other four districts, a higher proportion of people appear to be unaware of such services, with figures as follows: Gampaha (68%), Galle (53%), Kandy (85%), and Matara (65%). WEEE is considered valuable waste due to its content of valuable metal components that can be recycled and repurposed. To enhance efficiency, government regulations for the control and management of e-waste disposal and recycling can be formulated. A summary of the responses for public awareness about E-waste collection companies is shown in Fig. 4. As public awareness of the environmental impact of e-waste continues to rise, more individuals are recognizing the importance of proper management and disposal in contributing to a more sustainable environment.

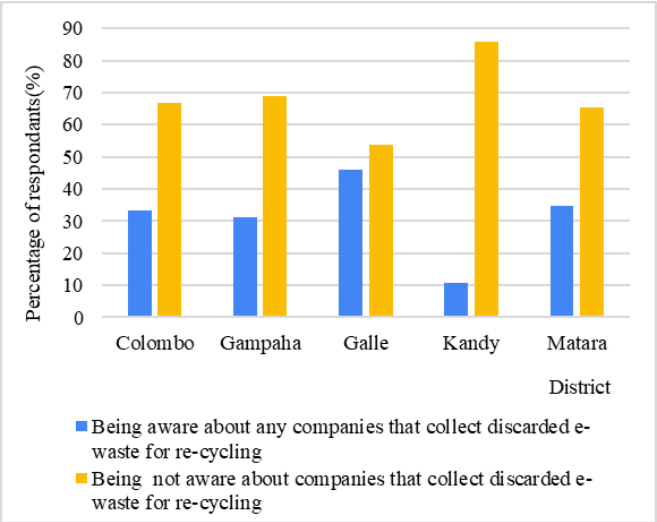

Fig. 4: Summary of public awareness about E-waste collection companies

E. *Awareness on WEEE and their impacts*

Based on the responses, it's evident that different regions exhibit varying levels of knowledge about the potential risks associated with electronic products. Colombo scored 50%, Gampaha 43%, Galle 61%, Kandy 35%, and Matara 34%. However, when considering the overall majority, it becomes apparent that a significant portion of the public is unaware of these risks. Despite the widespread use of electronic items in modern society, there remains a concerning lack of understanding regarding their potential impacts. This underscores the importance of increasing awareness and education in this area. The majority of respondents indicated that WEEE pollution has an impact on both the environment and human health. However, a notable percentage of respondents expressed the view that environmental contamination and harm to human health may not always be certain, and some respondents were also unaware of these potential concerns. Therefore, leveraging the cutting-edge communication tools available today, we can effectively engage with the public to educate them about these challenges. Fig. 5 and Fig. 6 depict the summary of the environmental impacts of WEEE.

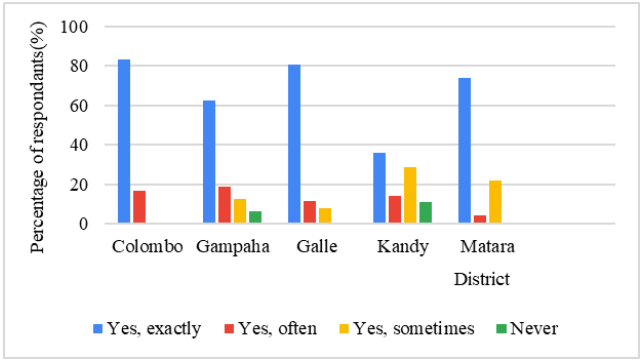

Fig. 5: Status of awareness about the environmental and human health impacts of Waste Electrical and Electronic Equipment

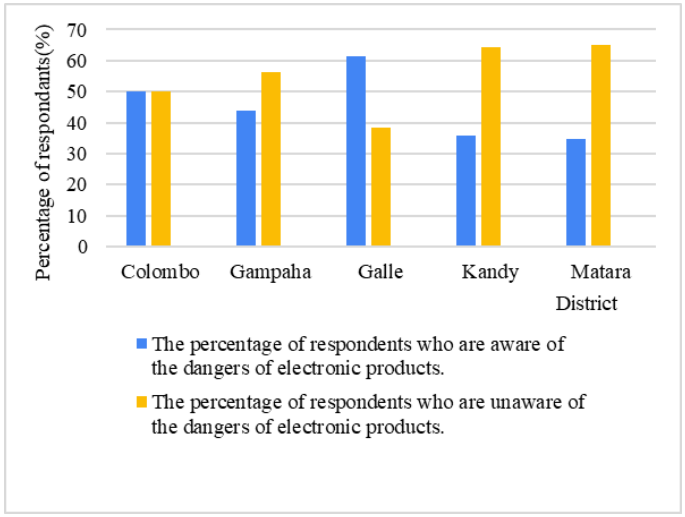

Fig. 6: Status of awareness about the hazards present in Electrical and Electronic Equipment products

F. *Public Preference for Alternative Usage*

When respondents were asked about the most effective way to control WEEE pollution, the preferences varied by region. In Colombo, the majority of respondents (50%) favored taking strict control over WEEE import as the preferred method for reducing WEEE pollution. In Gampaha, most responders believed that perfecting legislation, strict control over WEEE import, and enhancing public education on environmental protection (25%) were the best approaches. In Galle, the majority (34%) chose enhancing public education on environmental protection as their preferred method. In Kandy, 25% of those surveyed believed that enhancing public education on environmental protection was the most effective way to reduce WEEE pollution. Lastly, in Matara, a significant majority (69%) selected enhancing public education on environmental protection as their top choice for reducing WEEE pollution. When looking at the collective preference for enhancing public education on environmental protection, it's evident that a substantial number of respondents believe that modern society may not be sufficiently concerned about the negative environmental impacts resulting from human activities. This suggests a lack of comprehensive understanding of environmental harm, including the processes that lead to environmental contamination, the primary pollutants causing the most significant damage, and the potential consequences for future generations. Notably, a considerable portion of the population appears disinterested and indifferent to these pressing issues. It is crucial, first and foremost, to disseminate widespread knowledge about e-waste and its environmental consequences. Therefore, a prudent strategy may involve a combination of these methods to reduce WEEE pollution, with the support and participation of an informed community.

G. *Awareness of Regulations Related to EEE Usage*

Awareness of regulations related to Electrical and Electronic Equipment is one of the most important factors for WEEE management. According to the provided statistics, awareness rates regarding the government's e-waste management strategy vary across regions. Colombo has a 33.33% awareness rate, Gampaha 56%, Galle 65%,

Kandy 54%, and Matara 70%. The low levels of awareness in many areas suggest that the public may be insufficiently informed about the government's regulations concerning WEEE. This lack of knowledge can present significant challenges in recycling, managing, and controlling e-waste. Despite an understanding of the risks associated with e-waste, improper disposal practices persist due to a lack of awareness about regulatory requirements. This ignorance hinders the realization of the intended regulatory goals. Fig. 7 depicts the Summary of public awareness about E-waste management policy in Sri Lanka.

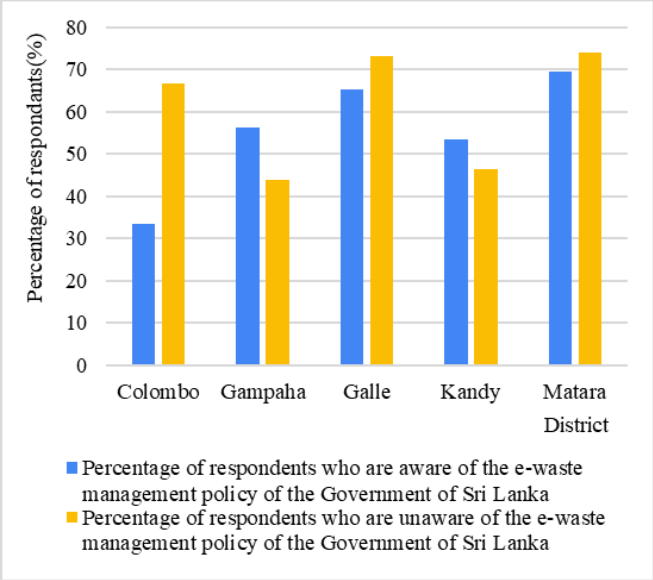

Fig. 7: Summary of the public awareness about e-waste management policy in Sri Lanka

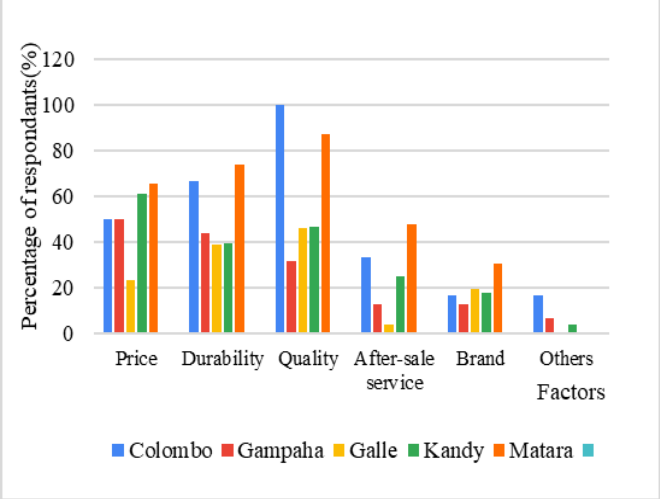

Fig. 8: Summary of the factors that respondents consider for electrical and electronic equipment (WEEE) replacement

Improving energy efficiency and removing hazardous and substandard equipment can be achieved by ensuring that electrical and electronic equipment comply with relevant standards and by raising awareness in society. When inquiring about the primary factors influencing replacement decisions for Electrical and Electronic Equipment, price, overall quality, durability, and product safety were consistently ranked as the top considerations for most individuals. Educating the general public about these criteria empowers consumers to make informed choices, selecting products that are not only safe and compliant with standards but also more energy-efficient and less likely to interfere with other electrical systems. Fig. 8 depicts the summary of the factors that public considers for Electrical and Electronic Equipment replacement.

H. Recommendation to Reduce EEE Pollution

The survey respondents were asked to provide recommendations for reducing the usage and pollution associated with EEE. In the Matara area, suggestions included the need for heightened public awareness through educational campaigns on the proper disposal of electronic waste, the implementation of regulations using stickers to discourage illegal dumping, promotion of WEEE compound recycling to minimize environmental impact, encouragement of manufacturers to design products with recycling in mind, establishment of a system for collecting WEEE from households and businesses, and some individuals preferred taking personal responsibility over government management. In Kandy, there was a call for a more effective and systematic approach, with recommendations for the government to provide separate bins in public places for e-waste, establishment of local recycling companies for the benefit of the community, and a strong emphasis on the government's responsibility in addressing this issue. In the Galle area, the primary recommendation was the establishment of a regular mechanism for collecting WEEE. Lastly, comments from the Gampaha and Colombo areas stressed the importance of proper recycling of all waste materials and highlighted the role of the government in collecting separated waste.

IV. CONCLUSION

The use, disposal, and eventual recycling or rehabilitation of electronic equipment encompass a range of behaviors associated with household e-waste management. Understanding these behaviors is crucial for the development of effective awareness campaigns, data collection methods, and policy initiatives. Variables such as the availability of disposal alternatives, knowledge of recycling facilities, financial incentives, and social norms can all influence household behavior when it comes to managing e-waste. In many households, there is a widespread lack of knowledge about the potential impact of e-waste and the available options for proper disposal. Often, the convenience factor plays a significant role, leading people to choose the simplest disposal methods without considering the environmental consequences. Accessibility to recycling facilities can also pose a barrier to proper e-waste disposal. Additionally, community behaviors can be influenced by monetary incentives and educational programs aimed at promoting ethical e-waste management practices. In conclusion, the results of the "Public Opinion Survey on WEEE Management" underscore the diverse perspectives and recommendations of the survey respondents. Notably, there is an urgent need for heightened awareness campaigns, particularly in areas with lower awareness, to educate individuals about the proper disposal and recycling of electronic waste. The pivotal role of government and local authorities in facilitating these educational efforts is evident. Moreover, a substantial number of respondents across various regions recognized

the significance of manufacturers incorporating recycling-friendly designs in their products. To effectively address the environmental challenges associated with EEE waste, it is imperative to adopt a more comprehensive, systematic, and region-specific approach. This approach should focus on public education, the enhancement of recycling infrastructure, and the promotion of responsible manufacturing practices. The insights gleaned from this survey provide a valuable resource for shaping future policies and initiatives aimed at improving WEEE management practices and reducing the environmental impact of electronic waste.

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