



PRACTICES, CHALLENGES, AND EXTENT OF IMPLEMENTATION ON DUMPING OF E-WASTE AMONG STAKEHOLDERS: BASIS FOR DEVELOPMENT OF AN ENHANCEMENT PROGRAM

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Article DOI: <https://doi.org/10.36713/epra15622>

DOI No: 10.36713/epra15622

ABSTRACT

This quantitative research using a descriptive survey design aimed to investigate the level and significant differences in practices, challenges, and extent of implementation of e-waste dumping among stakeholders. Using simple random sampling, 91 respondents from PNP Maritime Group, DENR personnel, and Philippine Coast Guards were taken. Utilizing the researcher-made questionnaire, data were gathered and analyzed using the appropriate descriptive and inferential statistical tools. The results revealed that the practices gained the response of "highly practiced," an indication of very good execution and implementation of practices given dumping e-waste. On the other hand, given the challenges, it gained the response "Very Difficult," an indication that addressing the challenges of the dumping of e-waste is very difficult. "Excellent" was the level indicating the extent of implementation because of e-waste dumping because the provision or condition is very extensive and functioning perfectly. Moreover, practices, challenges, and extent of implementation have shown significant differences because of dumping e-waste among stakeholders. Out of the results, the researcher proposed an enhancement program to continuously improve the stakeholders' practices, challenges, and extent of implementation on the dumping of e-waste.

KEYWORDS: *Dumping of E-Waste, Enhancement Program, Practices, Challenges*

INTRODUCTION

In our daily existence, innovation and technological enhancements have increased due to digital and electrical equipment. Almost everyone has smartphones and another type of electronic devices that have become the new lifestyle of global citizens (Balde et al., 2017). The use of electronic devices like smartphones, laptops, TVs, microwaves, and others has made our lives simpler and more superficial. However, these devices comprise poisonous materials and substances that need to be disposed of competently to shield humanity and preserve our ecological balance. For these reasons, proper e-waste disposal is very vital since it is the fastest-growing waste stream in the world, and both developing and underdeveloped countries are struggling with e-waste issues.

According to the data from the United Nations Environment Program, e-waste grows 40 million tons annually. Smartphones and computers waste are the biggest contributors, followed by gold and silver waste, palladium, and cobalt. The increasing of electronic devices use will lead to a high rate of e-waste in the future. It is predicted that there will be 200% increase in e-waste in China as a developed country and 400% increase in e-waste in South Africa as a developing country by 2020 (Nijman, 2019).

The article "A Systematic Review of E-Waste Generation and Environmental Management of Asia Pacific Countries" by Andeobu et al. (2021) emphasized that e-waste is one of the most urgent and pressing challenges of our time; however, it is routinely ignored. The challenges in e-waste management arise from the unsustainable production, use, and disposal of electronic devices in our digitally connected world. Seemingly, Forti et al. (2020) revealed that many countries, including those in the Asia Pacific region, lack sufficient e-waste management practices. It is crucial to make greater efforts towards smarter and more sustainable global production, consumption, management, trading, and disposal of e-waste. Bhaskar and Kumar (2016) added that implementing appropriate e-waste management strategies will contribute to the achievement of sustainable development goals and reduce the global climate crisis by developing the necessary, needed, and required e-waste policies.

This study provided background information for determining hazardous waste, which is often deliberately classified as items to deceive law enforcement authorities, especially in the NCR, most notably in Greenhills, Raon in Manila, and almost every store at the very heart of Metro Manila. Therefore, there is a need for us to equip and familiarize ourselves with smart procedures and steps that we need to take to dispose, recycle, and dump these faulty electronic waste devices. Moreso, there is a need for the



different government agencies in the National Capital Region to discuss their roles in the battle against the illicit dumping of e-waste in Metro Manila.

Further, this study was anchored to the Value-Belief-Norm Theory (VBNT) which served as the researcher's basis for the development of different enhance programs. VBNT was first established by Stern et al. (1999) to explain the influence of human values on behavior in an environmentalist context. The VBN Theory describes the level of engagement a person has with his environment and the way he prioritized and values good environmental behavior, such as recycling, and influences where e-waste travels to. Additionally, according to the VBN theory, individuals' actions are influenced by a combination of their personal beliefs, the values held by their peers, and the local environment. This theory proposes that people respond to environmental concerns in a manner that aligns with these established social norms. Simply stated, people tend to act according to their expectations of themselves and others' behaviors within their periphery (Whitemarsh & O'Neill, 2010). By applying this theory, the researcher was determined to extend some policies and programs about the implementation of environmental protection against the dumping of e-waste in Metro Manila, Philippines.

This study examined the practices, challenges, and extent of implementation to protect and minimize the negative impact brought about by the dumping of e-waste in the National Capital Region (NCR), Philippines. As part of this study, conclusions will present a series of policy recommendations and a proposed enhancement program pertaining to proper mitigation of e-waste disposal.

LITERATURE REVIEW

According to the report of the World Health Organization (2020), in 2019, Asia emerged as the leading contributor to the global e-waste crisis, generating a staggering volume of approximately 24.9 million metric tons. The Americas and Europe followed closely behind, producing 13.1 million metric tons and 12 million metric tons respectively. Meanwhile, Africa and Oceania generated 2.9 million metric tons and 0.7 million metric tons of e-waste respectively. These figures highlight the pressing need for sustainable practices and responsible management of electronic waste worldwide. This was followed by a report from the United Nations which announces that China produced a record 53.6 million tons of electronic waste, which is the same weight as 350 big cruise ships.

As per report released by the World Economic Forum in 2018, it was found out that India ranked 177 among 180 bottom countries on the Environmental Performance Index 2018. The inadequate implementation of environmental health policies and the detrimental effects of air pollution are contributing factors to the subpar performance in these areas. Additionally, India ranks fifth globally in e-waste production, following the United States, China, Japan, and Germany. These factors emphasize the need for

stronger environmental policies and sustainable practices to address the challenges posed by air pollution and e-waste in India. By prioritizing these issues, India can work towards improving environmental health and reducing its impact on a global scale. Surprisingly, less than 2 percent of the total e-waste generated in India is formally recycled each year. Since 2018, India has been generating over two million tons of e-waste annually and importing significant amounts from around the world. These statistics highlight the critical need for improved e-waste management and increased recycling efforts in the country. Additionally, the common practice of dumping waste in open dumpsites leads to problems like groundwater contamination and compromised public health. It is imperative to address these issues through sustainable waste management practices to ensure a healthier and cleaner environment for all (Manish & Chakraborty, 2019).

To sum up the reports, it is worthy to note that electronic waste is indeed a serious environmental issue in Asia. There is a need for the ASEAN countries to encourage issuance of several environmental laws, regulations and technical guidance while also collaborating on national and international e-waste projects. Effectively managing electrical and electronic waste is crucial for both domestic and international material cycles, with a focus on environmental preservation and resource utilization efficiency. Transboundary shipments of e-waste should align with the principles of sustainable development. Additionally, it is important to explore future research directions and potential collaborations in this area. By doing so, it can work towards sustainable e-waste management and contribute to the preservation of the environment and resources (Terazono et al., 2006).

According to the United Nations Industrial Development Organization (2022), the Philippines ranks as one of the leading e-waste generators in Southeast Asia. In 2019, the country produced an estimated 3.9 kg of e-waste per capita. The Environmental Management Bureau (EMB) also announced in 2019, that the Philippines generated a total of 32,664.41 metric tons. The EMB stated that e-waste, including computers, TVs, refrigerators, cell phones, and other electronic devices, consists of a complex combination of materials and components due to their hazardous content. Despite this, however, environmental group EcoWaste Coalition noted that e-waste continues to be improperly disposed of and is often found mixed with other trash in the country.

To address the issue of e-waste, environmental agencies should establish a framework for managing WEEE, reduce the amount of electrical and electronic waste, minimize the hazards of its components, and encourage the reuse and recycling of second-hand or used electronic equipment. There must be a way to encourage involvement of all relevant agencies and stakeholders in the life cycle of EEE and institutionalize the principle of "extended producers' responsibility," which will implement the circular economy concept on waste management. Thus, as part of



a comprehensive e-waste action plan, there is a need for the DENR to launch several public information and education campaigns about the looming e-waste crisis, its negative effects, and a menu of proper responses (DENR News Events, 2020).

The United Nations Environment Program (2018) highlighted the global e-waste challenge and established a Letter of Intent to facilitate coordination and collaboration for United Nations system-wide support in e-waste management. The United Nations organizations, through the Environment Management Group, have taken proactive steps to address e-waste. This includes strengthening collaboration, recognizing e-waste efforts, engaging with manufacturers and recyclers, negotiating for an E-waste Coalition, and partnering with the private sector to develop a knowledge sharing platform for information on UN e-waste projects and global statistics. In the Philippines, there is a need to equip and familiarize ourselves with smart procedures and steps that we need to undertake to dispose, recycle, and dumping of these faulty electronic waste devices. To address this global and national problem, and to control, supervise and regulate activities on toxic chemicals and hazardous waste, the government promulgated the Republic Act No. 6969 or the Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990. The law gave us a sound knowledge of the respective control of toxic substances and hazardous and nuclear waste. The primary goal is to regulate and control the importation, manufacturing, processing, sale, distribution, use, and disposal of chemical substances and mixtures that pose unreasonable risks to health and the environment. It also aims to prohibit the entry of hazardous and nuclear wastes into Philippine territory and promote research on toxic chemicals. Hence, it has been notably recognized that the public and the environment are at risk in the use or exposure to chemicals as well as the long-term damage brought about by careless handling or disposal of hazardous wastes which include electronic waste. Thus, the Department of Environment and Natural Resources (DENR) serves to be the implementing agency which shall be assisted by the Inter-Agency Advisory Council (R.A. 6969, 1990).

Further, DENR reported that the Global Environment Facility (GEF) is funding the project with a grant of US\$6.2 million through the United Nations Industrial Development Organization (UNIDO) as the implementing agency. Public and private stakeholders, including the Development Bank of the Philippines, are also co-financing the project worth over US\$35 million. DENR Assistant Secretary Rommel Abesamis added that, this situation is a long-standing global issue, however, for a developing country like Philippines, so much must be learned about Persistent Organic Pollutants (POPs), especially by the workers who are vulnerable to exposure and by women whose exposure can be passed on to their children (Duran, 2022). The DENR requires waste generators to register, report, and use authorized transporters and treaters for hazardous waste management. They also need to keep records and submit reports to DENR regarding the transport and disposal of the waste (DENR Administrative Order No. 29, Series of 1992).

The rapid pace of production and inherent short-term obsolescence of electronic products make the management of hazardous electronic waste (e-waste) a major challenge for regulatory policies designed to protect environmental quality and human health without compromising technological innovation, access to digital infrastructure, or employment opportunities associated with the international solid waste management enterprise (Schoenung et al., 2005; Ogunseitan et al., 2009; Awasthi et al., 2019).

Some countries have developed policies for managing e-waste but encounter obstacles against implementation. Most policies are based on extended producer responsibility (EPR) (Davis, 2021). An EPR-based system involves subsidies, fees, or penalties targeting electronic manufacturers (Pathak et al., 2019). However, difficulties in implementing e-waste management regulations are common in developing countries. For instance, Imran et al. (2017) highlighted the lack of import regulation of e-waste as one of the most important in Pakistan. Wang et al. (2016) concluded that households' habit of selling e-waste to street vendors is an important barrier in Liaoning Province, China. Kumar and Dixit (2018) show that lack of public awareness and incoherent e-waste policies are barriers to e-waste management in India. Chen et al. (2020) noted that economic and financial restrictions are the main obstacles in Ghana.

E-waste management is a pressing concern for many countries due to the presence of organic substances like plastic and heavy metals such as cadmium, chromium, mercury, and lead. These materials are nonbiodegradable and can accumulate in the food chain and the environment. Improper disposal of e-products, particularly plastics, in landfills leads to soil and groundwater contamination. Governments and industries need to invest in technology and education to ensure safe and cost-effective recycling and disposal methods for these materials. The rapid growth of technology leads to frequent updates in electronic products. However, there is a gap in effectively managing the production and disposal of these products. As a result, many obsolete electronic products are exported to developing countries due to cost and labor constraints. Despite this, there are also sustainable opportunities for underdeveloped areas in managing electronic waste. Developing technologies and improving policies of e-waste management plays an important role. As an important part of e-waste recycling and management, legislative rules played a vital role in a certain region. Different policies and legislations between developed countries and developing countries are of great help. To solve the problem of e-waste fundamentally, the role of the individuals also should not be ignored. E-waste education should be an important part to help individuals to change their lifestyles and strengthen their awareness about the positive effect of e-waste (Deng, W., 2019).

The limited research on e-waste policies in the Philippines, particularly in the National Capital Region, highlights the need for further investigation. This study draws insights from related



topics and literature, including the conflict between social responsibility and economic logic, electronic consumption trends, and the commodity chains of electronic waste (Lyon et al., 2008; Wilhelm et al., 2011; Lepawsky, 2011).

The other main component of the study involves taking an analytical role in understanding how the PNP, DENR thru City Environmental and Natural Resources Office (CENRO), and Environmental Management Board (EMB), and PCG can extend their help in connection to environmental protection against illicit dumping of electronic waste management practices. As discussed in an article entitled Environmental and Social Management Framework (2020), it said that there are studies that assess how these government agencies relates to the mandate of laws and provisions in a very consistent pattern, at the very least, doing more than they are required to do under applicable laws and regulations governing the environment, health, and investments in the communities particularly at the National Capital Region (NCR).

Needless to state, the study is very significant because despite the existing Philippine laws prohibiting or at least restricting the importation of certain goods for reasons of national safety, environmental and public health protection, order, and morality. In addition to complying with international treaties and obligations, toxic substances, and hazardous waste, including e-waste continuously pour in the Philippines. This study also endeavors to narrate the role of our environmental workers/officers from DENR thru CENRO, EMB, and Philippine Coast Guard located in the NCR on how they can adequately address and combat these environmental problems regarding E-waste (Philippine Country Commercial Guide, 2022).

As regards to the extent of implementation of environmental protection against illicit dumping of e-waste, the International E-Waste Management Network (IEMN) in 2018, conducted a workshop in the Philippines. This was sponsored by U.S Environmental Protection Agency (US-EPA) and Taiwan EPA who sponsored the 8th International E-Waste Management Network (IEMN) Workshop in Manila, Philippines to increase the implementation of environmentally sound management of electronic waste. Government officials from 11 countries (Argentina, Brazil, Chile, Colombia, Egypt, Indonesia, Malaysia, Philippines, Thailand, Tuvalu and Vietnam) enhanced their capacity to: assess downstream markets for e-waste materials; understand the opportunities and impacts of major market changes; examine the benefits and barriers involved with new processes and technologies; identify effective ways of building relationships and working with industry; and describe the elements of a facility audit to protect worker health and safety and the environment. Throughout the workshop, participants identified individual actions to enhance their comprehensive programs for the collection, reuse, and recycling of e-waste, as well as, collective and IEMN team actions to achieve our shared mission of increasing the implementation of environmentally

sound management of e-waste (United States Environmental Protection Agency, 2022).

In the Philippines, the Project 1 Phone program, launched in 2014, allows businesses, organizations, and the public to donate old electronic devices for recycling. This initiative conserves natural resources, prevents pollution from hazardous waste disposal, and reduces energy consumption and greenhouse gas emissions. The Globe E-waste Zero program, in 2019 alone, collected over 343,000 kg of e-waste, with a total collection exceeding 1.2 million kilograms. Collaboration with 52 corporations and organizations, including Unionbank of the Philippines, Huawei Philippines, and the Ayala Group of Companies, has been instrumental in the program's success (Globe Telecom, Inc., 2021). A study by UNIDO and EcoWaste Coalition found that only 28 out of 135 registered TSD facilities in the Philippines process e-waste. The informal sector benefits from these items but their dismantling and recycling methods pose health risks. Globe's E-waste Zero program aims to influence consumer behavior by promoting the extension of electronic gadget lifespan and responsible recycling of end-of-life devices. (Globe Newsletter, 2021).

The continuous dependence on electronic equipment at home and in the workplace has given rise to a new environmental challenge. Governments around the world have started instituting policies to address the growing problem of e-waste. In Japan, for example, the Home Appliances Recycling Law came into force in April 2001. This law targets four items: televisions, refrigerators, washing machines, and air conditioners. It states that retailers are obliged to accept end-of-life appliances from consumers and take them to manufacturers or importers for recycling. Consumers are charged fees for the collection, transportation, and recycling of their discarded appliances (Guidance Manual for Extended Producer Responsibility, 2001).

The Climate Change Commission (CCC) is recommending measures to address the growing problem of discarded electrical and electronic equipment in the Philippines, one of Southeast Asia's top generators of this e-waste. In a report published on October 16, 2020, entitled PCC Pitches Moves vs. E-waste, CCC Vice Chairperson and Executive Director Emmanuel de Guzman stated that our government must develop a national policy and regulatory framework on e-waste management. He is also recommending formulation of a national strategy and action plan for institutionalizing e-waste recycling and collection. There's a need to likewise undertake relevant research and technology development aside from stopping illegal entry of hazardous e-waste into the country, he continued. De Guzman raised urgency for action, noting global e-waste already ballooned to nearly 54 million metric tons (MT) last year. That's 21 percent more than the global e-waste level in 2014, he noted. Launched earlier this year, UN's 'The Global E-Waste Monitor 2020' report estimates e-waste generated worldwide will already exceed 74 million MT by 2030. Higher consumption of electrical and electronic equipment,



as well as short life cycle of and limited repair options for these, will likely fuel such increase, the report warned.

De Guzman added that cooperation among government and private business and manufacturers and consumers in driving innovations, and transition of sectors into a circular economy, are key to climate resilience and sustainable future of the Filipino nation (Teves, 2020).

On one hand, DENR Administrative Order 2013-22, stated that generators, transporters, and treatment, storage, and disposal (TSD) facilities of hazardous waste, including WEEE, are required to register with EMB to document and provide comprehensive details of each movement of the waste with the corresponding permit to transport (PTT) and manifest or the chain-of-custody document. A TSD facility is required to issue a certificate of treatment once the waste has been treated. This cycle follows the cradle to grave management of hazardous waste, tracking it from the point of generation to their transport, recycling, treatment, and disposal (DENR News Events, 2020).

Applications for registration as generator, transporter, and TSD facility, including PTT and manifest can now be processed through the Online Hazardous Waste Management System, which has been operational since June 1, 2020. The DENR also monitors the importation and export of hazardous wastes through a regulatory procedure, which requires importers and exporters to secure permits and clearances from the EMB. Importation of recyclable materials containing hazardous substances intended for recycling, recovery, or reprocessing may be allowed subject to the compliance requirements of EMB, as well as the requirements and procedures prescribed by the Basel Convention (DENR News Events, 2020).

To further strengthen the existing regulations, EMB Director William Cunado announced that the DENR is set to issue the Technical Guidelines on the Environmentally Sound Management of WEEE. This draft administrative order aims to provide the framework mechanism for the appropriate management of WEEE, reduce the amount of electrical and electronic equipment (EEE) type of waste and the hazards brought about by its components, and promote the reuse of second-hand or used EEE and valorization of its waste component. It also seeks to encourage involvement of all relevant agencies and stakeholders in the life cycle of EEE and institutionalize the principle of “extended producers’ responsibility,” which will implement the circular economy concept on waste management. The guidelines will also include provisions distinguishing used or second-hand from waste, which is patterned or aligned with the Basel Convention Technical Guidelines on the transboundary movements of e-waste and used EEE. At present, EMB is implementing a project entitled “Implementation of PCB Management Programs for Electric Cooperatives and Safe E-wastes Management” with support from the Global Environment Facility and the United Nations Industrial Development Organization (UNIDO). The UNIDO-assisted project has established linkages with the community-

based organizations in the informal sector, through EcoWaste Coalition, as contractor to undertake awareness raising activities (DENR News Events, 2020).

OBJECTIVES OF THE STUDY

This research aimed to describe the level of practices, challenges, and extent of implementation of dumping of e-waste among stakeholders in the NCR.

Specifically, this research sought answers to the following questions:

1. What is the level of practices, challenges, and extent of implementation on dumping of e-waste among stakeholders?
2. Are there significant differences in the practices, challenges, and extent of implementation on dumping e-waste among stakeholders?
3. What program will be developed to enhance the practices, challenges, and extent of implementation on dumping of e-waste among stakeholders?

METHODOLOGY

Research Method

This study employed Quantitative Research Design which involved large sample sizes, concentrating on the quantity of responses where each respondent was asked the same questions. The data was supplied in a numerical format and analyzed in a quantifiable way using statistical methods (DJS Research, 2023).

Further, this research utilized descriptive research as its methodology. As widely accepted, the descriptive method of research is a fact-finding study that involved adequate and accurate interpretation of findings. According to McCombes (2020), descriptive research aims to describe a population, situation, or phenomenon precisely and systematically, thus, this methodology was utilized for it will accurately describe and evaluate the levels of practices, challenges, and extent of implementation on dumping of e-waste by certain stakeholders.

This portion gives a detailed delineation of the participants in the study, the data-gathering instruments utilized, and the procedures followed in the data gathering.

The researcher utilized simple random sampling in choosing the respondents. In this sampling method, it only involves a single random selection and requires little advanced knowledge about the population (Thomas, 2022). It is considered as the simplest and most common method of selecting a sample, in which the sample is selected unit by unit, with equal probability of selection for each unit at each draw (Singh, 2003).

The respondents of the study were randomly selected by the researcher from the given list of personnel provided by the offices of PNP Maritime Police, DENR, and Philippine Coast Guard within the National Capital Region. The researcher chose the said government agencies because they were the most appropriate



respondents for this study since they have at least a transparent background and have been designated on tasks related to

environmental electronic waste problems in their area of responsibilities.

Table 1
Distribution of the Respondents

Type of Stakeholder	f	%
PNP-Maritime Group	30	33
DENR Personnel	30	33
Philippine Coast Guard	31	34
Total	91	100

The research instrument was a researcher-made questionnaire composed of four parts formulated based on the existing literature and results of previous studies.

The first part of the survey instrument focused on the respondents' data. Declaration of their name was optional. Respondents came from the PNP Maritime Group, DENR, and the Philippine Coast Guard. The second part contains the practices on dumping of e-waste among stakeholders. The study examined the awareness and adherence to government regulations and policies for environmental protection against illicit e-waste dumping. It also explored respondents' disposal methods and their understanding of the harmful nature of e-waste. These findings will inform environmental protection activities and best practices. The third part includes the challenges of dumping of e-waste among stakeholders. It provided for the hindrances or challenges of a stakeholder in facing the environmental protection against illicit dumping of e-waste such as ignorance, lack of funds and infrastructures and the like. The fourth part aimed to determine the extent of implementation on dumping of e-waste among stakeholders. It provides current methods of storage, processing, recycling, and disposal of e-waste to immense potential to avoid harm in human health and the environment.

Data Collection

The researcher-made questionnaire was validated by at least three validators who were experts in the field and who possess knowledge and understanding about e-waste dumping. They were tasked to deliver face and content validity of the questionnaire with the aim to evaluate whether the questions would effectively capture the topic under investigation and to determine the internal validity. For the reliability of the researcher-made questionnaire,

the researcher conducted pilot-testing with fifteen personnel coming from the office of PCG, DENR, and PNP Maritime Police. As a matter of courtesy, a request letter was sent asking permission to conduct a survey. Upon receipt of their permission to conduct the survey, the researcher-made questionnaires were distributed to the offices of the stakeholders and formally conducted the data gathering. Henceforth, the researcher communicated with the respondents and then collected all the forms.

Further, the data obtained from the questionnaire was computed and analyzed statistically using SPSS (Statistical Package for Social Sciences). The results were interpreted using descriptive statistical tools. The measures of descriptive statistics like mean and standard deviation were used to interpret the numerical data on the level of practices, challenges, and extent of implementation on dumping of dumping of e-waste among stakeholders.

RESULTS AND DISCUSSIONS

Level of Practices on Dumping of E-waste among Stakeholders

Table 2 shows the practices on dumping of e-waste specifically among stakeholders and in totality. Based on the derived mean, it intends to describe that the respondents composed of the Philippine Coast Guard (M=3.73, SD=0.25), PNP Maritime Police (M=3.71, SD=0.23), and the DENR Personnel (M=3.51,SD=0.49), represents a "Highly Practiced" level as well as in totality (M=3.65, SD=0.35), an indication of a very good execution and implementation of practices in view of government regulations, policies, and their adherence to various activities in relation to illicit dumping of e-waste.



Table 2
Level of Practices on Dumping of E-waste among Stakeholders

Stakeholder	Mean	Descriptive Rating	SD
DENR Personnel	3.51	Highly Practiced	0.49
Philippine Coast Guard	3.73	Highly Practiced	0.25
PNP Maritime Police	3.71	Highly Practiced	0.23
Grand Mean, Descriptive Rating, and SD	3.65	Highly Practiced	0.35

This is supported by the article written by Poppenheimer (2013), minimizing e-waste starts with reducing the purchase of new electronic devices and equipment. Before buying a new gadget, consider if an upgrade or new device is truly necessary. Making mindful purchasing choices benefits both the environment and your finances. According to Zaccarà (2008), consumer behavior is vital in environmental actions like buying environmentally friendly electronics, retaining, and using electronics to lessen their harmful effects on the environment, and criticizing disposal procedures. Environmental ethics serves as a bridge between the other two disciplines and analysis of the three critical disciplines that are necessary to the improvement and protection of the environment: environmental education, environmental laws, and ethics (Solomon, 2010).

Level of Challenges on Dumping of E-waste among Stakeholders

Table 3 presents the scores that describe the challenges experienced by stakeholders on e-waste dumping activities. Based on the derived mean, it intends to describe that the PNP Maritime Police (M=3.63, SD=0.29) shows “Very Difficult” level which means that they find it very difficult to address the challenges they encountered in view on dumping of e-waste. On the hand, the Philippine Coast Guard (M=3.47, SD=0.45) and the DENR Personnel (M=3.24, SD=0.82) represents a “Difficult” level as well as in totality (M=3.44, SD=0.58), an indication of a poor capacity to address the challenges identified in view on dumping of e-waste.

Table 3
Level of Challenges on Dumping of E-waste among Stakeholders

Stakeholder	Mean	Descriptive Rating	SD
DENR Personnel	3.24	Difficult	0.82
Philippine Coast Guard	3.47	Difficult	0.45
PNP Maritime Police	3.63	Highly Difficult	0.29
Grand Mean, Descriptive Rating, and SD	3.44	Difficult	0.58

According to Lundgren (2012), among the general challenges this presents are the limited capacity and capability of responsible institutions, poor implementation of legal instruments, poor participation among stakeholders, and a lack of specific definition, legal instrument, policy, or strategy.

Shahabuddin et al. (2023) stated that there are many challenges and opportunities regarding e-waste and its management. One of the key challenges is the lack of e-waste legislation.

Level of Extent of Implementation on Dumping of E-waste among Stakeholders

Table 4 shows the level of extent of implementation towards e-waste dumping activities. Based on the derived mean, it intends to describe that the DENR Personnel (M=4.42, SD=0.62) shows a “Very Good” level which means that the extent of implementation on provisions or conditions in dumping of e-waste is moderately extensive and functioning well. On the other hand, the Philippine Coast Guard (M=4.73, SD=0.20) and the PNP Maritime Police (M=4.67, SD=0.26) represents an “Excellent” level as well as in totality (M=4.61, SD=0.42), an indication that the extent of implementation on provisions or conditions in dumping of e-waste is very extensive and functioning efficiently.



Table 4
Level of Extent of Implementation on Dumping of E-waste among Stakeholders

Stakeholders	Mean	Descriptive Rating	SD
DENR Personnel	4.42	Very Good	0.62
Philippine Coast Guard	4.73	Excellent	0.20
PNP Maritime Police	4.67	Excellent	0.26
Grand Mean, Descriptive Rating, and SD	4.61	Excellent	0.42

In the study of Alam (2016), it describes the extent of implementation against illegal dumping of e-waste of which about 70% of the heavy metals present in the landfills come from the discarded and improper recycling of the waste. Equally, Yenita, and Widodo (2020) described that the increasing number of e-waste in another Asian country, which is Indonesia provide several factors, including: the lack of information, inaccuracy of data and limited sources about e-waste and the number of uses of electronic devices that can be accessed by public, the absence of public awareness in managing e-waste in a minimum scale, and different understanding between government institutions regarding of the regulations of e-waste and its management procedures.

Significant Difference in the Practices on Dumping of E-waste among Stakeholders

There is a significant difference in the practices on dumping of e-waste among stakeholders, $F(2,88)=3.595$, $p=.032$. Table 5

shows the result. This proves that the stakeholders who are involved in dumping of e-waste utilize various practices pertaining to e-waste disposal.

A review of published reports on e-waste problems in developing countries, and countries in transition, showed that China, Cambodia, India, Indonesia, Pakistan, Thailand, and African countries such as Nigeria, receive e-waste from developed countries although specific e-waste problems differ considerably between countries. For instance, African countries mainly reuse disposed electronic products whereas Asian countries dismantle those often-using unsafe procedures (Kiddee et al., 2013).

Furthermore, manufacturers of electronic goods have made efforts to safely dispose of e-waste using advanced technologies in both developed and developing countries (US Government Accountability Office, 2008; Widmer et al., 2005).

Table 5
Significant Difference in the Practices on Dumping of E-waste among Stakeholders

Sources of Variation	Sum of Squares	df	Mean Square	F	p
Between Groups	.846	2	.423	3.595*	.032
Within Groups	10.361	88	.118		
Total	11.207	90			
Note. Asterisk (*) means significant at .05 level of probability.					

The Philippine Coast Guard has the highest level of practice on dumping of e-waste among stakeholders. This could be attributed to their comprehensive knowledge and awareness of key aspects of e-waste, such as its definition, composition, and the potential impact of improper disposal on human health and the environment. According to Borthakur, et al. (2016), e-waste

disposal behavior and awareness could be helpful for a particular country to devise inclusive e-waste management strategies to adequately address their current e-waste crisis.



Table 6
Post-hoc Comparison of Means for Practices on Dumping of E-waste among Stakeholders

Type of Stakeholder	Level of Practices (Mean)
DENR Personnel	3.51 ^a
PNP Maritime Police	3.71 ^{ab}
Philippine Coast Guard	3.73 ^b
Note. Same letters mean not significant, significant if otherwise.	

Significant Difference in the Challenges on Dumping of E-waste among Stakeholders

Similarly, there is a significant difference in the challenges on dumping of e-waste among stakeholders, $F(2,88) = 3.659$, $p = .030$. Table 11 shows the result. This proves that the stakeholders have different experiences in view of e-waste dumping in which the challenges they encountered are varying.

Seemingly, e-waste dumping is a global challenge. Currently, e-waste is considered a top concern for sustainable consumption and production. About 17.4% of the globally generated e-waste was recycled, whereas the remaining 82.6% was either discarded, untreated, or informally processed (Ramanayaka, Keerthanan, & Vithanage, 2020). It is important to note that e-waste is an emerging problem within both developed and developing nations and requires special attention (Venugopal et al., 2022).

Table 7
Significant Difference in the Challenges on Dumping of E-waste among Stakeholders

Source of Variation	Sum of Squares	df	Mean Square	F	d
Between Groups	2.308	2	1.154	3.659*	.030
Within Groups	27.756	88	.118		
Total	30.064	90			
Note. Asterisk (*) means significant at .05 level of probability.					

The PNP Maritime Police at this time has the highest level of challenges met on dumping of e-waste among stakeholders. This might be due to the major obligation on this type of stakeholder and the greater responsibilities in their hands to understand the environmental consequences of the illegal dumping of e-waste as well as recognition to the individual and social responsibility to

conserve natural resources for future generations. This can be supported by Odili et al. (2018) which discussed that several recent studies in most parts of the world, e-wastes are not well managed because of unawareness of people and weak enforcement of laws as regards to conservation of natural resources and environment.

Table 8
Post-hoc Comparison of Means for Challenges on Dumping of E-waste among Stakeholders

Type of Stakeholder	Level of Challenges (Mean)
DENR Personnel	3.24 ^a
Philippine Coast Guard	3.47 ^{ab}
PNP Maritime Police	3.63 ^b
Note. Same letters mean not significant, significant if otherwise.	

Significant Difference in the Extent of Implementation on Dumping of E-waste among Stakeholders

In view of the extent of implementation on dumping of e-waste among stakeholders, there is a significant difference, $F(2,88) = 4.965$, $p = .009$. Table 13 shows the result. This proves that the stakeholders have different ways of implementation in view of e-waste dumping.

According to Liu et al. (2022), the government plays a crucial role as the supervisor and manager of WEEE (Waste Electrical and Electronic Equipment) internet recycling. It has authority over key stakeholders such as producers, recyclers, processors, and consumers. As stated by Acquah et al. (2021), the participation degree of residents in WEEE Internet recycling is very important to improve the



recovery rate. Knowing the extent of implementation among residents and the governments as stakeholders clearly enlisted their contribution to address the e-waste dumping.

Table 9
Significant Difference in the Extent of Implementation on Dumping of E-waste among Stakeholders

Square of Variance	Sum of Squares	df	Mean Square	F	p
Between Groups	1.619	2	.809	4.965*	.009
Within Groups	14.345	88	.163		
Total	15.964	90			
<i>Note.</i> Asterisk (*) means significant at .05 level of probability.					

Both the PNP Maritime Police and the Philippine Coast Guard has the highest levels for extent of implementation on dumping of e-waste among stakeholders. This might be due to the major obligation on these types of stakeholders and their absolute

commitment from all major stakeholders, including consumers, and recyclers, to make e-waste management convenient. Thus, organizations positively affect the proactive orientation of stakeholders (Pinto, 2019).

Table 10
Post-hoc Comparison of Means for Extent of Implementation on Dumping of E-waste among Stakeholders

Type of Stakeholder	Extent of Implementation (Mean)
DENR Personnel	4.42 ^a
PNP Maritime Police	4.67 ^b
Philippine Coast Guard	4.73 ^b
<i>Note.</i> Same letters mean not significant, significant if otherwise.	

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings, the researcher concluded the following:

1. The stakeholders execute a very good implementation of practices on dumping of e-waste, an indication of adherence to various activities in relation to illicit dumping of e-waste. However, they experience very difficult ways of addressing the challenges of dumping e-waste, an indication of poor capacity to address challenges identified in view on dumping of e-waste. In addition, the stakeholders' extent of implementation shows that the provisions or condition is very extensive and functioning perfectly pertaining to dumping of e-waste, an indication that the stakeholders are functioning efficiently.
2. It was also concluded that the Philippine Coast Guard has the highest level of practices and extent of implementation on dumping of e-waste, while the PNP Maritime Police has the highest level of challenges on dumping of e-waste. Therefore, it shows that the Philippine Coast Guard were religiously doing the best practices which resulted to an efficient implementation on dumping of e-waste, while the

PNP Maritime Police needs to find ways to overcome and properly address the challenges on dumping of e-waste.

Align to the findings and conclusions, the researcher recommends the following:

1. Stakeholders may participate in various seminars/conferences or workshops pertaining to reusing and recycling of e-waste as well as adopting innovative programs for the reuse of e-waste as practiced in different industries and sectors. In addition, they may create programs or projects in their respective offices or various departments pertaining to e-waste recycling.
2. Regular symposia may be conducted to different stakeholders pertaining to effective data collection and dissemination on material flow of e-wastes. The offices of the identified government agencies must continue to implement electronic waste segregation and separation of collection of e-waste be adhered to/by the community as mutual cooperation to the implemented programs of the LGUs.



3. The stakeholders may take the initiative to lobby and to suggest the concerned offices, to establish an accessible drop-off center to segregate and properly dispose of the e-waste at the same time may upgrade the various ways of collecting and transferring electronic waste to designated safe material recovery facility.
4. The stakeholders may increase the cooperation pertaining to the establishment of linkages with the community-based organizations in the informal sector, as well as to build a strong partnership with the public sector, the commercial sector, non-governmental organizations, and the community to implement innovative policies that will improve e-waste management and sound governance must be done.
5. Stakeholders may strengthen the ways of educating the people involved in view of hazardous nature of e-waste by regularly conducting seminars and talks related to the topic by resource speakers who are experts in the field.
6. Create programs on incentives and rewards for the stakeholders that would promote their participation at all levels in dealing with e-waste management for every office in their respective agency, as well as to intensify conformity towards local policies against dumping of e-waste through formal sanctions and punishments.
7. Examine and evaluate the private and public e-waste management system to carry out the requirements effectively and efficiently in the implementation of environmental management.
8. Designate priority funding for local government units to meet the needs in implementing the goals of the law on e-waste management.
9. Allow the Local Government Units (LGUs) to enact multiple ordinances to improve policy framework on waste electrical and electronic equipment (WEEE), placing an emphasis on fines, penalties and appropriate sanctions as well as strictly impose in making each

individual accountable for delivery of e-waste to address one of the fastest growing waste streams in the Philippines.

10. For more efficient and effective implementation of e-waste management through the support of the different government agencies like DENR, PNP Maritime Group, and PCG, with the participation of other local government units, the following are recommended to be studied by future researchers: (a) revisit the environmental laws and their impact on the community; (b) examine the different programs and offices in protecting the environment; and (c) align extension activity based on research outputs using qualitative or mixed design for future researchers.

Enhancement Program for Practices, Challenges, and Extent of Implementation on Dumping E-waste among Stakeholders

This part introduces programs and activities to improve the practices, challenges, and extent of implementation on dumping of e-waste among stakeholders. The enhancement program and activities were based on the items with the lowest mean item as revealed by the result.

As to practices, “the reuse of second-hand or used electrical and electronic equipment (EEE) and valorization of its waste component” gained the lowest mean. On the other hand, in view of challenges, “ineffective data collection and dissemination on material flow of electrical and electronic equipment” gained the lowest mean. Finally, in view of the extent of implementation, “setting up an accessible drop-off center for e-waste like IT Dept for the recycling items not to pile up” gained the lowest mean.

Relating the analytical role of the gathered data of the perceived assessment on practices, challenges, and extent of implementation across the three groups of stakeholders: DENR Personnel, Maritime Police, and the Philippine Coast Guard.

Enhancement Program for Practices on Dumping of E-waste

Item	Objective	Strategies	Persons Involved	Budget	Expected Outcome
The reuse of second-hand or used electrical and electronic equipment (EEE) and valorization of its waste component	Improve and enhance the poor practices on dumping of e-waste	Conduct monthly seminars/conferences or workshops pertaining to reusing and recycling of e-waste Adoption of innovative programs for the reuse of e-waste in different industries and sectors	People who are directly involved to e-waste disposal such as PNP Maritime Police, Philippine Coast Guard, DENR, BFAR, and the Bureau of Customs It will also include the LGUs, Ship	Funds may be derived from the government, non-government organizations and concerned citizens	Reusing and recycling of e-waste will be part of best practices in view of e-waste disposal Industries and other sectors will develop innovative programs



		Creation of a program/ projects in offices or various departments for e-waste recycling	Owners, Seafarers, NGOs, and Environmentalists as well as other citizens who are concerned with pollution and proper waste disposal, particularly with e-waste		pertaining to reuse, recycle or proper disposal of e-waste with life-long sustainability
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Enhancement Program for Challenges on Dumping of E-waste (cont'd)

Item	Objective	Strategies	Persons Involved	Budget	Expected Outcome
Ineffective data collection and dissemination on material flow of electrical and electronic equipment	Improve the capacity to face the various challenges pertaining to e-waste disposal	Conduct regular symposia about effective data collection and dissemination on material flow of e-wastes Strengthen the ways of educating the people involved in view of toxicity or hazardous nature of e-waste	People who are directly involved to e-waste disposal such as PNP Maritime Police, Philippine Coast Guard, DENR, BFAR, and the Bureau of Customs It will also include the LGUs, Ship Owners, Seafarers, NGOs, and Environmentalists as well as other citizens who are concerned with pollution and proper waste disposal, particularly with e-waste	Funds may be derived from the government, non-government organizations and concerned citizens	People will be knowledgeable of the hazardous impact of improper disposal of e-waste as well as gaining awareness pertaining to these issues Stakeholders will be equipped with adequate knowledge in view of the material flow of e-waste disposal

Enhancement Program for Extent of Implementation on Dumping of E-waste (cont'd)

Item	Objective	Strategies	Persons Involved	Budget	Expected Outcome
Setting up an accessible drop-off center for e-waste like IT Dept for the recycling items not to pile up	Improve and enhance the poor implementation on dumping of e-waste	Lobbying and suggesting the right office to establish an accessible drop-off center to segregate and properly dispose of the e-wastes Intensify obedience towards local policies against	People who are directly involved to e-waste disposal such as PNP Maritime Police, Philippine Coast Guard, DENR, BFAR, and the Bureau of Customs. It will also include the LGUs, Ship Owners, Seafarers, NGOs,	Funds may be derived from the government, non-government organizations and concerned citizens.	Existence of adequate drop-off centers for proper disposal and segregation of e-wastes. With rigid sanctions and punishments, citizens and responsible agencies and departments will be religiously



		dumping of e-waste through formal sanctions and punishments Upgrade the various ways of collecting and transferring electronic waste to designated safe material recovery facility	and Environmentalists as well as other citizens who are concerned with pollution and proper waste disposal, particularly with e-waste.		following the provisions and laws pertaining to proper e-waste disposal.
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