The Assessment of the of E-Waste Management Generated from Cellular Phones, Laptops, and Personal Computers in the Philippines

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ABSTRACT

This study focuses on the management of e-waste generated by the disposal of personal computers, laptops, and mobile phones because of the extraordinary growth in the use of these products over the past few years by the Filipino population. The aim was to explore the current methods of disposal of the aforementioned gadgets and to gather baseline data in terms of the disposal methods of these three electronic gadgets within the geographical boundary of Metro Manila and the suburbs of Manila, Philippines. An attempt to find the level of awareness of the respondents about the hazards of e-waste was also made. The Filipino population largely stores three electronic gadgets, namely, cellular phones, laptops, and personal computers, once the models become old and obsolete. The other most popular disposal method is selling the gadgets to junk shops. A very low percentage of people actually recycled their products. Sixty-nine percent of the respondents did admit that they were actually concerned about the impact of improper disposal of e-waste on human health and environment. All of the respondents admitted that they had no idea about the final fate of the discarded electronic gadgets. Based on the results of the survey, a review of overall management of e-waste generated from these three gadgets in Philippines is recommended. These surveys and data are collected to arrive at an estimation of e-waste generated by the disposal of these three gadgets as well as help the stakeholders and the government agencies to formulate legislations and policies to manage e-waste effectively and efficiently in the Philippines.

Keywords: E- Waste Assessment, Philippines, Toxic Electronics, E-Waste Management, Pollution, Recommendations, Health Impact

INTRODUCTION

The Philippines, like many other countries, has made a big foray into the field of information technology with an impressive increase in mobile subscription, possession of personal computers/laptops, and Internet access (Table 1). Due to the fast pace of upgrading these and other electronic gadgets by the Filipino population, the quantity of e-waste has increased alarmingly in the past decade or so. Among the vast array of electronic gadgets, cellular phones, computers, and laptops are causing the biggest problems, as they are the ones that are replaced the most often after batteries. Every year, most mobile phone companies launch new models thereby luring the consumers to buy the latest model and discard their older and (often), working cellular phones. The average working life of a mobile phone is seven years but across the globe today, an average consumer changes his or her mobile phone every 11 months (Sharpe, 2005). Because of this fast turnover, the life

cycle of a mobile phone is now reduced to less than 18 months (Environmental Protection Agency, 2004). The Philippines maintains its status as the "texting capital" of the world by sending around 2 billion SMS messages everyday (BuddleComm, 2014). Hence, it is not surprising that cellular phones have become one of the most commonly used gadgets by the Filipinos (Table 2). The Philippines is ranked 15th position among the top countries in the world with mobile penetration reaching 112% by March 2013. Among the Southeast Asian countries, the Philippines is at the second position in terms of number of mobile phones per 100 citizens (Table 2). Along with the increase in the mobile subscribers, there has been a continuous increase in Internet users in the past few years, and Philippines is at 17th place among the top 20 countries in the world with the most Internet users. From just 2% of Internet users in 2000, there were almost seven million broadband subscribers in the country by early 2013 (BuddleComm, 2014).

ICT Data on Philippines	Value	
Fixed-telephone subscriptions per 100	4.1	
inhabitants		
Mobile-cellular subscriptions per 100	106.8	
inhabitants		
Fixed (wired)-broadband subscriptions per	2.2	
100 inhabitants		
Mobile-broadband subscriptions per 100	3.8	
inhabitants		
Households with a computer (%)	16.9	
Households with Internet access at home	18.9	
(%)		
Individuals using the Internet (%)	36.2	

Table 1. Philippines IT Profile (2012)

Source: International Telecommunications Union Country profile

Country	Number of Mobile phones per 100 citizens
World	97
Singapore	151.8
Philippines	113.8
Malaysia	106
Thailand	105
Indonesia	99.68
Vietnam	79
Cambodia	Data not available

Table 2. Comparison of the Number of Mobile Phones per 100 Citizens in the Philippines with the
Neighboring (ASEAN) Countries in the Year 2013

Source: Euro Monitor International, 2014

In the Philippines within a time period of 15 years (1995-2010), an estimated 39.3 million electronic products were rendered obsolete, 20.2 million were reused, 8.4 million were recycled, 24.3 million were landfilled, and 20 million were stored in the houses (Table3). These numbers are increasing every year. Between the years 2000 and 2010, based on the direct sales data, an estimate was made that 1.3 million units of personal computers would become obsolete (Peralta & Fontanos, 2006). It is estimated that by 2030, about 400-700 million personal computers will become obsolete in the developing countries (Yu, Williams, Ju, & Yang, 2010). It is noteworthy to mention that beyond 2009-10, most cellular phone, desktop, and laptop manufacturing companies have introduced many new models in the market, thereby accelerating the process of replacing the old models with the latest available model in the market by the consumers. Hence, these gadgets are being disposed of before the end of estimated life span (Table 4). In 2009, a low-cost desktop model, the Nettop ng Bayan, was introduced by the Commission on Information and Communications Technology (CIFT) as part of the government's ICT program for the price-sensitive consumers (Business Monitor International, 2010). These incentives have further fueled the demand for the consumption of electronic gadgets and at the same time increased the generation of e-waste once these gadgets become obsolete and redundant.

The problem of generation of e-waste has become even more complex to deal with due to the importation of secondhand and scrap electronics from some of the developed countries. Therefore, the Philippines has e-wastes from two sources—locally generated e-waste that comes from the obsolete models discarded by the end-users and foreign e-waste that comprises end-of-life products or products that have been disposed of by developed countries and exported to the Philippines (Gutierrez, 2010).

OBJECTIVES

The main objective of this study is to gather preliminary/baseline data regarding the methods adopted by the Filipinos in disposing their cellular phones, laptops, and PCs, which will aid in arriving at the estimated values of e-waste generation in terms of these three gadgets.

There is insufficient data regarding the true value and extent of e-waste generation in the Philippines as there is no official inventory of the actual e-waste. Very few studies have been done in terms of estimations and projection levels of e-waste generation using assumptions based on indicators like economic and population growth. Some of the studies have used indirect methods to arrive at an estimated projection of the current and future quantities of the e-waste generation in the Philippines. Most of the data collected is based on domestic sales data (Peralta & Fontanos, 2006) and others have used material flow models. Some of the other methods used are end-of-life model, establishing the relationships among reuse, storage, recycling, and landfills (Matthews, McMichael, Hendrickson, & Hart, 1997). Yang, Xu, and Liu (2004) and Jain and Sareen (2004) used the sales data per year and the assumed product lifetimes to calculate the e-waste generation.

One of the consistent recommendations of most of the academicians and environmental watch groups is to collect information and prepare baseline data of total e-waste generated from different sources in the Philippines. The research and regular data gathering will help to develop analytical and mathematical models to predict the volumes of e-waste generation in the future. This will help frame policies and guidelines to manage the e-waste properly. The studies regarding the estimation of e-waste generation based on the domestic sales data of six major electrical and electronic products, namely, televisions, air conditioners, washing machines, refrigerators, radios, and personal computers, in Philippines were done by Peralta and Fontanos (2006), and Peralta, Villavert, and Ramos, (2008). However, there is not much data about the estimated e-waste generation from the cellular phones, laptops, and desktop computers.

Keeping this in mind, the present study was undertaken to assess the current methods of disposal of e-waste—with focus on cellular phones, personal computers, and laptops among Filipinos. This is the first direct study that can be used to make estimation about the e-waste generation from these three gadgets and finding the possible solutions to the growing problems of e-waste disposal.

MATERIALS AND METHOD

This study includes the disposal methods adopted by the respondents for only three electronic gadgets: cellular phones, laptops, and desktop computers.

A questionnaire was prepared after carrying out the initial survey to find out the most commonly used method of disposal of cellular phones, laptops, and desktops and the general awareness about the disposal method of these gadgets among the respondents (see Appendix I). The survey was conducted by students from St. Paul College, Pasig, and De La Salle University in and around Metro Manila. The researchers decided to conduct the survey to respondents from all walks of life living in Metro Manila and nearby areas to come up with a diverse and factual analysis. Hence the survey included office goers, professionals working in IT and BPO sectors, household helpers, drivers, housewives, teachers, and so forth. For every 50 respondents surveyed, 10 were selected from provinces around Manila such as Laguna, Los Baños, Antipolo, Marikina, Cavite, and Tarlac. Almost 2,500 respondents were interviewed and also answered the questionnaire. Upon the completion of the survey, the results were analyzed to find the trends.

RESULTS AND DISCUSSION

Our survey clearly shows that storage is the most used mode of disposal of cellular phones, laptops, and personal computers. For cellular phones, this method of disposing garnered the highest rate (33%) followed by giving it away to their relatives, family, and friends (23%, see Figure 1). Discarded cellular phones are usually stored in their cabinets for most of the respondents that we interviewed. About 19% of the respondents sold their old phones to junkshops, and about 13% threw the phone in the garbage. There is a general tendency to either store the old and obsolete equipments or throw them along with solid waste.

About 1% of the respondents recycled it and 1% swapped or traded it, which is same as the world average: less than 1% of the millions



Figure 1. Common disposal methods for cellular phones in the Philippines.



Figure 2. Common disposal methods for laptops/desktop computers in the Philippines.

of discarded cellular phones are recycled (Cleveland, 2009). If swapping/trading is categorized under recycling, then about 2% of the respondents actually recycled their cellular phone.

Regarding the disposal methods of laptops and personal computers, the survey indicates that storage is the most preferred method of disposal by the respondents. About 26% of the respondents do not own any personal computer or laptops though they did admit using cyber cafes for Internet surfing. Thirteen percent of the respondents sold their PCs and laptops to junk shops, and 5% just threw it in their regular garbage. Six percent of the respondents recycled their PCs and laptops (Figure 2). Constant efforts are being made to calculate the volume of e-waste especially comprising gadgets used in the IT sector. An estimated 2.078.695 units were sold from 2000 to 2010. Based on the calculations and analysis of end-of-life models, a total of 1,360,739 units of personal computers have been declared obsolete based on the sales from 2003 to 2010 (Villavert, Peralta, & Ramos, 2009). Of this total, 33% were estimated to have been recycled and 14% to be land filled, and the rest are stored. This study also shows a similar trend where almost 36% of the respondents stored their old laptops and personal computers.

Comparison Between the Method of Disposal of Cellular Phones and Laptops/PCs

The survey clearly shows that storage is the most preferred method of disposal of cellular phones and laptops/personal computers among Filipinos as a typical Filipino household keeps these electronic gadgets as stock for emergencies. Though the survey shows that more people recycle their PCs and laptops (6%) compared to cellular phones (2%), in absolute numbers cellular phones are more recycled. This is because almost 26% of the respondents do not own any PCs and laptops whereas almost 100% of the respondents owned one or more than one cellular phone.

The accumulation of e-waste due to discarded cellular phones is a bigger cause of concern as compared to the e-waste due to discarded laptops and personal computers as more people own cellular phones compared to laptops/personal computers. Further, almost 13% of the respondents just threw their cellular phones in garbage (part of solid waste) as the compared to 5% in case of laptops and personal computers. This disposal method can have serious repercussions on the ecosystem and health of the citizens. It has been reported that 91.5% of the total population of the Philippines owned a cellular phone by 2011, up from 60% in 2005 (Capistrano, 2013). Therefore, in absolute numbers the component of e-waste generation due to cellular phones is much bigger in the total e-waste generation from all other electronic gadgets. Our results show the same trends and further highlight the urgency of management of e-waste and the consequences on health and environment due to improper disposal of discarded cellular phones.

Awareness about the Impact of E-Waste on Human Health and Environment Among the Filipino Population.

Almost 69% of the respondents were aware of the harmful effects of e-waste on human health and environment while 31% of the respondents had no idea about this issue. The top three health hazards mentioned by respondents were radiation, lead or mercury poisoning, and other health-related problems such as miscarriage, birth deficiency, and skin problems.

Almost 100% of the respondents had no idea as to what finally happens to their discarded phones and laptops/PCs in terms of e-waste management. Sixty-five percent of the respondents did not know that under the E-trade, Philippines imports secondhand electronic gadgets from neighboring countries like Japan, Korea, and so forth.

This study clearly shows that the obsolete models of cellular phones, if in working condition, are either stored or passed onto another member of the household. They are also sold to secondhand shops to either swap or trade in for latest models; however, the overall percentage of people opting for this disposal method is very low. Nonfunctional electronics are often disposed of along with the municipal waste that is picked up by the scavengers who sell it to junk shops. The junkshops sell it to formal recyclers who dismantle the product for the recovery of precious metals or for some useful components to be reused again. In the case of institutional users of laptops and computers such as government offices and other organizations, discarded electronics are disposed of through a lengthy and tedious process of bidding by the recyclers to acquire the products for disposal.

In the Philippines, broken or nonfunctional cellular phones can be easily repaired or restored, and their software can even be upgraded. The restored old and defective mobiles phones are often called "reconditioned units." The other popular process often practiced for mobile phones, laptops, and personal computers is "cannibalization" whereby the new local computers or laptops are assembled using the functional parts of the discarded units. These are sold as "refurbished" items. Companies like HMR Philippines buy old computers and sell them as secondhand items after refurbishing. In fact these methods also qualify as methods of recycling.

The present trends in terms of e-waste disposal show that there is equal amount of e-waste entering the recycling channel as the one being stored in households (Figure 3). It is expected that with more awareness and consistent efforts, the recycling process to manage e-waste will show an upward trend in the coming years (Figure 3). Our results also show that in the Philippines, there is also a large amount of e-waste stored in households and only a smaller fraction is entering the recycle channel.

Many policy makers, academicians, and environmental groups do acknowledge that this trend is also because of lack of a proper framework and infrastructure to deal with the massive e-waste generation and its proper disposal in the country. This realization has to the adoption and launching of many initiatives and programs to manage the e-waste disposal in the country.

While most of the manufactures send their e-waste to licensed waste treatment facilities/ plants for proper treatment and disposal, the smallscale manufacturers generally end up using informal recyclers to dispose of their e-waste (Greenpeace Southeast Asia, 2005). The most well known formal companies that are engaged in e-waste recycling and processing are HMR Envirocycle (www.envirocycle-inc. com), Integrated Recycling Industries (www. iri.com.ph), and the Ayala Foundation, aside from 12 other DENR-accredited companies. These companies source out their e-waste from large-volume industrial markets and have arrangements with various offices to collect their discarded electronics. They also import secondhand electronics. The formal recyclers export the processed e-waste exported to other countries but the informal recycling is often a problem as the final disposal method or the destination of the processed e-waste is unknown.

All the three electronic gadgets-cell phones, personal computers, and laptopscontain precious and hazardous metals in their circuits (Table 4). About 70% of the heavy metals present in the landfills come from the discarded and improper recycling of the waste. The heavy metals leach out from the e-waste and contaminate the ground water and pose a risk to the environment and public health (Environmental Protection Agency, 2001). Further, the informal recyclers use very dangerous and unsafe processes, most of the times using bare hands or crude instruments to break the circuits and to dismantle and burn in open areas to recover these precious metals such as copper and gold. The scavengers, waste pickers, and junk dealers constitute the informal recyclers.

Most of these recycling activities take place in crowded areas and slums around big cities. According to Gutierrez and Agarrado (2011), the e-waste is being dumped at the Smoky Mountain, Pier 18 of Manila, and Dreamland in Rosario, Cavite.

The issue of e-waste management has become more complex to solve for the government and other major organizations, as the informal e-waste recycling sector has become a source of livelihood for many Filipino households. Many e-waste recyclers called "mambuburaot" sell motherboards for Php220-250 per kilogram, copper wire for Php280-290 per kilogram, and lead for Php30 per kilogram (Gutierrez & Agarrado, 2011). As these workers get a reasonably good price for selling these materials obtained from essentially what is known as scrap it is very hard to dissuade them from indulging in dangerous practices used for extracting these precious metals from e-waste.

Electronic	Lead**	Mercury**	Copper (% by Weight)	Silver	Gold	Palladium
Personal Computer (PC) Board*	6.2988% by weight	0.0022% by weight	20%	1000 (ppm)	250 (ppm)	110 (ppm)
Mobile Phone	>10ppm	>10ppm	13%	3500 (ppm)	340 (ppm)	130 (ppm)
Desktop	4.5-13% by weight	By and large absent of very minute amount	6.93%	0.0189 (% of total weight)	0.0016 (% of total weight)	0.0003 (% of total weight)

Table 4. Concentration of Metals in Various Electronics

(*) Source: Umicore Precious Metals Refining (2007, 2012).

(**) Source: Microelectronics and Computer Technology Corporation (MCC), 1996.

Electronic Industry Environmental Road Map, Austin, TX (MCC).





Figure 3. Weight of E-Scrap (in million tons), E-waste, Recycled/Reused, and in Storage from Adjusted Sales by Year, World Markets: 2010-2025

Table 5. E-Waste Generation Among the Association of Southeast Asian Nations (ASEAN) Cou	ntries
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Country	Year	Population	E-waste Generated (total in metric kilotonnes
			243.48
(In Millions)	2012	15.24	21.36
Vietnam	2012	90.39	187.16
Lao People's Democratic Republic	2012	6.38	11.19
Thailand	2012	64.46	378.62
Indonesia	2012	244.47	708.38
Malaysia	2012	29.04	289.32
Singapore	2012	5.37	196.43
Brunei Darussalam	2012	0.43	13.12

Source: Data compiled from http://www.stepinitiative.org/index.php/WorldMap.html

RECOMMENDATIONS FOR ACTION

As discussed, in the Philippines, the major challenges in the management of e-waste are unavailability of accurate estimates of quantities of total e-waste generation, low level of awareness among the consumers about the health hazards and environmental impact of improper e-waste disposal, and lack of proper legislation and government policy on e-waste management.

Based on our studies we recommend five ways that will help towards effective management of the e-waste in the Philippines, specifically in terms of mobile phones, PCs, and laptops.

Spreading Awareness

According to a survey conducted by the Social Weather Station (SWS) in 2007, 50% of the survey respondents were aware of the existence of antipollution laws and 40% of the respondents perceived that environmental laws are rarely enforced. Our survey also indicates that the level of awareness on this issue is still low among the Filipino population. Though 69% of the respondents were aware of the devastating effects of e-waste on human health and environment, they had no clue about the present scenario of the e-waste in the country in terms of anti-pollution laws and the programs available to manage the e-waste. Almost 31% of the respondents replied in negative when they were asked about what is e-waste and why it is a cause of concern. The prevalent practice of "sayang" (waste) among the Filipinos further makes it difficult for them to dispose of their used and non-functional electronic items.

Hence there is an urgent need to educate and inform the Filipinos about the dangers of improper disposal of e-waste and overall impact of accumulation of e-waste. The use of electronic and print media to promote and campaign and the use of celebrity and VIP endorsements are some of the means to achieve this goal. All stakeholders, especially the corporate and manufacturing sectors, should be made aware of the existing environmental laws and legislations in the country.

Restructuring of the Recycling Programs

Recycling of discarded electronics should be promoted in a big way to further address this issue. Several efforts have already been made in this direction.

In 2007, a national pilot project was launched under the leadership of the Department of Trade and Industry (DTI) where major mobile phone manufacturers, mobile phone operators, service providers, and distributors participated to manage the e-waste generated from the cellular phones. As part of their "Corporate Social Responsibility Program", these companies participated in this project called Cell Phone Waste Collection and Recycling with the aim to initiate a take back system for mobile phones with many collection bins and drop off points placed in various malls ("Cell Phone Waste Collection Pilot Project," 2007).

A prominent international mobile phone company in collaboration with a local broadband service provider company and a prominent business house along with Philippine Tarsier Foundation, Inc. (PTFI), launched a novel program in 2012, where the recycled phones were used to save the Philippines Tarsiers. Under the "i-rEcover.i-rEcycle" program, the international mobile phone company donated a fixed amount to PTFI for every mobile phone donated at recycling bins located in various stores and malls all over the country. The amount collected was donated to the Tarsier sanctuary in Tagbilaran City, Bohol, for preserving the Philippine tarsier and its habitat ("M. Lhuillier Donates 222 Old Mobile Phones," 2013).

Another commendable initiative that needs to be further endorsed here is the Mobile Phone Partnership Initiative (MPPI). In 2002, MPPI was launched under the banner of Basel Convention where approximately 15 mobile phone manufacturers signed a declaration to pledge their support for efficient management of end-of-life mobile phone units (United Nations Environmental Program, 2013). To focus on the issue of e-waste management of discarded personal computers and laptops, in 2008, the Partnership for Action on Computing Equipment (PACE) was launched under the banner of the Conference of the Parties to Basel Convention to find environmentally sound management of used and end-oflife computing equipment, refurbishment, recycling, and their proper disposal (United Nations Environmental Program, 2013).

Though there is a lack of national legislated Extended Producer Responsibility or (EPR)related system, some of the local electronic companies have taken the initiative to reduce the e-waste generation by reducing and recycling along with the implementation of Environmental Management Systems (e.g., ISO 14000) and launching the "Take Back" policy in terms of mobile phones and personal computers and laptops. The government along with the stakeholders should collaborate to implement the take-back scheme.

Some progress has been made in this direction, but much more effort is needed. Under the product stewardship plan, some of the big mobile phone companies have started "Take Back E-cycling Campaign" where the consumers are encouraged to deposit their discarded units and accessories back to the company. In 2014, another prominent telecom company launched a project dubbed as "Project 1 Phone" to recycle the discarded cellular phones by putting up 21 recycle bins across the Philippines for people to dispose of their old phones (Crisostomo, 2014). These units are then shipped to recycling plants in countries like Singapore where they are dismantled and converted into raw materials for other products ("Analysis of Transboundary Movements," 2007).

Since the year 2006, the "Recyclables Fair" has been regularly held at different malls with the purpose of collecting discarded electronic equipments such as mobile phones, mobile phone batteries, and other wastes such as used printer cartridges, lead acid batteries, and so forth. The Philippines Business for the Environment (PBE) is a non-profit organization that has been active in sensitizing the Philippine industry to the need for their participation and their responsibility towards e-waste recycling. PBE, in partnership with some big business houses under the scheme of corporate social responsibility, have organized "recyclable collection events" (RCE) with easy collection centers in the malls for the consumers to dispose of their discarded electronic gadgets. They also now organize a recyclable collection day on special days like "Earth day." The practice of "Bote-Bakal-Diardio-Garapa" where the vendors go door-todoor to buy old and discarded stuff should be used to collect the discarded phones, laptops, and personal computers. These traditional collectors are now known as "Eco-Aides." The discarded items can also be given to the barangay collector or delivered to a material recovery facility (MRF).

Many electronic manufacturers are densely concentrated in the industrial zones of the Calabarzon, Clark, and Baguio cities, and these areas are identified as PEZA zones that enjoy the economic incentives and tax breaks (Carisma, 2009). Special e-waste management programs should be launched in these areas to manage the e-waste generated in this zone. As the cellular phone usage and network have penetrated deep into the interiors of the country, additional convenient locations should be made available for people to dispose of their obsolete electronics. The best locations to place the recycling kiosks/desks are near the churches and malls as these are the places that are visited by the majority of the Filipinos. To increase the reach of the recycling efforts for managing the e-waste, mobile units should be arranged to visit interior and remote areas on (preferably) weekends and holidays to collect specifically only the e-waste from people's houses just like the collection of solid waste. In order to increase the public participation and encourage the people to recycle, appropriate incentives should be given by the companies and the government.

Policy-Level Interventions

The two areas where the government needs to take urgent action are, first, the formulation of a comprehensive policy framework where an official definition of e-waste should be issued and secondly, the ratification of the Basel Ban Amendment (Alegre & Borcena, 2010).

Up till now, there is no separate framework or legislation for the e-waste specifically, and it is being dealt as part of solid waste management only. Senate Bill 911 has been drafted on e-waste and cellular phones recycling in 2013. Policy makers should also give serious thought to the adoption and implementation of EPR to specifically deal with e-waste management (Carisma, 2009). EPR is defined as the "policy principle that promotes total life cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of the product to various parts of the product's life cycle, and especially to the take-back, recovery and final disposal of the product" (Lindhqvist, 2000, p.v, Executive summary). The Organization for Economic Co-operation and Development (OECD) defines the EPR as "an environmental policy approach in which

a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. There are two related features of EPR policy: (1) the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities, and (2) "to provide incentives to producers to incorporate environmental considerations in the design of their products" (OECD, 2001). Many countries are in dialogue with stakeholders to adopt EPR as a policy option for managing e-waste and the Philippines should also give it a serious consideration to solve the impending e-waste crisis.

International Efforts

The Home Appliances and Recycling Law in Japan, the German Packaging Act (Deubzer, 2011), and WEEE Directive in the EU (European Commission, 2012) has forced Philippine electronic product manufacturing companies to adhere to the strict environmental standards, regulations and guidelines enforced by these laws. According the UNEP-UNCTAD (2007), the environmental regulations in developed world "...create an effect of increasing requirements for suppliers to become more aware of environmental issues, especially, product-related aspect concern with material and energy efficiency, reduced toxicity and increased recycling" (p. 4). Due to these guidelines, some of the products in the Philippines, like the mobile phones and battery products, carry the mandatory WEEE symbol (a crossed out wheeled bin) that signifies separate collection though in practice it is not followed due to the lack of clear policy framework and infrastructure.

As the informal sector carries out a substantial portion of recycling e-wastes in the Philippines, separate guidelines or framework with a regulated formalization of informal recyclers should be done. On the basis of Japanese experience of recycling lead batteries (Kojima, 2002), the barangay municipality government should prepare a framework under which the pollution control regulations can be imposed on the recyclers. The recyclers should form an association to share information, understand guidelines, and arrange funding for improving the recycling facilities. Already some efforts have been made in this direction, where in 2010 a scheme was launched in Luzon, Visayas, and Metro Manila by the National Solid Waste Management Commission (NSWMC) in partnership with the Ecowaste Coalition to develop a safety module in the Philippines to reduce the occupational hazards of the informal waste sector workers (The vanishing e wastes of the Philippines, 2010).

Exporting some of the e-waste is another solution to solve this problem. In the context of the transboundary e-waste trade, the ASEAN (Association of Southeast Asian Nations) has so far failed to draft a common policy response to address this issue (Ibitz, 2012). Many ASEAN countries have shown rapid increase in the volume of e-waste generation. Whereas Thailand has reported a rise in the volume of e-waste by an annual 12%, the Philippines is ranked 4th in terms of e-waste generation (Table 5). Malaysia, Hong Kong, China, and Singapore are engaged in the import of e-waste from the European Union to be used as source of secondary raw materials (Ibitz, 2012). The Philippines can take the lead to improve the collaboration and coordination between different governments among the ASEAN countries to develop a framework for efficient e-waste management in this entire region.

Technical Interventions

Another cause of improper disposal of e-waste is the inadequate facilities and rudimentary treatment techniques in the Philippines. The e-waste management facilities in the Philippines are only limited to refurbishing or de-manufacturing processes. There is an urgent need for a fully integrated recycling plant for which the technology should be imported with special emphasis on capacity building (Guiterrez & Agarrado, 2011).

Development of E-Waste Management as a Lucrative Business Model

The e-waste treatment and management in the Philippines can be managed using a different approach. The e-waste not only contains hazardous substances but also valuable materials. A ton of discarded mobile phones contains about 240 g gold, 2.5 kg silver, 92 g palladium, 92 kg copper, and 38 kg cobalt, worth about USD13,885 (Ibitz, 2012). In 2008, about 1.3 billion mobile phones were sold worldwide and the worth of gold alone accounts to USD 1.1 billion. An estimated USD 1.35 worth of retrievable materials per mobile phone makes trade a lucrative business (Hagelüken, 2010). The revenue generated from the e-waste management market for just the formal sector is expected to grow from \$9.15 billion in 2011 to \$20.25 billion in 2016 around the world (United Nations University, 2010). The Philippine government and various stakeholders can grab this golden opportunity to organize the informal sector by resource availability and formulating regulatory framework to encourage entrepreneurs to establish businesses anywhere within the e-waste supply-demand chain.

CONCLUSION

In order to formulate and implement the guidelines for efficient e-waste management, the most immediate task is to collect actual data on the generation of e-waste including the importation and disposal of second hand electronics. The data regarding the domestic e-waste generation per year is still very scanty. My study shows that there is a huge amount of e-waste still lying in the Filipino households that has not joined the e-waste disposal/recycle chain due to the storage of the obsolete models by the people. My study suggests that the government can easily implement the "Take Back Scheme" with at least three electronic products, namely, personal computers, laptops, and cellular phones, to get these devices into the recycle chain and proper disposal. Later on, more innovative ways can be found to extend this scheme to cover other electronic products.

The management of e-waste generated from cellular phones, laptops, and personal computers and other sources needs a multiprolonged approach such as policy-level intervention to reduce the generation of e-waste; collaboration between the stakeholders, environmental groups, government, and NGOs to recycle the electronic waste; policy review of importation of the e-waste; providing incentive to the industry to make eco-friendly products; and spreading awareness about the importance of recycling among the Filipino population.

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