

Electrical and Electronic Waste Management–A Case Study in University of Duhok, Iraq

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Abstract

The aim of this paper is to estimate the perception, knowledge and attitude of the households towards electrical and electronic equipment waste (e-waste) management in Duhok city, Iraq. It also tried to identify current e-waste management practiced by households in Duhok. It has been found in this study that much of the electrical and electronic equipment was updated within two thirds of their designed lifetime. Most of the respondents informed that they just threw their e-waste to the waste bin. It can be concluded that all stakeholders of e-waste management, from the government and nongovernmental sectors should consider shifting the management options towards the top of the waste management hierarchy (prevention and waste minimization) by substituting the hazardous materials in e-waste and encouraging redesign of equipment for a better control of the negative impacts of e-waste.

Keywords: e-waste management, awareness and attitude, product life time, updating time, deposit and disposal

1. Introduction

Electrical and electronic equipment waste (e-waste) is said to be the fastest growing waste stream in the world (Nnorom & Osibanjo, 2008), with the growth rate at 3% to 5% per year (Mohan, Garg, & Kumar, 2008), which is three times faster than the general waste (Network, 2005), thus creating a great management challenge to most countries worldwide. Managing e-waste is a challenging task, not only due to its rapidly increasing volume, but more importantly because of its hazardous nature. E-waste contains numerous hazardous substances which may pose a threat to the environment and human health if they are not disposed of in the correct manner. On average, 9% of the weight of e-waste is made of hazardous substances such as lead, cadmium, mercury (heavy metals) and other toxic chemicals (Sarkar, 2008).

Petroleum refinement is easily the most valuable and developed modern industry in Duhok, Iraq. So, income level as well as standards living depend on Iraqi oil price (Izady, 2008). Recently, increasing in the income level is pushing the consumers to buy more electronic and electric equipments (EEE). In every house in Duhok city, there are more than one TV set, refrigerators, air conditioners, personal computers and mobile phones. As a result, deposit and disposal of municipal solid waste (MSW) has become one of biggest environmental issues of today. The experiences from developed countries show that sorting of MSW should be the first step for handling this issue. E-waste is an increasing stream in MSW.

Currently e-waste recycling efforts in the Arab region have mostly been limited to random and small scale initiatives. So, the problem of e-waste management in most countries of the Arab Region is in a dire need for immediate solutions, technically financially and indeed politically. In the absence of dedicated facilities to handle hazardous waste, there is a real concern that such waste will be disposed of with non-hazardous waste, thereby contaminating landfills, soil, water, air and exposing public health to great environmental risks. The aim of this paper is to estimate the perception, knowledge and attitude of the respondents towards environment and specially e-waste management in Duhok city, Iraq. It also tried to identify current e-waste management practiced by households in Duhok.

2. Definition of E-waste in Arab Country

Most of the Arab states have already ratified the Basel Convention (BC) for the Control of Trans-boundary Movement of Hazardous Wastes. Although they took this step, until recently, countries of the Arab Region have underestimated the problems and impacts caused by the generation of hazard waste. Several countries classified all wastes generated from industry as industrial waste regardless whether it is hazardous or not. In some countries of Arab region, several shipments of toxic (and radioactive) wastes are illegally entered the region for disposal (e.g., Somalia). Chemical and petrochemical industries are the main contributor to hazardous waste

generation; however, other industries and facilities are also contributing (e.g., mineral and metal processing, health care facilities and laboratories etc.). Small and medium size enterprises (SMEs), such as electroplating shops, tanneries, auto-repair garages, have also their significant share in generating hazardous waste. Municipal wastes always contain certain portions of hazardous wastes (e.g., chemical solvents, paints, cleaning products, pharmaceutical substances, and batteries). Unfortunately, there are no comprehensive databases reflecting accurately the amounts and types of hazardous (and other) wastes generated in the Arab Region. The World Bank estimated the hazardous waste quantity on gross domestic product (GDP) basis which has been presented in Table 1.

From the estimation, it can be found that the amount of hazardous waste is higher in high income country compare to medium low and low income country. It can be concluded that as industrial developments and urban expansions proliferate in the Arab Region, the rates of hazardous waste generation will continue to rise. The establishment and implementation of e-waste reuse and recycle management systems depend on public awareness and involvement.

3. Methodology

In this study the survey questionnaire includes the questions related to the public knowledge/awareness of the environment, the EEE product lifetime, the reasons for updating and the deposit and disposal of e-waste order to provide the fundamental information of public awareness and environmental performance to the local government and decision-makers. A sample was taken in the University of Dohuk in Dohuk city including graduate and postgraduate staff. All of the residents were Iraqi citizens. The questionnaires have been distributed to 350 respondents and then collected. Of the 350, there were 332 acceptably completed the questionnaire. Public environment awareness is one of the most important indicators for displaying many aspects of environmental status, such as peoples' knowledge, personal consideration and behavior and the local citizen's attitudes towards sustainable society as a whole. All of the information is useful for decision makers, environmentalists, educators and businessman in planning for social sustainable development(QH., 1999). In the survey, 64% of the respondents weren't satisfied with Dohuk's environmental quality, while 36% were satisfied. In Kuala Lumpur, the majority of the households (54%) were dissatisfied with the quality of the current waste collection services (Afroz & Masud, 2010).

4. Results and Discussion

Attitude of the respondents towards household waste sorting at source

Petroleum refinement is easily the most valuable and developed modern industry in Dohuk, Iraq. So income level as well as standards living depend on Iraqi oil price (Izady, 2008). Recently ,increasing in the income level push resident to pay more electronic and electric equipments . In every house in Dohuk city there are more than one TV set , refrigerators, air conditioners, personal computers and mobile phones. As a result, Municipal solid waste (MSW) deposit and disposal has become one of biggest environmental issues of today. The experiences from developed countries show that sorting of MSW should be the first step for handling this issue. Waste electrical and electronic equipment is an increasing stream in MSW. Therefore, some questions in the survey were designed to obtain local public opinions and attitudes towards the handling of MSW.

The survey data revealed a positive attitude towards sorting of MSW, at the source. The percentage of the respondents choosing "I am willing to sort household wastes into separate containers" is about 40%. About 23% of the respondents selected "I will sort my household wastes if the government requires me to do it." That means that about 63 % of the respondents accepted sorting of waste, at the source. About 16.3% and 20.8% of the respondents chose "It is not a proper time since there is no sorting and collecting system" and "It is impossible because of the lack of public environmental awareness even if there is a sorting and collection system," respectively (Table 2).

4.2 Deposit and disposal of waste electrical and electronic equipment

Electrical appliances provide satisfaction and increase convenience in everyday life and, as a result, their usage becomes more and more popular in Iraqi households. Rapid development of technology in electrical and electronic industries not only offers a wide range of product choices but also price choices. Now some products are available in more affordable prices. With the increase in purchasing power and the generally affordable prices of electrical and electronic equipment (EEE), the residents of Iraq are able to own more than one type of EEE or multiple units of the same type of EEE such as mobile phones. It gives individuals the opportunity to have electronic goods in their home(Kalana, 2010).

4.3 Product lifetime

The updating rate is associated with the designed lifetime of the product. According to commonly adopted international criteria, the product lifetimes are 8 to 10 years for color TVs, 13 to 16 years for refrigerators, 8 to 10 years for general washing machine, and 6 years for personal computers. The survey shows that the time to updating the electrical and electronic equipment is different. For example, the percentage of refrigerators phased out within 10 years reaches 55% and the figure for washing machine is about 49%. The percentage of TV set phased out 6 years and above has higher percentage which is about 33%. However, there are some residents that use electrical and electronic equipment past their designed lifetime. It was observed that much of the electrical and electronic equipment was updated within two thirds of their designed lifetime, such as 37.7% of personal computer, 51% Mobil phone, and 34.3% of camera (Table 3). In this study, there are six reasons to update electrical and electronic equipment which is shown in Table 4. The results indicated that 52% of respondents mentioned that they had updated the EEE because previous product damaged or not functioning anymore. Another significant reason which is stated by 32 % of the respondents is new items have additional and more advance technological features. Only few respondents mentioned that they had updated the EEE because their disposable income increased, the EEE had less capacity or they had been influenced by others.

4.4 Methods for Deposit and Disposal of Electrical and Electronic Equipment

In this study, the respondents were asked how they deposit and disposed of their EEE. The information related to this question has been presented in Table 5. Most of the respondents (39%) informed that they just throw out their old equipments to the waste bin. Another two preferred methods of e-waste disposal by the residents shown in Table 4 are “Keep in house” and “give to charity or transfer the products to relatives” is about 16 % and 16 % respectively. Only a small fraction of e-waste (5% and 13%) finds it way to manufacturer and recycling centre respectively as there is no efficient take back scheme for consumers and recycling facilities.

5. Conclusions

In this study it has been found that 64% of residents are not satisfied with the local environmental quality and about 70% of the residents would like to share environmental responsibility. As the economy expands with strong support from local environmental policy, more attention should be paid to environmental protection. The government of Iraq and the related organizations are suggested to improve their environmental performance to improve local environmental quality. It is interesting to find that 40% of the respondents are willing to sort their household waste into separate containers. The percentage of the respondents willing to sort the waste is high and it is an welcome attitude for the environmental development of Iraq.

The amount of electrical and electronic equipment held by the city and township inhabitants has increased dramatically and most of them are phased out within product lifetime. The main reasons for them to update their products are new items have additional and more advance technological features and previous product damaged or not functioning anymore. Electronic products are very often retired early even though they still work perfectly because new products offer more or better features or have more fashionable designs (C. J. Williams, Mendell, Murphy, Johnson, & Richter, 2008). However, it has been reported that normally the purchase of new equipment is driven by the desire to update new Software or other functionality (Herat, 2007) , not due to breakage of the machine and at the same time it is due to the decreasing lifespan of all consumer electronic products (C. J. Williams, et al., 2008) . Most of the respondents informed that they just throw out (their old EEE to the waste bin. Currently, no structured mechanism is in place to handle e-waste from households compared to e-waste generated from industries. Extensive literature has proven that most consumers store their unused or broken electrical and electronic equipment for years before the equipment is resold or otherwise disposed of (Hischier, Wäger, & Gauglhofer, 2005).

Currently, there is no mechanism on a proper segregation or disposal system to encourage the public to recycle and discard e-waste. Continued generation of e-waste over time, together with lack of structured mechanisms of institutional framework and inadequate infrastructure, results in improper e-waste management. Even though at present electrical or electronic appliances are rarely disposed of indiscriminately, with little regulation in place this has created hazards to the local population as well as the environment.

As mentioned in our above discussion, main issues relating to adoption of this waste management option in Iraq includes illegal import or smuggling of e-waste, rapid growth of locally generated e-waste, indiscriminate dumping and improper disposal of e-waste, tracking down illegal e-waste recycling operators, low public perception about the adverse impacts of e-waste and low willingness to pay for recycling of e-waste. These call for a strong cooperation of government and nongovernmental stakeholders to govern this environmental issue

together, as traditional governing by the government alone has proved to be too challenging for the government (McLendon et al., 2008).

It is envisioned that the implementation an e-waste management programme in the Arab region will be executed through Public-Private Partnerships, in cooperation with other entities, particularly Non-Governmental organizations (NGO). Government institutions can support this initiative by providing the necessary enabling environment for effective E-waste management. A forum is planned that will include executive levels entrepreneurs from ICT private sector enterprises, ICT government organizations, environmental agencies, and non-government organizations. A key objective of this forum is to share knowledge about E-waste management success stories, from an international, regional, and national perspective.

Recycling practices in Asian and African countries are mainly based on economic potential. In these countries, e-waste is treated as just another type of recyclable item and the process is characteristically undertaken without proper environmental procedures, often by illegal recycling operators who operate informally outside of the main business circle. This has brought many consequences such as high occupational health risks to the workers due to the exposure to hazardous materials, and negative impact on the environment and the society at large as a result of the inappropriate disposal of hazardous materials from the recycling and material recovery processes (E. Williams, 2005). From the resource conservation perspective, such informal practices are ineffective as the percentage of recovery is low and many of the valuable materials are lost during the inefficient recovery processes. It is thus obvious that leaving the recycling of e-waste to the informal sector is not a sustainable option, both environmentally and economically. Although e-waste recycling practices in the more economically developed countries appear to be more technologically advanced and environmentally sound compared to those in the less economically developed countries, they still pose environmental and health threats as it is impossible to recycle e-waste without any environmental impacts (W. S. Robinson, 2009). Recycling process may remove some contaminants, but some amount of hazardous substances may still be concentrated at e-waste recycling centres (Awang, 2010). However, e-waste recycling and material recovery management strategy have a relatively lower environmental impact compared to disposal (through landfill or incinerator) management option (B. H. Robinson, 2009). [However, all stakeholders of e-waste management, from the government and nongovernmental sectors should consider shifting the management options towards the top of the waste management hierarchy (prevention and waste minimization) by substituting the hazardous materials in e-waste and encouraging redesign of equipment (which facilitates replacements of parts of equipment to cope with technology advancement instead of disposing items in whole) for a better control of the negative impacts of e-waste.

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Table 1. Estimate of hazardous waste quantity based on GDP

State	World Bank Classification	GDP estimates for 2006(in \$million)	Estimates of hazardous waste quantity (Around 1000 tons)
Egypt	Medium-Low	107,378	214
Saudi Arabia	High	348,673	Over 697
UAE	High	164,865	Over 329
Kuwait	High	101,904	Over 203
Bahrain	High	15,828	Over 31
Oman	Medium- High	35,656	71
Qatar	High	52,722	Over 105
Yemen	Low	21,196	21
Jordan	Medium-Low	14,258	28
Morocco	Medium-Low	65,899	132
Syria	Medium-Low	34,190	68
Tunisia	Medium-Low	31,416	63
Lebanon	Medium- High	23,285	46
Sudan	Low	43,894	44
Mauritania	Low	2,713	3

Source: World Development Indicators: Washington,DC USA(2007)

Table 2. Attitude toward Household Waste Sorting at the Source (N=332)

	Frequency	Percentage (%)
I'm willing to sort house hold waste into separate containers	133	40.0
I will sort my household waste if the government requires me to do it	76	22.9
It is not a proper time since there is no sorting and collecting system	54	16.3
It is impossible because of the lack of public environmental awareness even if there is a sorting and collecting system	69	20.8
Total	332	100.0

Table 3. Updating Time for EEE (N=332)

Item	Product life time in year	Percentage (%)
Television	1 to 2	11.1
	2 to 4	30.1
	4 to 6	25.6
	Above 6	33.1
Refrigeraton	1 to 2	5.7
	2 to 4	12.3
	4 to 6	26.8
	Above 6	55.1
Washing Machine	1 to 2	6.3
	2 to 4	18.4
	4 to 6	26.2
	Above 6	49.1
Computer	1 to 2	19.6
	2 to 4	37.3
	4 to 6	20.2
	Above 6	22.9
Mobile Phone	1 to 2	50.9
	2 to 4	30.4
	4 to 6	7.5
	Above 6	11.1
Camera	1 to 2	27.1
	2 to 4	34.3
	4 to 6	13.0
	Above 6	25.6

Table 4. Reasons for Updating Household EEE (N=332)

	Frequency	Percentage (%)
Previous product damaged or not functioning anymore	169	52.0
Not powerful/not enough capacity	24	7.0
New items have additional and more advance technological features	107	32.0
Increase in disposable income level	12	3.0
Influences by others (ex; through advertisement, friends and trend)	10	3.0
Other reasons	10	3.0
Total	332	100.0

Table 5. Methods for Deposit and Disposal of Electrical and Electronic Equipment

	Frequency	Percentage (%)
Keep in house	54	16.0
Return to the manufacturer	16	5.0
Recycling centre	44	13.0
Give to charity or transfer the products to relatives)	55	16.0
Waste bin	130	39.0
Others	33	10.0
Total	332	100.0