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AVOIDING RISKS OF ELECTRONIC WASTES ON HUMAN'S HEALTH THROUGH ESTABLISHMENT OF AN E-WASTE MANAGEMENT SYSTEM IN EGYPT (REVIEW).

By

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Abstract

This paper shed the light on the undue impacts of the electronic wastes on human's health and environment in the absence of the wise management. This type of waste contains heavy metals and toxic materials that help in destructing the environment and human's health. In fact, the absence of legal infrastructure that controls the handling, dismantle, recycling and disposal of e-wastes played a role in maximizing the bad consequences whether on the environment or the man's health. Three e-wastes management systems have carefully been analyzed for three countries for standing on the regulations and components that form the management systems in these countries. After that it could be established an Egyptian e-wastes management system fit both the social and economic situations of Egypt. This system will positively affect human's health, environment and national income.

Key Words: e-waste, Environmental management system, Egypt e-waste management system, E-waste's health impact.

Introduction

During the past few years, the environment experienced many of the risks that represent the dark side of technological development, and one of the most impacts is electronic waste, which ended their useful life. This is a waste time bombs capable of causing dozens of dangerous diseases to humans and also all other objects. The e-waste pollution is the scourge of modern-day of the progress of rapid scientific and technological in the field of electronic industries, and threatens the safety and integrity of the environment, through the accumulation of metals, plastics toxic chemicals that make up the electronic devices. It is a global problem because they pose a threat to human health and the environment if it is incorrectly disposed and filled randomly landfills with other organic and inorganic waste, which is not ready to receive this type of waste. Although many people know the dangers of e-waste, but they nevertheless dispose of them by traditional methods in the absence of a specific and well-known mechanism for getting rid the disused devices where they throw them in the garbage including content of materials may adversely affect human health.

Egypt lacks the policies and regulations that give specific and clear guidance for the management of electronic waste in the absence of a comprehensive management system. Most electronic waste is currently managed by the informal sector and civil society organizations or ending on an open dump sites mixed with municipal solid waste. Recent studies have revealed that the amount of electronic waste around the world exceeded to the size of other waste by 3-times and has become the largest environmental problems in a lot of countries. Electronic equipment is made up a wide range of materials including metals, plastics and ceramics. For example, a mobile phone may contain more than 40 elements including base metals like copper and tin, special metals such as cobalt, indium and antimony, and precious metals like silver, gold and palladium (Salman , 2015).

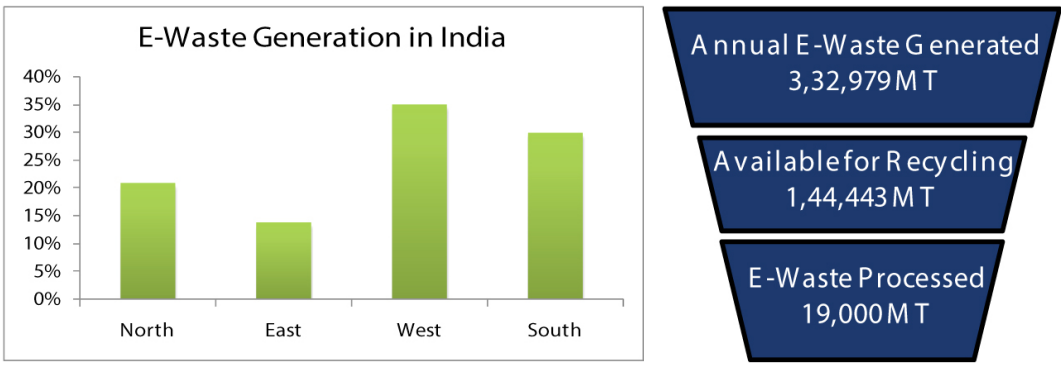
Electronic waste (e-waste) continues to increase dramatically amid growing global demand for electronic and electrical goods. It is estimated that in 2004 alone, 315 million Personal Computers (PC) became obsolete globally and 130 million mobile phones

were estimated to have reached their "end of life" in 2005 (UNEP, 2005). The USA produces most electronic scrap, reportedly 3.16 million tons in 2008 (EPA, 2009). The total e-waste generated worldwide rose from 6 million tons in 1998 to 20-50 million tons in 2005 (UNEP, 2005). Jinglei Y et al., 2010 predict that obsolete PCs in developing regions will exceed those of developed regions by 2016- 2018 and that by 2030 they could amount to 400-700 million units (compared with 200- 300 million units in developed countries) (Schwarzer et al,2005, UNEP 2005, UNEP and UNU 2009).

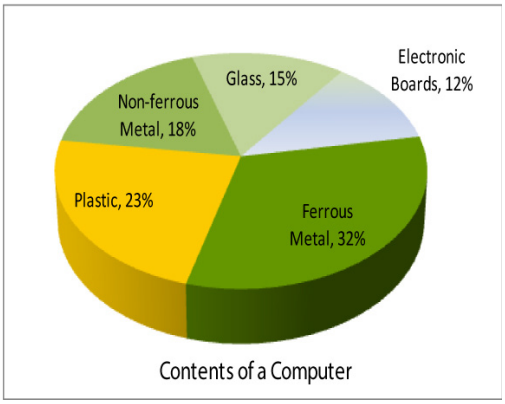
Table 1: Estimates of e-waste generation (tons per year) in some different countries (UNEP & UNU, 2009)

Countries	Assessment Date	PCs	Printers	Mobile phones	TVs	Refrigerators	Total
South Africa	2007	19,400	4,300	850	23,700	11,400	59,650
Kenya	2007	2,500	500	150	2,800	1,400	7,350
Uganda	2007	1,300	250	40	1,900	900	4,390
Morocco	2007	13,500	2,700	1,700	15,100	5,200	38,200
Senegal	2007	900	180	100	1,900	650	3,730
Peru	2006	6,000	1,200	220	11,500	5,500	24,420
Colombia	2006	6,500	1,300	1,200	18,300	8,800	36,100
Mexico	2006	47,500	9,500	1,100	166,500	44,700	269,300
Brazil	2005	96,800	17,200	2,200	137,000	115,100	368,300
India	2007	56,300	4,700	1,700	275,000	101,300	439,000
China	2007	300,000	60,000	7,000	1,350,000	495,000	2,212,000

For example, in India, as per a study released by Ministry of Communication and Information Technology, India generated 330,000 million tons (MT) of electronic waste in 2007, while an additional 50,000 MT was illegally imported by 2011, e-waste in India touched 470,000 MT. The Western region contributes maximum to e-waste generation – up to 35% as shown in (Fig.1).Sixty five cities in India generate up to 60% of total e-waste. Ten states alone generate more than 70% of total e-waste. Ministry of Communication and Information Technology estimates that only 19,000 tons of the total e-waste generated gets ultimately processed by the formal recycling sector. Around 94% of corporate in India do not have a policy on disposal of obsolete IT products/ e-waste (Sandesh and Kirti, 2015). Also, according to Sandesh and Kirti , 2015, the material resulted as waste from one personal computer is: glass 15%, electronic boards 12%, ferrous metal 32%, plastic 23% and non-ferrous metal 18% as shown in (Fig. 2)



Fig, 1 shows the Magnitude of e-waste in India



Fig, 2 shows the percentage of contents of a Computer resulted as e-waste

Aim of work:

Make a comparison between different countries' methods in treatment of E-waste and chose the suitable method (economically & environmentally) to recommend it to be applied in Egypt. Action to make recommendations that can be implemented to preserve and protect the environment and benefit economic.

Environmental and Health Hazards :

The hazards associated with the e-wastes on human's health could be summarized as follows;

- Unsafe disposal of this type of waste, either burial or cremation cause environmental and health damage such as osteoporosis, neurological and memory impairment and premature aging and diseases in addition to the damage caused by broken.
- One of the reasons for the spread of diseases of the chest in the country, is the random ways that are followed for the disposal of electronic appliances damaged, particularly the old TVs contain toxic materials ascending into the air and causing respiratory diseases.
- Environmental experts in the field of e-waste assert that toxic and hazardous materials involved in the installation of many mobile phone industries, small and large batteries, car batteries and electronic devices, including lead, cadmium, zinc, mercury, and refractory materials, and that if they were buried with soil to cause severe damage to water sources, and contribute to soil pollution , these devices if they were burning, they occur hazardous emissions of dioxin gas which threatens life in general. One of

the international studies on waste electronic industries, which are a mixture highly toxic, increase the abortion rate among women three times more than the cancer cases and groundwater contamination, and living among piles of waste .In a search on minerals level on sellers who sell by weight, including e-waste, electrical appliances, they are suffering from many diseases the least severe headaches, strong cough, accompanied by blood diseases in some cases. Others who are exposed to burning of wires and cables from copper material component whatsoever are suffering from diseases of the respiratory system, nervous system, and rarely recovered (Anna et al ,2008)

- Recycling techniques for e-waste include burning and dissolution in strong acids with few measures to protect human health and the environment. E-waste workers often suffer from bad health effects through skin contact and inhalation. Workers, consumers and communities are exposed to the chemicals contained in electronics throughout their life cycle, from manufacture through use and disposal. The incineration, land-filling, and illegal dumping of electronic wastes all contribute toxic chemicals to the environment.
- Electronics recycling workers have been shown to have higher levels of brominated flame retardants in their blood, potentially from exposure to contaminated indoor air. Similar exposures are likely for communities where recycling plants are located, especially if these plants are not adequately regulated. Much of the electronics industry in the Middle East, Europe and North America has outsourced manufacturing and disposal to developing countries of Southeast Asia, China and India. Uncontrolled management of e-wastes is having a highly negative effect on local communities and environment in these countries.
- The majority of the dismantling and recovery processes are usually carried out in small household workshops in rural villages, where most of the residents are directly or indirectly involved in e-waste-related activities. In the e-waste recycling plants researchers studied

the impact of heavy metals in 349 people and compared results with a control group of 118 people. Questionnaire surveys for risk factors were also performed and analyzed. It was found that urinary levels of lead, cadmium, manganese, copper, and zinc were considerably high. Results of the study indicated that the levels of urinary cadmium in both workers and people living in the area were significantly higher than in the control group. The primitive e-waste recycling activities are therefore the cause of the changes of urinary heavy metal levels and indicate increased health risk for those permanently working in e-waste recycling (Wanq et al, 2011).

Table (2): Effects of E-waste constituent on health

(Ramachandra et al., 2004)

Source of e-wastes	Constituent	Health effects
Solder in printed circuit boards, glass panels and gaskets in computer monitors	Lead (PB)	Damage to central and peripheral nervous systems, blood systems and kidney damage. Affects brain development of children.
Chip resistors and semiconductors	Cadmium (Cd)	Toxic irreversible effects on human health. Accumulates in kidney and liver. Causes neural damage. Teratogenic.
Relays and switches, printed circuit boards	Mercury (Hg)	Chronic damage to the brain. Respiratory and skin disorders due to bioaccumulation in fishes.
Corrosion protection of untreated and galvanized steel plates, decorator or hardner for steel housings	Hexavalent chromium (Cr) VI	Asthmatic bronchitis. DNA damage.
Cabling and computer housing	Plastics including PVC	Burning produces dioxin. It causes reproductive and developmental problems; Immune system damage; Interfere with regulatory hormones
Plastic housing of electronic equipment and circuit boards.	Brominated flame retardants (BFR)	Disrupts endocrine system functions
Front panel of CRTs	Barium (Ba)	Short term exposure causes: muscle weakness; damage to heart, liver and spleen.
Motherboard	Beryllium (Be)	Carcinogenic (lung cancer), Inhalation of fumes and dust causes chronic beryllium disease or berylliosis. Skin diseases such as warts.

Table (2) shows some of the negative health effects of some constituent emitted from e-wastes

Four e-wastes management systems from four countries which are Saudi Arabia, Sweden, China and Japan have been analyzed with the purpose of understanding the regulations required and the components of the system needed to establish an Egyptian e-wastes management system. The administration of this type of wastes through an environmental management system will diminish or prevent the associated risks.

It is realized that all systems involved the private sectors in the process. The government in all countries encourages the private sector to invest in recycling process, energy recovery and metal reclamation projects, in addition, the e-waste management system in each country of three stages which are collection stage, treatment stage and recycling stage.

In Japan the collection of e-wastes through "recycling tickets" enables to know the volume of electrical and electronic home appliances collected, and a system to maintain the recycling tickets for three years ensures specifications of a route from collection to treatment and cycling of home appliances discharged by consumers. The system however, requires consumers to pay transportation and treatment fees for their waste home appliance, bringing about problems such as illegal dumping and illegal export. In Japan, e-wastes are recycled mainly in recycling plants specifically for e-wastes with commitment to maximize recycling rates partly for environmentally friendliness and easiness to monitor data on recycling process. In Japan, the treatment stage starts with a complete dismantle of the appliance. This process is carried out in 48 recycling plants around the country. The recycling plants are committed to maximize recycling rates not only for compliance with the regulations but also with taking into consideration their business conditions as well as environmental impacts. Additionally, treatment of home appliances by almost fully dismantling has pushed forward designing of new environmentally friendly products. This is because first, consumers purchase new home appliances now for replacement more often than before due to low reuse rates; second, problems associated with the treatment of home appliances enables the design of products easier to recycle. (Bi and Kayoko , 2010).

In China, e-wastes are primarily collected by individual collectors. The individual collectors visit the residence of consumers to purchase e-waste, because e-wastes are valuable items rather than trashes, the illegal dumping has not become a very large problem, but the real problem associated the collection manner is the difficulty acquiring data on collection and unclear route from collection to treatment and recycling due to wider spread and liberalization of the individual collectors. In China, most of the collected e-waste sold as products in the rural areas. On the other hand, non-reusable e-wastes are treated by individual dismantlers manually. Therefore, the treatment cost would be low. However, individual dismantlers dispose of non-treatable e-wastes by burying in the ground causing very serious problems such as soil and water pollution. Another issue is the illegal import of e-wastes from foreign countries because of low cost collection and treatment systems in the country. In China about 80% of e-waste are collected, dismantled, treated and recycled by individuals. This wider spread makes it very difficult to acquire quantitative data on recycling of e-wastes (Bi and Kayoko, 2010).

Concerning the recycle stage, in Saudi Arabia the government encourages the private sectors to invest in recycling the e-wastes, but it reviews the plans of treatment and recycling to ensure its compliance with the national regulations and international standards In Saudi Arabia, the government assigns bodies to collect the e-wastes, and another party to regulate the e-wastes. Regarding the treatment stage, in Saudi Arabia the municipalities buy the collected e-wastes to sell them to traders to recycle them. (Sulaiman, 2012).

On the other hand in Sweden, the law gives the right to municipalities to contract with private companies to share them the responsibility of e-waste recycling. In Swedish system, the government has established a collection system based on an agreement between a producer's organization called (EL-Kretsen) and the Swedish municipalities. The agreement was concluded in 2001, in connection with the implementation of the Swedish producer responsibility, establishing that the local authorities of the municipalities of Sweden will bear the costs of the collection of electric waste and El-Kretsen will bear all other costs. Thus assuring that the electric waste will be treated and recycled in

accordance with the Ordinance. In 2008 the Swedish Association of Recycling Electronic Products (EÅF) was launched as a producer organization. EÅF uses its members' shops as collection points, but since those shops are not located in all municipalities, an agreement with El-Kretsen has been concluded. The agreement is a financial clearing agreement implying that EÅF will pay the same fee as other members of El-Kretsen for the part of their electric waste that is collected by El-Kretsen. A schematic representation of the collection system is shown in (Fig. 3) (UNU, 2008 and Van, 2008).

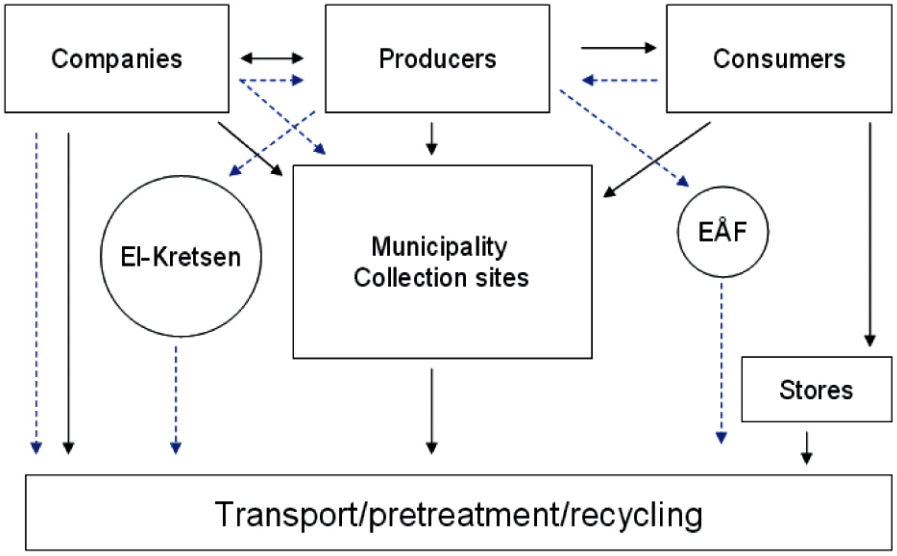


Fig. 3 Flows of electric waste (solid arrows) and economic flow (dashed arrows) in the Swedish waste collection system (UNU, 2008)

E-Waste Management System for Egypt

After the anatomy of the four e-waste management systems of the four countries (Saudi Arabia, Sweden, Japan and China), it could be established an Egyptian e-waste management system (Fig 4). It considered the socio-economic situation of Egypt in establishing such a system. This system consists of the following stages.

Legislation stage:

A package of legislations shall be issued by the government and parliament. These legislations shall cover the bodies that are responsible for collection, treatment, re-use and recycling for this kind of waste. Also, this package of legislations will pose the permissible limits of environmental aspects associated with such a kind of wastes. Also, the legal requirements will regulate all processes and activities connected to handling, collection, reuse, dismantle, treatment, recycling and disposal of e-wastes.

Collection stage:

It is suitable for Egypt that the government would be represented by municipalities who will be responsible for the collection of e-wastes. In the same time, municipalities have the right to contract with the private sector to share in collecting the e-waste. Consumer also would bear the fees of transportation. Also, the government will get a way count the annual production of each electronic appliance to build a data base on the accumulated e-wastes in future. The main purpose of this data base is to help the government to draw the policies and strategies to manage e-wastes.

Classification stage:

In the places designated for the storage of collected wastes, the process of classification will be started. In this process, each type of electronic device or machine will be separated. For example, The collected home appliances can be classified according to its current status of operation to:

a. Appliances to re-use: this can be sold to the retailers to sell in rural areas.

b. Appliances to dismantle; this can be sent to the centers of treatment to dismantle and extract the valuable metals like lead, cadmium, artesian…etc, and other valuable materials to be used again. The remaining non-usable materials will be crashed to recovery.

Treatment stage:

The government set out a number of treatment stations in which the e-wastes will be dismantled and separation of components from each other occurred. The well functioned components will be recycled again and the un-functioned components will be crashed and recovery.

Recycling stage:

Like in treatment stage, a number of recycling plants are specified to e-waste recycling with the commitment to maximize the recycling rate to mitigate its bad impact on environment.

Disposal stage:

In this stage, all disused remaining parts of e-wastes will be abandoned into the ground, but in site selection of landfill, it shall be considered the site selection factors like site geology, site seismicity, site hydrogeology, and other factors may affect the safety operation of the landfill during its exposure life time.

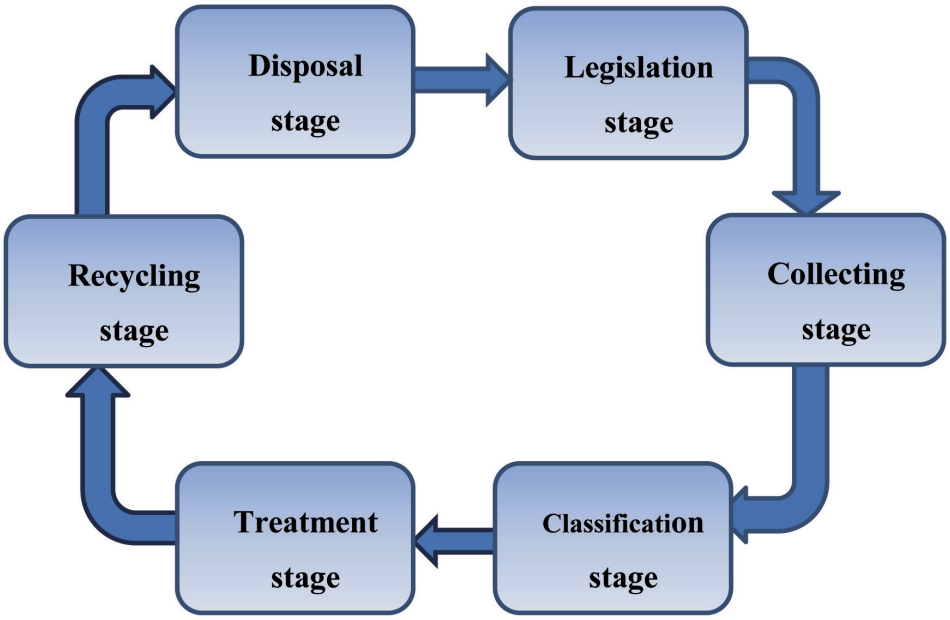


Fig. 4. Model for an Egyptian e-waste Management System

Conclusion and Recommendations

E- waste term universally used in the classification of electronic equipment that has reached its end of life (the default for use), but the biggest reason for the increase in the volume of this waste globally, is the turnout at replacing obsolete equipment with modern in order to keep up with the latest technological development, and if we couldn't get rid of these wastes through effective and nicely management system it will be a source of risk to the environment and human health because of its contents of from toxic substances when they are burned or dismantled. This waste is one of the fastest growing in the world, due to the rapid progress in technology what leads to their increase.

The unsafe disposal of this type of waste either burial or cremation is the major cause of environmental damage such as groundwater pollution and health damages such as osteoporosis, neurological diseases and poor memory and premature aging and other diseases, in addition to the damages caused by the breaking. The use of random ways that are followed for the disposal of electronic devices damaged or expired is one of the causes of the spread of chest diseases in the country because they contain toxic substances can volatilize into the air and inhaled by man, causing respiratory diseases. Developed nations has realized the seriousness of e-waste and started to export these wastes to developing countries.

Until now not any action has taken on the ground to deal with e-waste in Egypt for facing this serious environmental issue which is spread among us and be a source of fatality of children without there being a minimum level of awareness to avoid environmental harm case.

Thus, there is a need to speed up the development of scientific and practical solutions for how to get rid of electronic waste in the country, where the main problems affecting the country on the organization to get rid of this waste is the lack of clear statistics on the size, in addition to the lack of a clear mechanism for disposal only buried inside regular landfills.

The anatomy of the e-wastes management systems in the four countries revealed that these systems help in mitigating the risks associated with the e-wastes on environment, man's health and getting a benefit affecting positively the national income

of the country where this waste contains precious metals such as gold, silver, nickel, aluminum, platinum, currently there is no companies exist in Egypt which are specialized in the process of recycling to exploit them. Although, the four systems range between simple one like in Saudi Arabia system and complicated one like in Japan system but all of them achieve its goals which are the prevention of pollution and maximize the economic benefits from e-waste. All systems treated e-wastes as hazardous wastes. So, they need to an environmental regulation law. It is clear that we need a package of legislation related to collection, classification, treatment, reuse, recycle, and safely disposal of this waste. A clear policy and strategy should be established. This policy should be also based on three pillars prevention of pollution, comply, with legislations and continual improvement.

As conclusion, an environmental management system for the e-wastes has been proposed. This system includes the following stages which are regulatory infrastructure stage, collection stage, treatment stage, recycling stage and finally disposal stage. This system will impact positively the environment, human's health and increase the national income.

Conflict of interest:

Authors have declared that no conflict of interest exists

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