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Evaluation of the Current Situation of Cell Phone Waste in Egypt: Review Article

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ABSTRACT
In the last decade, the total number of cellular phone (CP) subscribers in Egypt increased from only 654000 subscribers in October 1999 to 55.352 million in December 2009. Latest available data in February 2012 recorded 112.74 CP subscribers per 100 inhabitants. CPs are composed of a variety of materials containing toxic substances that have bad impacts on both health and environment when disposed of an incorrect manner. On the other hand, environmentally friendly cellular phone waste management system has many benefits. More than 70% of the CP can be recycled, one ton of this recycled waste can generate up to 230 grams of gold. This paper aims to assess the current situation of CP waste in Egypt. Published data were collected from concerned institutions of cellular phones in Egypt as: Ministry of Communication and Information Technology (MCIT), Ministry State of Environmental Affairs (MSEA), as well as regional and international ones as: Basal convention Regional office in Cairo (BCRC),The Center of Environment and Development for the Arab Region and Europe (CEDARE), world Bank (WB) and International Telecommunication Union (ITU).The study revealed that CP waste in Egypt is not well assessed. Few efforts were done to collect specific CP batteries, while efforts to manage other CP waste components were not satisfactory due to absence of facilities and expertise for proper dismantling, recycling and disposal of this precious yet hazardous waste. To conclude, there is a need for assessment of different types of electronic waste (e-waste) in general in Egypt. Establishing governmental and private partnership and a legal framework for e-waste trade in Egypt is recommended. Organizing awareness campaigns about e-waste is also needed.

Key words: *Cell phone penetration, Cell phone waste, e-waste, Egypt*

List of abbreviations

BCRC	Basal convention Regional office in Cairo
CEDARE	Center of Environment and Development for the Arab Region and Europe
E-Waste	Electronic Waste
ICT	Information communication Technology
ITU	International Telecommunication Union
IMC	Industrial Mobilization Center
MAP	Mediterranean Action Programme
MCIT	Ministry of Communication and Information Technology
MPPI	Mobile Phone Partnership Initiative
MSEA	Ministry State of Environmental Affairs
UNEP	United Nations Environmental Program
UNU	United Nations University
WB	World Bank
WEEE	Waste Electrical and Electronic Equipment

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INTRODUCTION

Electronic Waste is a generic term encompassing various forms of electronic equipment which are old and have ceased to be of any value to their owners.

E-waste comprised more than 5-10 percent of all municipal waste in 2011 and this percent is growing steadily, it 2011is nearly the same amount of all plastic packaging.[1, 2]

The environmental significance of this waste stream is due to the heavy resource, energy consumption and the rapid product obsolescence.[3]

CP subscriber growth is still on the rise with the developing markets offering further opportunities for growth[2]; there is a growing demand for higher bandwidth multimedia services offered by smart phones. Around the world there are continuing technology developments via the deployment 3G and 4G services.[4]

In the last decade, the total number of CP subscribers in Egypt increased from only 654000 subscribers in October 1999 to 55.352 million in December 2009. The latest available data in February 2012 recorded 112.74 cellular subscribers per 100 inhabitants.[5]

At the same time,the life time of the CPis estimated to be about 4 years which leads to the prediction of accumulation of very large amount of generated CPwaste that must be well managed.[3]

The CP contains a wide variety of materials such as carbon, steel, plastic, heavy metals and salts. While materials such as carbon are not so aggressive to the environment and can quickly merge into the eco-system without noticeable impacts, others such as heavy metals including nickel, cadmium, lithium, potassium, lead, and cobalt in a complicated arrangement of battery cells surrounded by metals then plastic casing which pose threat to the ecosystem and man [6-8] leading to debilitating pain with fatal consequences.[9]

Unsafe treatment methods cause environmental and occupational safety problems due to toxic emissions from burning, soil and water contamination due to chemical disposal and inefficient recovery of scarce resources.

On the other hand, environmentally friendly CP waste management system has many benefits.[10]More than 70% of a CP can be recycled, one to of this recycled waste can generate up to 230 grams of gold.[11]

So, this paper aims toevaluate the current situation of cell phone waste as an electronic waste in Egypt.

METHODOLOGY

Data reported about cell phone penetration in Egypt and the actual actions taken about its waste management were reviewed from concerned Egyptian ministries, websites and reports as: Ministry of Communication and Information Technology (MCIT), Ministry State of Environmental Affairs (MSEA), Data from original as well as international institutions were also tackled as: Basal convention Regional office in Cairo (BCRC),The Center of Environment and Development for the Arab Region and Europe (CEDARE),The World Bank (WB) and International Telecommunication Union (ITU).

Reviewed Data

World Bank indicators reported that the total world population was 6.504 billion in the year 2005 which increased to 6.895 in the year 2010[12].The total number of CP subscription reached almost 6.0 billion by the end of 2011, corresponding to a global penetration of 86.0%.[13]

In the year 2011,It also reported global gradual increase of CP subscriptions from34 cellular subscribers /100 inhabitants in the year 2005 to 78.2CPsubscribers/100 inhabitants in the year 2010, [14-16] (table 1).

Table 1: World Population, fixed and CPs subscription (per 100 inhabitants) and population covered by mobile cellular network in World, Middle East & North Africa (MENA*) and Egypt (2005-2010)[14-17]

ITEM	2005			2010		
	World	ME NA*	Egypt	World	MENA*	Egypt
Population (millions)	6,504	304.0	74.0	6,895	331.0	81.0
Fixed telephone subscriptions (per 100 people)	19.4	14.3	14.1	17.2	16.5	11.9
Cellular telephone subscriptions (per 100 people)	34.0	22.2	18.4	78.2	86.1	87.1
Population covered by a mobile-cellular network (%)	67.0	80.0	92.0	93.0	..**	100.0

**Middle East and North Africa: Algeria, Djibouti, Arab Republic of Egypt, Islamic Republic of Iran, Iraq, Jordan Lebanon, Libya, Morocco, Syrian Arab Republic, Tunisia, West Bank and Gaza, Republic of Yemen*
***indicates that data are not available or that aggregates cannot be calculated because of missing data.*

Egyptian CP subscription

Total Egyptian CP subscription

Information Communication Technology (ICT) statistics (2011)indicated that total Egyptian CP subscription increased from 18001.1 subscribers in the year 2006 to 83,425,100 subscribers in the year 2011 as illustrated in table(2).[18]

Table 2: Egyptian population: fixed and CP subscriptions (2006, 2008 & 2011)[18]

Item	2006	2008	2011
Population (million)	--	78.32	82.537
Number of fixed phone subscription	--	--	10560000
Number of total cellular phone subscription	18001.1	--	83425100
Number of CP subscription per 100 inhabitant	35.9	--	101.08
Ratio between CP subscriptions to fixed phone lines	3.5:1	--	9.6:1

The UN-ESCWA in 2007 reported that the total number of subscribers was 30,599,626 subscribers[11&19]. Between 2008& 2009 the number of Egyptians who owned CPs went from 30 to 48 million as reported (2012) by Al-Majalla.[20] Slightly the same actual total numbers of CP subscribers were recorded by Industrial Mobilization Center (IMC-2010) which recorded 31and 46 million subscribers in the two successive years 2007 and

2008.Moreover, The IMC estimated that the number of CP subscribers was 59 million subscribers in the year 2009.

The IMC also estimated in 2008 that Egypt would record 73 million CP subscribers in the year 2010. Moreover, it estimated gradual increase of CP subscriptions to be 85and 99 million subscribers for the years 2011and 2012, respectively. The IMC predicted that this number would reach110 millions in 2013. Growth rate increased from only 24% in the year 2006 reach 117% in the year 2012.IMC predicted that this growth will reach 128 % in 2013 (table 3).[21]

Table 3: Egyptian CP demand *(21)*

Item	2006*	2007*	2008*	2009**	2010**	2011**	2012**	2013**
Number of subscribers (million)	16	31	46	59	73	85	99	110
Growth Rate %	24	40	59	74	90	104	117	128
CPs sales (million U$)	599	1357	1680	1767	2045	2346	2658	3035

*actual values **estimated values

On the other hand, The MCIT in 2011recorded in its annual report lower total numbers of CP subscribers. It reported 42.47 &55.85million subscribers in January 2009 &2010 respectively with a change equal 31.5%. The total number of CP subscribers was increased from 52.7 to 66.87 million subscribers in November 2009&2010 respectively with 26.9 % change as illustrated in table (4).[22]

Table 4: Number of CP subscribers (millions) in Egypt during 2009&2010[22]

Item	Number of CPs (millions)		% Change
	2009	2010	
January	42.47	55.85	31.5
February	43,49	56.49	29.9
March	44.59	57.70	29.4
April	45.59	58.67	27.7
May	46.66	58.25	24.8
June	48.31	58.97	22.1
July	50.07	60.27	20.4
August	51.48	61.80	20.1
September	53.43	63.93	19.7
October	53.00	65.49	23.6
November	52.70	66.87	26.9
December	55.40	--	--

A recently published report (April 2012) by The Information Center of the Council of Ministers and concluded in Al-Ahram journal news revealed that the total cellular phone subscribers increased to 83.4 million by the end of December 2011.[23]

In addition, worldwide Telecom -Key statistics (2010) estimated that the penetration rate in Egypt was 77% in Q1 2010 which sharply increased to 115% in Q4 2012.(Table 5).[5]Egypt Telecoms 2010also added that the recorded price that was paid for the license highlights the enormous potential in the Egyptian CP market. The penetration rate has been tripled since beginning of CP penetration in Egypt till it reached an increase of 80% in mid 2010.[24]

Egyptian CP subscription per 100 inhabitants

The WB (2011) illustrated that Egypt recorded 18.4 of CP subscribers per 100 inhabitants in the year 2005 which increased to 87.1 subscribers per 100 inhabitants in the year 2010 (table 1).[14]

Table (5): Estimated market penetration rates in Egypt's telecoms sector in Q1 2010 and Q4 2012[24]

Market	Penetration rate	
	Q1 2010	Q4 2012
CP	77 %	115%
Fixed phone	12 %	10 %

The International Telecommunication Union, World Telecommunication/ICT Development Report (2011) and database besides World Bank (2011) estimated Egyptian CP subscriptions per 100 people during the years (2007-2010) as illustrated in table (6).

Table (6) Estimated CP subscriptions in Egypt per 100 inhabitants (2007-2010)[18, 25]

Year	2007	2008	2009	2010
Number	39	53	69	87

Estimates revealed that the number of subscribers in the year 2007 was only 39 cellular phone subscribers per 100 inhabitants and increased by 35.89, 76.923 and 123.076 % during the years 2008, 2009 &2010 respectively[18, 25]. On the other hand, ITU (2011) indicated that number of CP subscribers per 100 inhabitants increased from only 4.06 subscribers in the year 2001 to 101.08 subscribers per 100 inhabitants in the years 2011 as illustrated in table (7) representing an increase by about 25 folds (24.89) between these two years (2001&2011)[13]. In addition, Egypt Telecoms (2010) estimated that CP penetration would break the 100% barrier by the end of 2012, with a contentious decline in the fixed line subscription. The estimated decrease in the penetration rate for the fixed line subscription was estimated to be from 12% in Q1 2010 to

10% in Q4 2012. However, the estimated market penetration rates recorded for the CP subscription increased from77.0 % in Q1 2010 to 115 % in Q4 2012 (table 5). Not only the international foundation for control of business predicted that the Egyptian CP sale's was16.6 million units in 2009 which more than that was predicted for the year 2008 which was 15.5 million. Furthermore, it predicted that this sale would reach 19.5 million units in 2010 and 25.8 million units in the year 2013[24].

The final IMC report indicated that CP sales increased from 599 million U$ in 2006 and predicted that it would reach 3035 million U$ in 2013(table 3).IMC indicated that the sales of CP represent about 63% of the Egyptian consumer spent for electronics during 2008.It predicted that CP sales would reach 30 billion U$ in 2013.[21]

Table (1) revealed a good quality for Egyptian population covered by mobile cellular network which reached 100% and exceeded the global recorded value (93.0%) for population covered by mobile cellular network by 7% in the year 2010.[17] It is noticeable that while CP subscription is sharply increasing, there is a corresponding decline in fixed phone subscription indicating that CPs had substituted the fixed ones due to its unique characteristics and features.

Table (7) Number of Egyptian fixed and cellular telephone lines during 10 years (2001-2011)[13]

Data Name	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Fixed telephone lines per 100 inhabitants	9.72	11.11	12.22	13.09	14.12	14.41	14.59	15.13	12.94	11.86	10.56
Cellular subscriptions per 100 inhabitants	4.06	6.41	8.11	10.49	18.37	23.82	39.11	52.71	69.44	87.11	101.08

Cellular phone components

Table (8) provides an overview of the weight and the composition of the CP. The table illustrated the small average weight of CP (0.088 – 0.10 Kg). Plastic is the main component of the CP as it constitutes 59.6 % of its weight, while non Fe-metals constitutes 20% followed by glass(10.6%) and finally by Fe (8.0%)[26].

Table (8): Average weight and composition of the CP[26]

Item	Quantity
Average weight (gm)	0.08 to 0.100
Iron (Fe) % weight	8
Non Fe- metal % weight	20
Glass % weight	10.6
Plastic % weight	59.6
Others % weight	1.8

On the other hand, CPs are composed of a variety of materials containing toxic substances (table 9). Phthalate and plasticizer are present in plastic wires and external cables, while toxic and heavy metals as lead, mercury and antimony are found another parts and the batteries[27].Table (10) revealed the precious metals' content in a CP ranges from 9.0 mg of Pd to 9.0 gm of Cu[3].

Table (9): Possible hazardous substances in a CP[27]

Component	Possible hazardous content
Metal	--
Plastic	Phthalate, plasticizer
Insulation	Foam, asbestos, refractory ceramic fiber
Glass	--
Wiring/Electrical	Phthalate, plasticizer, lead
Concrete	--
Circuit boards	Lead, Beryllium, antimony
Batteries	Lead, lithium, cadmium, mercury
External electric cables	Plasticizers

Table (10): precious metals content in a CP[3]

A CP **Unit contains**	**1200 Million units of** CP **contain**
9 gm Cu	~ 11.000 ton Cu
250 mg Ag	~ 300 ton Ag
24 mg Au	~ 29 ton Au
9 mg Pd	~ 11 ton Pd
In case of Li-ion battery (20 gm)	
3.8 gm Co	~ 4500 ton Co

Cellular phone waste

At the end of the CP life, both the hazardous and the precious components of the CP, itself, would be converted to waste after 3-4 years. On the other hand its accessories (batteries, covers, chargers, hands free…) components would be converted into waste in less than a year.

Generally, data about the quantities of the CPs' and their waste are not available. A study that was carried out by United Nations Environmental Program (UNEP) and United Nations University (UNU) hardly collected data about CP waste in some developing countries and estimated that china had 7000 metric tons of CP waste in the year 2007. For the same year (2007), each of India and Morocco had 1700 metric tons of CP waste. On the other hand, Brazil had 2200 metric tons of CP waste in the year 2005[3].The obvious penetration of CP in Egypt in which almost all people have CPs is an alarm for the coming mountains of CP waste in the country. On the other hand, no data about CP quantities or its different categories were available.

Management of CP **waste in Egypt**

Since 2005, BCRC has been concerned with e-waste challenges. However, only specific actions concerning CP had been translated and published by the BCRC. One of these publications is the Mobile Phone Partnership Initiative (MPPI) guidelines on used and end-of-life CPs. On

the other hand, BCRC is conducting many activities for raising awareness. It organized various activities concerning the different types of e-wastes such as:

- Signing an agreement with the UNEP Mediterranean Action Programme (UNEP/MAP) to carry out e-waste assessment in the Arab Mediterranean Countries. Including The E-Waste Africa project (2008-2012) in a comprehensive programme of activities aiming at enhancing environmental governance of e-wastes and catalyzing partnerships and small businesses in the recycling sector in Africa.

Moreover, BCRC had launched a number of e-learning courses on e-waste management and methods of establishing an e-wastes collection and dismantling center for. BCRC also provides technical assistance for governmental organizations and ICT private sector enterprises. The recommendations of BCRC for Egypt are to assist competent authorities to develop proper legislation for the management of e-waste, to support the informal sector in creating partnerships, to grow with improved environmental performance, and to support e-waste collection[11,28-31].

Within the framework of the National Egyptian Green ICT Strategy, and in cooperation with MCIT and MSEA, CEDARE it has been reported in October 2011 under the title: “Needs Assessment of the E-Waste Sector in Egypt”: that CP waste in Egypt is not very well assessed. The report highlighted the few efforts that were initiated by local CP operators to collect specific CP batteries. However, those efforts were not publicly propagated. It also reported that other CP waste components were not satisfactory disposed of due to absence of facilities and expertise for proper dismantling, recycling and disposal. Moreover, CEDARE added that there is no overall integrated environmental policy regarding Waste Electrical and Electronic Equipment (WEEE) in Egypt.

It's worth mentioning that CEDARE has been actively promoting the development of e-waste collection and recycling sector in the Arab Region since 2009.It has been taking a leading role in promoting dialogue between different stakeholders. Also, CEDARE organized twoe-waste forums that had been held in Egypt (2009) and in Morocco (2010) [32].Generally, an inter-ministerial committee has been formed in (2009) and is currently discussing a road map for e-waste management in Egypt[33].

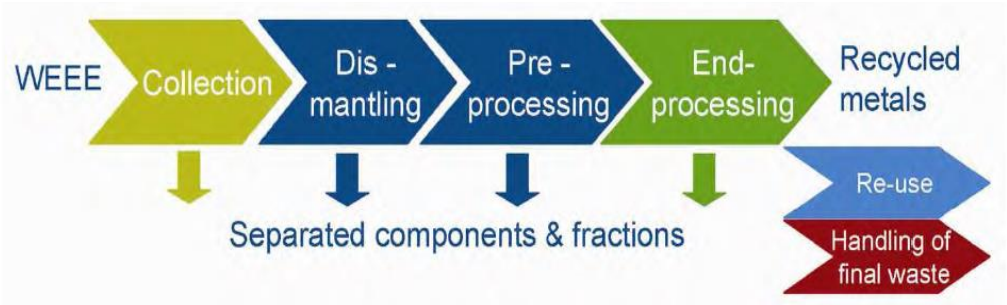

Fig (1) Recycling chain for e-waste [3&10]

DISCUSSION

All available data showed increases in CP penetration all over the world. In Egypt CP penetration had recorded an obvious increase which may be attributed to the increase in the number of active cellular-broadband that enhanced the world population mobile cellular signal coverage rate. At the same time, penetration of the Chinese and the Indian CPs to the Egyptian market, with their low prices and relatively high efficiency, caused more CP penetration in all Egyptian socio-economic classes even the poorest ones. Despite its small weight, the high CP penetration in Egypt, which broke the 100% barrier, and it is still rising, act as a warning sign for the coming mountains of CP waste in Egypt. This is considered a critical point; if these

wastes wouldn't be properly managed (burning, incineration or dumping), they would cause many hazards to both health and environment. However, proper management of these wastes could turn the expected harmful effects of these wastes into beneficial ones. In order to achieve the call 'From Waste to Resources', an integrated waste policy and management, which addresses environmental impacts along the whole life-cycle of products, materials and processes, is crucial. According to the 3R Principle – Reduce, Reuse, Recycle, recycling reduces waste going to final disposal, decreases consumption of natural resources and improves energy efficiency. It is, in this respect, a key process, which can be improved through innovative and more effective processes and technologies. With respect to the 3R Principle the focus of this study is on recycling and recovery.

Generally, the recycling chain for e-waste consists of three main subsequent steps: i) collection, ii) sorting/ dismantling and pre-processing (including: sorting, dismantling, mechanical treatment) and iii) end-processing (including: refining and disposal) as shown in figure (1). The efficiency of the entire recycling chain depends on the efficiency of each step and on how well the interfaces between these interdependent steps are managed[3&10].

Effective Management would generate decent employment and safeguard the environment by supporting sustainable e-waste management and recovering the valuable metals and other resources locked inside products that end up as e-waste. Efficient management measures such as improved collection strategies and establishing more formal recycling structures can limit environmental damage and provide economic opportunities. Effective management of the growing amount of E-waste generated in is an important part of the transition towards a low-carbon, resource-efficient Green Economy[34].

CONCLUSION AND RECOMMONDATION

Reviewed data concluded that generally no any management for E-waste was done in Egypt. So, this study recommended assessment of all types of Electronic Waste in general in Egypt and especially for cell phone. It also recommended establishment of governmental and private partnership for E-waste management, and implement awareness campaign about E-waste as well as establishing legal framework for E-Waste trade.

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