



OPEN ACCESS INTERNATIONAL JOURNAL OF SCIENCE & ENGINEERING

CHALLENGES AND STRATEGIES FOR E-WASTE MANAGEMENT IN DEVELOPING COUNTRIES

Meenu Vijarania¹, Swati Gupta², Ashima Gambhir³

Assistant Professor, Amity University Gurgaon, Haryana, India¹

Assistant Professor, Amity University Gurgaon, Haryana, India²

Assistant Professor, Amity University Gurgaon, Haryana, India³

mvijarania@ggn.amity.edu¹, sgupta@ggn.amity.edu², agambhir@ggn.amity.edu³

Abstract: Electronic waste generated in developing countries are not scientifically handled causing direct and indirect hazardous problems to the global environment leading to enormous effect on human health and society. Currently it is expected that 400 million of e waste is generated per year by a developing country like Bangladesh. The E-waste management is exacerbated due to several problems which include lack of proper infrastructure, scientific, economic, technically trained human assets and inadequate infrastructure. The composition of E-waste are toxic materials like Beryllium(Be), Barium(Ba) , Arsenic(AS), Mercury(Hg), Cadmium(CD), Lead(PB) which are being generated from discarded electronic products such as computers, mobile phones, televisions, fax machines, audio equipments and batteries. There is a certain lack of awareness of how to reused, rescale and refurbished these products so as to minimize their effects as some of their e waste which are dump to landfills reduces the quality of land due to the percolation of the toxic materials into the soil through the leach ate. Due to improper E-waste policy and restricted use of preventive procedures adopted in developing countries like India, Pakistan and Bangladesh has cause an alarming concern for effectively handling E-waste. In this paper, we investigate the effects of E-waste problem in developing countries, challenges that are being faced in handling the e waste. We have also proposed certain solutions which can be undertaken to recover and reuse the best from the E-waste.

Keywords: E waste, Recycling, ICT

I INTRODUCTION

The rapid growth of technological industry, frequent innovations, technology changes and shorter life span of electronic equipment are contributing towards the higher production of E-waste in developing nations [1]. The Electrical appliances contain both valuable as well some toxic materials, if they are not disposed scientifically it may cause enormous effect on public health and global environment . The occurrence of heavy metals (like Nickel, Zinc, Sulphide, Arsenic, Mercury, Cadmium, Barium, Lead, Lithium, and other contaminated substances like PCB (Polychlorinated biphenyls) etc. are of great concern for global environment [3, 4] ITU has accepted the fact that regulations carried out in developing countries for handling E waste are inadequate. These countries do not have proper funds or resources to dispose their E waste. Many developed countries find it cheaper to ship their e-waste to these

developing countries, which only adds to the quantity of E-waste generated as these developing countries see the immediate economic incentives but fail to understand the potential negative effects of unsafe disposal [6].

The E-Waste recycling for developing countries need to be emphasize as valuable items such as glass, copper, nickel, chromium, silver, etc can be extracted .If the E-waste are not recycle suitably than it is a big threat for the landfill and harmful toxicity produced from it [7]. It is predictable that in emergent countries like Nepal, Nigeria, the amount of E-waste which are recycle is only 5%, which are handle by the workers which are working in hazardous, polluted conditions under informal sectors.

Our paper therefore addresses the following knowledge gap: the lack of inadequate knowledge about how to manage E-waste in emergent countries; the universal gap around locally created e-waste in the given area. In our paper we try to find out answer two fundamental questions: what

are the challenges we are facing for e-waste management within the developing countries [8], and what are the strategies we can implement to recycle the E waste. The broader principle of our research is to discover the implications of finding the answers to these problems for handling of e-waste – which can thereby improve recycling rates. We have taken into account several of the emergent countries like India, Pakistan, China and have try to figure out the main challenges to handle the E waste ,at last we proposed our strategies which can thereby adopted to reduce the production of E waste so that best can be regenerated from the E waste.

II THE GENERAL ASSESSMENT OF E- WASTE IN DEVELOPING COUNTRIES

E-waste is being generated at gathered at a rapid rate in developing countries around the world. Developed countries are currently producing large amounts of E-waste now days. In developing countries, the rate of production of E waste is growing is a major concern. In this paper, we will discuss the estimation of E waste in emergent countries like Pakistan ,India, Nigeria and Argentina. Without proper government oversight these intended countries have established many businesses that dispose of the E-waste Sources of E waste in emergent countries are:

- E waste from certain urban countries.
- New products sales in country
- Second hand products used in country.

A.Assessment of E waste in India

Level of E waste is increasing sharply across India. From last five years, quantity of E waste in India is enhancing by 63%. Due to consumers purchasing many electronic items like mobile phones, computer, televisions and refrigerators. Hence India has become major source of generating E waste only 2% E waste generated in India is recycled through an institutional process. Figure 1 shows the estimation of E waste in India [14].

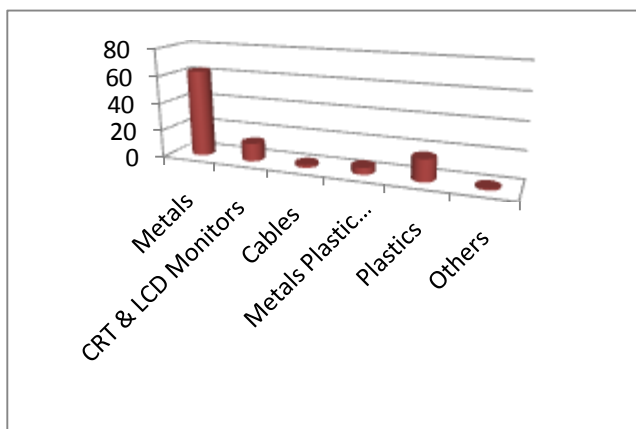


Figure 1 Estimation of E waste in India [14]

B. Estimation of E waste in Pakistan

Pakistan receives thousands of tons of E-waste from urbanized countries like the USA and Europe. On average, 95,415 tons of hazardous material like metals, plastic and glass is imported in Pakistan per year. Figure 2 shows the forecast of E-waste imported to Pakistan from developed countries.

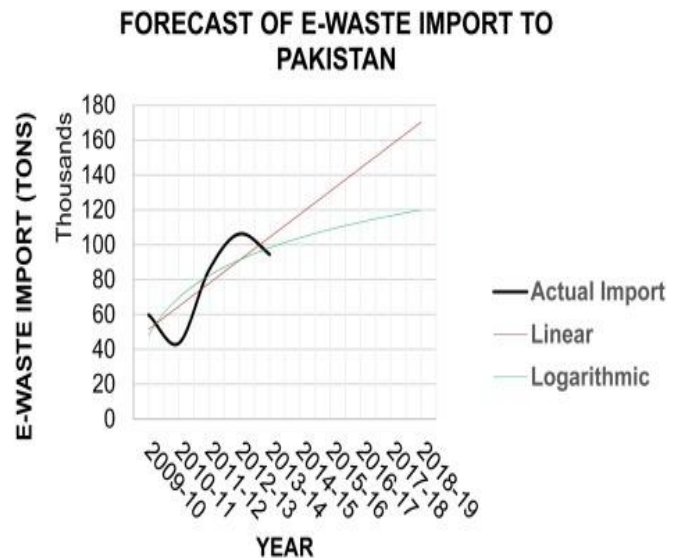


Figure 2 Forecast of E waste import to Pakistan [3]

C. Estimation of E waste in Argentina

Argentina is currently experiencing major rises in the levels of E waste due to increase the use of ICTs (information and communication technologies), which results from both, the disposal of tech products and their production. On average, 2.5 kg (100,000 tons) of E waste like metals, plastic and glass is generated in Argentina per year.[12] It is also calculated that 40% of total amount is generated from computers and telecommunications. According to Argentina branch of the environmental organization named Greenpeace, approximate 40% of the public is aware that old mobile phones are a source of toxic substances so they keep old mobile phones at home only but 30% of the public dispose the old mobile phones with regular trash. In Argentina, some organizations handle E waste equipments from many large companies but not deals with individual users.

D. Estimation of E waste in Nigeria

Nigeria imports thousands of tons of E-waste from developed countries. In Nigeria, 50% of E-waste are handle by public such as distributors, dealers, and repairing center of companies which treat E waste as solid waste but rest of the public treat E waste by supplying or handling to the kabaddis or disposed as garbage. In Nepal, E waste can be managed through ICT (Information and communication technology). [16]Figure 3 shows the ICT framework to manage the E waste in Nigeria.

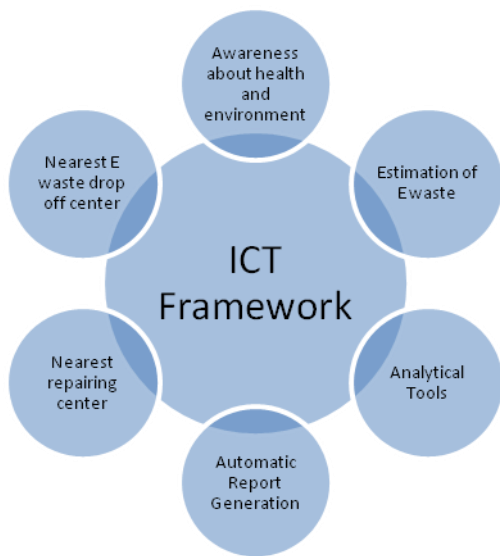


Figure 3 E-waste management through ICT in Nepal [17]

III CHALLENGES FOR HANDLING E -WASTE MANAGEMENT

There are some major challenges while handling e-waste management .Firstly it requires the need of officially permitted environment and dictatorial for the deployment of effective use of ICTs to deal with ecological challenges, together with e-waste. There is not much infrastructure development available with the developing countries. As e-waste management of a country is a direct reflection of its governmental support, thus present rules for E-waste need to be revised. A collection channel for e-waste from the generator to the recycler needs to be established. Currently as the principles and practices for handling E-waste management are not followed by the collector agencies, the health, safety and environmental norms are hampered. There is deficiency in of finance and capability in Government for monitoring and enforcement of the regulations. Unofficial recycling and dismantling of E-wastes, is up-coming in developing countries. Crude recycling measures are taking place in some of the countries like Africa and Asia which intended to improve on material resurgence from E-waste. In these regions, ‘backyard operations’ are only carried out to handle the e-scrap which is often handled in using open cyanide leaching, simple smelters and sky incineration and to recuperate primarily gold, silver and copper, with reasonably little yields For instance, wires are burned and collected in open piles in order to resale.[20]

In order to take out copper and other precious metals circuit board are treated in open next to rivers causing water pollution. Knowledge about the harmful effects of E-waste is little because of structural insufficiency in execution of measures; illiteracy and weak economic condition is an important major stake holder (informal sector). The limited

awareness regarding E-waste amongst consumers indirectly promotes unsafe recycling as consumers deposit E-waste for safe recycling at prices lower or are less likely to compensate for refurbishment of related services than those presented by the informal sector. Another important social challenge is that approximately 2% of the population depends on waste picking or informal waste management sector for livelihood in developing countries. Developing countries have thriving informal e-waste markets that seem to have advantages when compared to their formal counter parts. Absence of “market intelligence” exists, on how the market values individual components. Very limited information is available regarding the recycling of materials. The maintenance and disassembly information of various electronics items is not available as they are not designed for remanufacturing.

IV STRATEGIES FOR E-WASTE MANAGEMENT

The finest solution for handling with E-wastes is to decrease the amount. Electronic devices should be built for repair, re-use and/or enhanced while designing. Main focus should be use of easily recoverable, recyclable and less toxic materials which can be used for disassembly, refurbishment, reuse and remanufacturing. The probable solution to diminish e-waste is recycling and reuse of material.

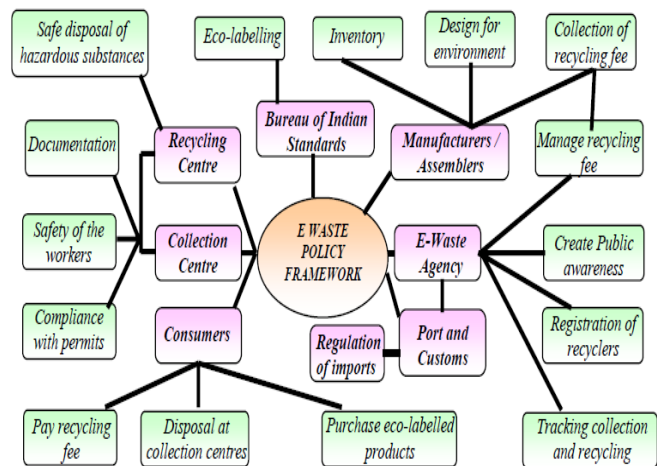


Figure 4 System for E-waste Management for Developing Countries [12]

As shown in figure 4 the manufactures, consumers of the goods, state agencies, government bodies and policy regulators has to understand the criticality of huge generation of E waste affecting the global environment and certain measures should be adopted so as to recycle the E waste which can be the combination of certain integrated activities which can emphasize on “e-waste-policy” and national regulatory frame work where these government bodies can disseminate the proper usage of E-waste & stress on how we can recycle the E-waste.

With the consumer association certain recycling systems has to be adopted which can plan out the strategies

with the government bodies how to handle E-waste.[19] There is an urgent need to educate the local vendors to stress on how to segregate the E-waste in efficient manner. It is best for industry to initiate E-waste policy development cooperatively to ensure effectiveness of E-waste management system.

In developed countries like Australia, US forming an integrated e-waste recycling system are mandatory to prohibit informal e-waste recycling. In our belief, such recycling system must be adopted in the developing countries who lack in proper handling of E-waste may include this steps.

The first step is to set up and enhance the building of certain new subsidy scheme which integrate an Extended Producer Responsibility and Advance Recycling Fee [4]. The second step we think we can build an efficient E-waste assembling system, which can incorporate informal curbside collectors and secondhand markets into it, and convert from informal E-waste recycling system into formal E-waste recycling system with enhanced monetary support and technology enhancement . We can incorporate curbside assembler into the official e-waste recycling system, with hostile e-waste generated into informal recycling system, State-civic-business alliances: As mentioned above, there are multiple actors with diverse objectives implicated in e-waste management in India. To devise and implement a sustainable working model, there is a desideratum for across the board collaboration involving regime, NGOs, informal sector and formal recycling businesses. There is consequential evidence to suggest that immensely colossal scale transformation in subsisting consumption and engenderment patterns would require collaborative efforts of actors with diverse objectives.

Hub and Spoke Model for Infrastructure: A high-tech refinery that can excretion precious metals from sorted e-wasteland components needs billions of dollars in investment funds.[17] Therefore, it is only possible to install such plants to cater to an entire region, while state-wide material recovery facilities and city -wide collection infrastructure is required to provide adequate amount of material for the regional refinery. This strategy for developing hub and spoke model for infrastructure can play a crucial character in maintaining viable recycling businesses.

The guidance of the Central Pollution Control Board is needed for developing such models that require across-state planning, strategic orientation for development of adequate and appropriate infrastructure. Capacity Building of Regulators: With the introduction of new e-waste rules it is crucial to devote significant investments for capacity building of regulators. While training modules are available or are being prepared there is a need for handholding and mentoring of officers at the local level to ensure enforcement.

The Department of Electronics and Information

Technology (Deity) has also launched a nation-wide initiative for such capacity building. This initiative needs to be sustained and up-scaled for efficient accomplishment of the e-waste rules in the long run.

V CONCLUSION

The rapid growth of electronic industry, frequent innovations, technology changes and shorter life span of electronic equipment are contributing towards the higher production of E-waste in developing nations. The E-waste is not handled effectively in these countries there is an urgent need to carry out some revolutionized steps which can stress on how we can handle E-waste efficiently. The paper discuss about certain challenges we face to gather & handle E-waste. The paper also discuss certain preventive strategies we can adopt for enhance improvement on reusability from E-waste. The government should launch certain awareness program which can facilitate the proper utilization of E-waste. Segregation of e-waste is required in developing countries so that we can effectively handle the waste coming from the industries , we can also promote dumping of non toxic material on regular basis so that volume of e-waste generation can be reduced.

VI ACKNOWLEDGMENT

In writing this paper, we had to take the help and guideline of some respected persons, who deserve our greatest gratitude. The completion of this assignment gives us much Pleasure. We would like to show our gratitude Dr R K Malik, HoD Civil Department, Amity University Haryana.

REFERENCES

- [1] Sthiannopkao S, Wong MH (2013) Handling e-waste in developed and developing countries: Initiatives, practices, and consequences. *Sci of the Tot Environ* 463: 1147-1153.
- [2] Garlapati VK (2016) E-waste in India and developed countries: Management, recycling, business and biotechnological initiatives. *Renew and Sustain Ener Rev* 54: 874-881.
- [3] Perkins BD, Nxele S (2014) E-waste: A Global Hazard, *Annals of Global Health*. *Articl and Rev* 80: 286-295.
- [4] Dr Kausar Jahan Ara Begum (2013) E-waste Management in India. *10: 46-57*.
- [5] Afroz, R., M.M. Masud, R. Akhtar, and J.B. Duasa (2013). Survey and analysis of public knowledge, awareness and willingness to pay in Kuala Lumpur, Malaysia—A case study on household WEEE management. *J. Clean Prod.* 52:185–193. doi:10.1016/j.jclepro.2013.02.004.
- [6] Babu, B.R., A.K. Parande, and C.A. Basha (2007). Electrical and electronic waste: A global environmental problem. *Waste Manage. Res.* 25:307–318. doi: 10.1177/0734242x07076941.

- [7] Dwivedy, M., and R.K. Mittal. (2010). Estimation of future outflows of e-waste in India. *Waste Manage.* 30:483–491. doi:10.1016/j.wasman.2009.09.024.
- [8] Khattar, V., and J. Kaur. (2007). *e-Waste Assessment in India: Specific Focus on Delhi*, ed. A.Chaturvedi and R. Arora. 66: GTZ-ASEM.
- [9] Ongondo FO, Williams ID, Cherrett TJ (2011) How are WEEE doing? A global review of the management of electrical and electronic wastes. *Waste Manag* 31(4):714–730.
- [10] European Parliament, Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast). 2012, Official Journal of the European Union.
- [11] R. Widmer, H. Oswald-Krapf, A. Sinha-Khetriwal, M. Schnellmann and H. Boni, “Global Perspectives on the e-Waste,” *Environmental Impact Assessment Review*, Vol. 25, No. 5, 2005, pp. 436-458.
- [12] M. Schluep, “E-waste Management in Developing Countries-with focus on Africa,” *ITU Symposium on ICTs and the Environment & Climate Change*, Cairo, 2-3 November 2010.
- [13] Madeleine Cobbing, *Toxic Tech: Not in our backyard, Uncovering the Hidden Flows of e-Waste*. 2008, Greenpeace.
- [14] Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE), E. Union, Editor. 2002.
- [15] Gustavo Fernández Protomastro, *Estudio sobre los circuitos formales e informales de gestión de Residuos de Aparatos Eléctricos y Electrónicos en Argentina*. 2007, e-srap, Ecogestionar-Ambiental del Sud SA: Buenos Aires.
- [16] Robinson BH (2009) E-waste: an assessment of global production and environmental impacts. *Sci Total Environ* 408:183–191.
- [17] Huisman J, Magalini F, Kuehr R et al (2008) Review of directive 2002/96 on waste electrical and electronic equipment (WEEE). United Nations University, Bonn, 2007.
- [18] Jinhui L, Brenda NLN, Lili L, Nana Z, Keli Y, Lixia Z (2013) Regional or global WEEE recycling. Where to go? *Waste Manage* 33:923–934.
- [19] Elshkaki A (2005) Dynamic stock modeling: a method for the identification and estimation of future waste streams and emissions based on past production and product stock characteristics. *Energy* 30:1353–1363.
- [20] Bernardes AM, Tenório JAS, Espinosa DCR (2003) Collection and recycling of portable batteries: a worldwide overview compared to the brazilian situation. *J Power Sources* 124:586–592.

SSWM-17
National Conference on Sustainable Solid Waste Management

Organized by:

**Department of Civil Engineering,
 Amity School of Engineering & Technology
 Amity University Haryana**

