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Socio-Economic Policy for E-Waste Management Using Reverse Logistic Network

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Abstract— **Electronics waste is defined as all the electronic items which are discarded like computers, mobile phones, medical devices, printers, televisions, microwave ovens, e-toys etc. All over the world, about 30-60 million tons of e-waste is annually generated which are causing a serious social as well as environmental issues and concerns for many developed and developing countries.**

India is experiencing fast increasing rates of consumption of electrical and electronic products. This, accompanied with high obsolescence rates, has gain higher rate of e-waste generation accounting for 70% of the total waste. E-waste handling is a problem of increasing proportion, especially when crude methods are adopted for recovery of useful components from it. Advance technology in the field of electronic makes an impact on human life.

In this paper, efforts have been made to provide option for bridging the gap between the formal and informal divide in E waste management in India. The informal sector has a historic role in waste management. The informal E waste recycling sector provides jobs to thousands of people in urban and semi urban areas and supports the formal waste management systems. The path to formalization of informal recycling units requires number of stages with different levels of involvement to integrate these informal stakeholders in the formal recycling scheme.

Keywords: *E-waste, socio-economic policy, waste management, informal stake holder*

I INTRODUCTION

Consumer electronics have been considered an important part of daily life. It revolutionized the way people communicate, entertain ourselves, and retrieve information. The rapid developments in the electronics sector over the past few decades achieved an unprecedented growth record in terms of sales, exports, innovative capacity, and spin-off potential for activities. Accordingly, this development causes a constant stream of new products with decreasing short life span. Hence, the rate of disposal has been on the rise, more and more discarded devices are thrown away, and the volume of e-waste has significantly increased causing different dangerous problems. As technology grows quickly and electronics reach to the end of their life span faster, there is an urgent need for end-of-life management options (also known as e-waste management).

1.1 What Is E-Waste?

There is no standard definition of e-waste. A number of countries and associations have come out with their own definitions, interpretations and usage of the term e-waste. The e-waste management guidelines provided by Government of India defines e-waste as follows: "E-waste comprises of wastes which are not fit for their original intended use and are destined for recovery, recycling or disposal. Such wastes encompass wide range of electrical electronic devices such as computers, hand held cellular phones, personal stereos, including large household appliances such as refrigerators, air conditioners etc."

Internationally, the most accepted definition of e-waste is the definition as per the WEEE Directive which defines electronic waste, "e-waste" or "Waste Electrical and Electronic Equipment"("WEEE") as the „waste material consisting of any broken or unwanted electrical or electronic appliances. Electrical and electronic equipments have been further classified into components, assemblies and sub-assemblies. (Detailed list is provided in Annexure to the paper)

1.2 E-Waste Type:

E-waste includes the following product categories:

- Large/small household appliances
- IT and telecommunications equipment
- Lighting equipment
- Medical devices (with the exception of all implanted and infected products)
- Electrical and electronic tools (with the exception of large- scale stationary industrial tools)
- E-Toys.
- Monitoring and control instruments
- Automatic dispensers

1.3 E-waste Components and Composition

Primary materials and components produced thereof, which are assembled to produce "Electrical and Electronic Equipment" include metal, motor/ compressor, cooling, plastic, insulation, glass, LCD, rubber, wiring/ electrical, concrete, transformer, magnetron, textile, circuit board, fluorescent lamp, incandescent lamp, heating element, thermostat, FR/BFR-containing plastic, batteries,

CFC/HCFC/HFC/HC, external electric cables, refractory ceramic fibers, radioactive substances and electrolyte capacitors (over L/D25 mm).

The composition of these components is very diverse and may contain many different substances which fall under "hazardous" and"non-hazardous" categories. These consist of ferrous and non- ferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete and ceramics, rubber and other items.

1.4 Hazards of Electronic Waste

E-waste and its components are classified as a hazardous waste because of the presence of elements like Lead, Mercury, Arsenic, Cadmium, Selenium, Hexavalent Chromium and flame-retardants beyond threshold quantities.

1.5 Current Issues in E-waste Management

Electronics wastes contain several metals, many of which are valuable, and some of which are hazardous, Thus managing e-wastes is imperative to recover the precious components and to reduce the environmental impact by handling the hazardous substance properly. Recovering processes include reusing, refurbishment, repairing, recycling, or disposal. Reuse, refurbishment, and repair are considered the most desirable methods for recovering as they help in extending the life span of the product.

Dealing with e-waste management is a long term activity that requires cooperation between all stakeholders and technological advancements. In most developed countries, the integrated electronic waste management has been well developed and adopted. For instance, e-waste management in Europe provides a good example for dealing with growing e-waste issues through serious laws and regulation and besides the high consumer awareness. Consequently the electronics manufacturers are committed to be in line with current regulations and customer's culture. They have to manage their discarded product in a friendly manner. On the contrary, most developing countries have not adapted themselves to the concept of e-waste management where the recycling rate of e-waste is still relatively low. There are many obstacles to recycling e-waste in the developing countries, including the lack of recycling infrastructure and lack of national regulations beside the breach of the laws by some developed countries which export their wastes to developing countries such as Nigeria, Ghana, and other parts of Africa and Asia.

Also in India formal recycling companies are limited & most of the generated e-waste goes to informal sector. This causes improper handling of e-waste causing pollution of air, water & risk to human who handles this e-waste.

1.6 Probable Solution:

To reduce e-waste there are following probable solution

- Strict implementation of Government legislation.
- Improvising the processes of existing informal industry and limiting their presence till Collection and Dismantling stage
- Integrating a formal recycling company with the informal sector for taking over the hazardous recycling processes
- Awareness creation
- Defining Roles for major stakeholders
- Extended Producer Responsibility
- Consumer Responsibilities

1.7 E-waste Generation in India

Based on the findings of national level e-waste inventorization study for GTZ by IMRB, India generated around 3,32,000 tonnes of e-waste in 2007. Products covered in this inventorization study included Computers (both Desktops and Laptops), Televisions and Mobile phones. It was found that around 50,000 tonnes of e-waste comes through imports besides 3,32,000 tonnes generated domestically. Due to factors like lack of proper collection systems, extended storage and second hand use, only 1,44,000 tonnes, out of 3,82,000 tonnes, is available for recycling. Based on the estimates from individual e-waste streams, the total e- waste likely to be generated in the next few years is summarized in the figure below.

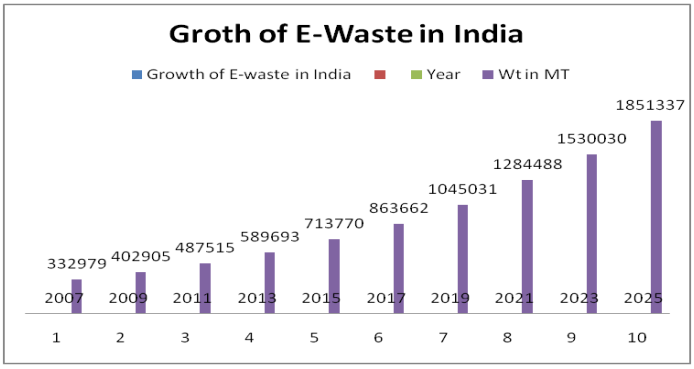


Figure 1: Forecast of E-Waste Generation in India for Years 2007 - 2025

1.7 E-waste Recycling Practices of India:

E-waste recycling in India is undertaken by two different types of recyclers –

1. Formal, also known as organized recyclers
2. Informal, also known as unorganized recyclers

The latter is responsible for recycling major proportion of e-waste processed in India. According to the national level e-waste assessment study conducted in 2007, 95% of the e-waste is recycled by the unorganized sector. Current operations of formal recycling companies in India are limited only to pre-processing of the e-waste material where the crushed e- waste with precious metals is sent to smelting refineries outside India.

Indian E-waste recycling is presently concentrated

in the informal(unorganized) sector. Operations of the informal sector are mostly illegal and processes are highly polluting. In terms of recycling, the informal sector of India gets engaged in dismantling, sale of dismantled parts, valuable resource recovery, export of processed waste for precious metal recovery.

1.9 Sustainable e-waste management in india: model for integration of the formal and informal sector.

Informal Sector: Current Scenario

Informal workers are those whose legal status is not clear. These include workers who work in units or who may be individual workers employed on a daily basis. They also include migrant workers who are used as cheap labor in the unorganized sector. They are not governed by any laws related to employment. Most workers in the cities are a part of this informal or the unorganized sector such as the daily wage workers in markets, domestic helpers, rag pickers, etc.

1.10 Integrating the Formal and Informal Recycling Sectors: Proposed Future Scenario

As a first step in integrating the formal and informal recycling sectors, positive aspects of both the units are considered. In the proposed model, the collection, segregation and primary dismantling of e-waste are focused in the informal sector, while the other higher order processes are concentrated in the formal sector.

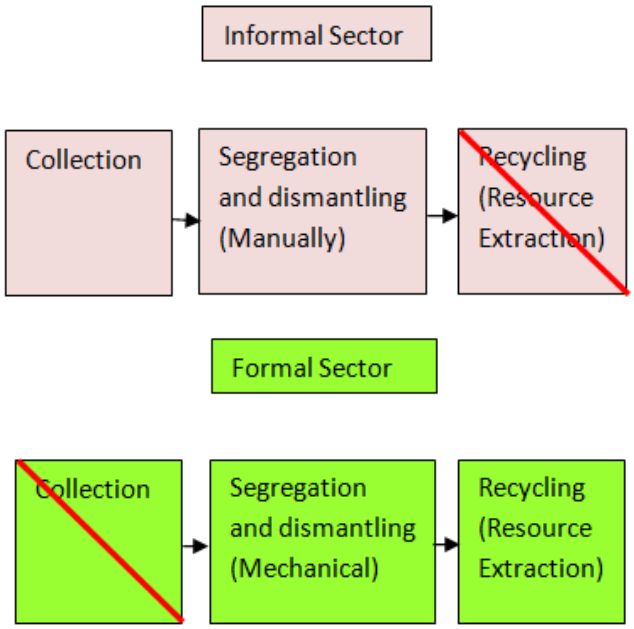


Figure 2: Dovetailing Activities of Formal and Informal sectors

Manually dismantling (informal) e-waste achieves the highest degrees of material purity. Such high levels cannot even be obtained by mechanically dismantling electronic waste as it is done in Europe. However, when it comes to extractive metallurgy, for example from printed circuit plates, a higher yield of material can be extracted using modern hydrometallurgical processes (formal) like in Europe rather than relying on extracting metal in acid baths in Indian backyards. By making the informal sector more formal, the small businesses wholly focus on collecting and dismantling the e-waste, while leaving the higher order operations to the formal recyclers in India and Europe. This guarantees that the competitive advantage of the informal sector in collecting and dismantling e-waste more efficiently is made use of. Recovering the resources professionally on the other hand decreases the environmental impact and ensures the highest possible yield of raw material at the same time.

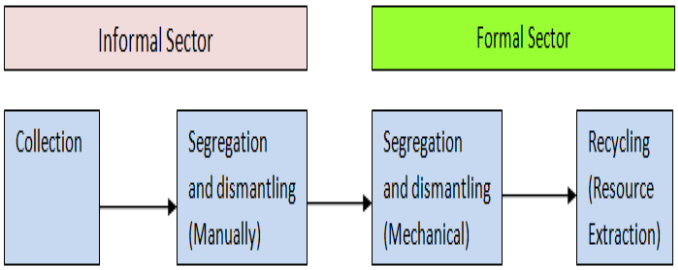
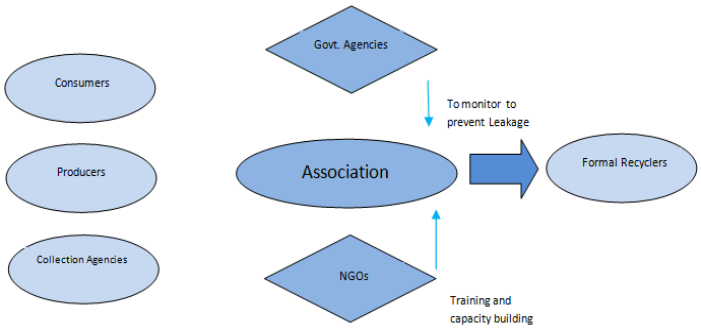


Figure 3: Integration of Formal and Informal Recycling Sectors

The creation of associations that comprise different informal e-waste recyclers can be the first step towards achieving a formalization of the informal sector stakeholders. The regulatory agencies can monitor the flow of e-waste so that it is within the clean channel. Civil Society Organizations (NGO) can also play very critical role in building capacity of the recyclers and also in bridging the gap between the regulator and informal sector. The government could support financially by provision of financial aid, financial incentives such as subsidies and introduction of insurance schemes.

II CONCLUSION

The informal sector in e-waste management stands the risk of losing their livelihood in the wake of the new rules and mushrooming of formal entrepreneurs. Although it is important to have big investment recycling infrastructure in the country for e-waste recycling, it is equally important to safeguard livelihood of thousands who survive on this waste.



In the current scenario, incorporating informal sector workers into e-waste management in India can be socially desirable, economically viable, and environmentally sound. The integration of the informal sector can contribute to reduce

overall system costs, negative environmental and climate impacts by shifting the waste headed for disposal through improved reuse and refurbishment. And finally, it can help to generate income and improve working conditions of poor population who often do not have other economic opportunities.

This paper has tried to suggest a basic framework for integrating most players in the informal sector currently engaged in e-waste management. This can be changed depending upon local conditions and opportunities. This paper shows that the integration of informal workers in e-waste management systems is possible and that it can contribute significantly to sustainable development.

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