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E-Waste: A Challenge for Sustainable Development and Government Policies

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Abstract: E-waste has been identified as the fastest growing waste stream in the world at present. Rapid socio-economic development and technological advancement are the main drivers of this trend. The hazardous chemical components of e-waste have potential adverse impacts on ecosystems and human health if not managed properly. This represents an imminent challenge to achieving sustainable development goals. Although technologically developed countries are the main source of e-product production and e-waste generation, the generated volume has also been increasing in developing countries and those in transition due to transport and transfer from e-waste source countries. Consequently, developing countries are in a vulnerable situation due to their lack of inventory data, waste management policies and advanced technology for environmentally sound management.

Keywords: Development, Developing countries, E-waste, Environment

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I. INTRODUCTION

The world economy has gone through a massive transformation in the last two decades. The World Trade Organization (WTO) was formed in 1995 with the main aim to promote globalization and foster easier global movement of goods and services. Evidence suggests that the volume of global trade of goods and services has jumped manifold since then. The total volume of global trade has gone up from little more than US$6trillion in 1995 to over US$36 trillion in 2014 (IMF2016). The pattern of trade has also undergone a change. Today the bulk of global trade happens between advanced economies and emerging economies, while in 1995 most global trade used to happen among the advanced economies. Among the three sectors of global economy, services sector continues to contribute the maximum to global economy and, with the rise of industries like information technology (IT) and financial services, has seen its share increase at the expense of industry and agriculture (Table 1).

Table 1: The Three Sectors of the Global Economy

Sector	Share in world economy 1995	Share in world economy2014
Services	58.5 %	68 %
Industry	33.5 %	28 %
Agriculture	8%	4 %

II. OBJECTIVES

This study aims to demonstrate that the present global e-waste scenarios and health hazards could prolong the achievement of sustainable development targets. This study illustrates scenarios from different perspectives and raises concerns about e-waste, identifies information gaps, and provides a basis for knowledge and awareness building and technological improvement to facilitate global long-term sustainable development.

Size and Scope of Global E-Waste Problem

Figures for past and current sales, in volume terms as well as in value terms, of electrical and electronic equipment(EEE) are available in the public domain at various levels (e.g., for a company, a country, a region, or the world). The main sources of these figures are reports of national governments and government agencies, annual reports published by the companies and economic and market databases of various firms. For e-waste, however, there are no official figures available for past or current global generation. One of the main reasons for that is the fact that inventory of e-waste has not been maintained in most parts of the world and even today many countries do not have such official inventory figures. For example, India does not yet have official inventory

figures for domestic e-waste generation. There are, however, many country-specific and region-specific estimates available from various agencies worldwide. One of the most recent global estimates of e-waste was carried out by United Nations University (UNU) (Baldéet al.2014). According to these estimates, the global e-waste generation in 2014 was expected to be 41.8 million metric tons (MT), up from 33.8 MT in 2010, and projected to grow to 49.8 MT by 2018. The report also provides estimates for e-waste generation at regional level as shown in Table 2

Table 2: Global and Regional E-waste Estimates

Region	Population in 2014 (millions)	E-waste generation in 2014 (MT)	Per capita e-waste generation in 2014 (kg/person)
Africa	1156.6	1.9	1.7
Americas	982.8	11.7	12.2
Asia	4349.6	16	3.7
Europe	738	11.6	15.6
Oceania	38.8	0.6	15.2
World	7265.8	41.8	5.9

Source: Baldéet al. (2014); United Nations World Population Prospects (2015)

There are some key insights from the above table. The first is that there is a large difference in e-waste generation across regions. For example while Europe and Americas (North and South America) generate almost the same quantity of e-waste, Africa generates less than one-fifth of that. The second is that, there is large disparity across regions in terms of per capita e-waste generation. Africa has the lowest per capita e-waste generation followed by Asia while Europe and Oceania have the highest per capita generation of e-waste. On per capita basis, Europe, Oceania, and Americas generate more than double the average world figures. More than 75% of world's population resides in Asia and Africa but the two regions contribute only about 43%of world's annual e-waste quantities. Richer regions in general generate far more e-waste compared to the comparatively poorer parts of the world.

E-waste and Challenges for Sustainability

E-waste poses a sharply rising challenge to global sustainability. Before we foray deeper into this challenge; we need to understand the basic nuances of sustainability. We begin by discussing overarching phenomenon of sustainability from various points of view, and then turn to a discussion of the challenges of e-waste to sustainability from different perspectives. We then move on to discuss key implications for policymakers and the market

People-Planet-Profit and E-Waste The 'people-planet-profit' or the 3P approach follows the triple bottom line term coined by John Elkington in early 1990s (Elkington1994). The triple bottom line and the 3P approach have been popular with many corporations since then. According to this accounting-focusedapproach, sustainability has three elements: one that deal with people (society), one that deal with the environment (earth), and one that deal with the profits (business). Corporations are expected to account not just for one P (profit) but for the other 2 Ps also (people and planet). Sustainability encompasses the three elements and the vital interfaces between each of the three. Let us look into e-waste from the point of view of each of the Ps more closely.

People: A major proportion of global e-waste is managed by the informal and unorganized sector(Baldéet al. 2014;Manomaivibool 2009). A number of small to medium scale organizations employing millions of people in many countries of the world, including women and children, are involved in managing e-waste generated domestically within a country as well as e-waste imported through largely illegal means(Manomaivibool and Vassanadumrongdee2011; Manomaivibool 2009; Widmeret al.2005; Zeeman, KrikkeandVenselaar2010).The largely informal nature of these organizations means that they are mostly outside the ambit of various national regulations on employment, trade practices, and environment. As such there is often scant regard paid by these organizations for meeting existing national norms. People employed in these sectors come in contact with toxic metals and are exposed to their toxic fumes, all of which present grave occupational, environmental, and health hazards (Bandyopadhyay 2008; Manomaivibool2009).

Planet: There are two main aspects related to planet in connection with e-waste. The first deals with the extraction of materials for production of EEE. The increased demand for EEE in the last two decades have led to increased extraction of rare earth metals, metals which are found in limited quantities in select regions of the world(Alonso et al.2012). The continuous and unabated exploitation, in absence of proper recycling of such metals from e-waste, raises questions about the ability of mankind to keep extracting such rare earth metals for long. The second aspect deals with the unsafe and unscientific e-waste disposal practices being followed in many regions of the world. Many precious metals and rare earth metals are lost by the use of primitive practices like open hammering and burning in the informal sector. The presence of several toxic elements in e-waste

further mean that such practices also end up causing damage to the local environment, including water bodies, air, and land.

Profit: There are two components of e-waste that have a vital interface with the tremendous value lost by not recycling e-waste –one being the loss of precious metals like gold and silver, and rare earth metals; and the other being the direct impact on human value degradation such as health hazards due to exposure of metals like lead and chromium.Traditionally,firms have kept their focus on basic buying behaviors of the consumers, which is mainly pivoted on the pre-consumption activities. Firms primarily focus on the attributes of the products to match the needs and wants of the consumers and hence their overall emphasis revolves around the issues like pricing, promotions, branding and so on. There is limited focus by the firms, so far, on the post-sales consumption behaviors of consumers which spans issues like faster obsolescence and engineered obsolescence. There is an equal lack of focus on post-consumption behavior comprising of vital issues like disposal of the used products, take-back mechanisms and systems for exchanging the used products.

Scarcity-Equity-Pollution and E-Waste According to this ecology-focused approach, sustainability deals with scarcity (natural resources extracted from earth systems), equity (how those natural resources are distributed across regions and across people), and pollution (the damage to ecosystem because of activities involved in extracting, processing, and consumption of natural resources). Scarcity: In the context of e-waste, it refers to varied availability of different natural resources used in the manufacturing of EEE. Several precious metals, rare earth metals, other toxic and nontoxic metals, and other materials like silica and wood are used in the manufacturing process. While some materials like wood are available in relative abundance, others like rare earth metals are available in finite quantities in the earth. Scarcity of such rare earth metals which are an important component in the manufacturing of not just EEE but for several applications in the clean tech sector, has serious considerations for sustainability. Existing industrial and market practices do not focus on the recovery, reuse, and recycling of materials from waste and instead focus on the extraction of virgin materials from earth.

Equity: There are issues of both inter-generational and intra-generation equity with e-waste. Over-extraction of rare earth metals for production of EEE and lack of focus on reuse and recycling of precious and rare earth metals raise question on the ability of mankind to keep producing EEE for future generations. The intra-generational equity concern samplify; with the wide disparity in e-waste generation across regions, and the wide difference in practices of e-waste management among developed and developing economies. Within a region also, it is the rich that are the major consumers of EEE, but it is often the poor who have to manage e-waste, and –in case of several developing economies –it is the poor, working in the informal sector, who are exposed to numerous ill effects of handling e-waste. Pollution: Environmental pollution occurs broadly in two instances. One during the mining and extraction processes of metals from underground reserves. The second is when e-waste is dealt in an unscientific manner. Water gets polluted when toxic metals from e waste are released to groundwater bodies or percolate to underground reserves in areas where e-waste is processed in unsafe and unscientific ways. Open burning of e-waste also releases several toxic fumes in the air that contributes to local air pollution

Social-Economic-Environmental and E-waste

According to this development-centric approach, sustainable development has three aspects: social, economic, and environmental (Basiago1999). Development, according to this approach, is sustainable only when it considers the effect on social aspects, environmental aspects, and the economic aspects

Policy Implications

The challenges arising from the growing volume and current state of management of e-waste are not just for the local environment but for sustainability on a much wider scale. Traditionally businesses have limited their attention to manufacturing and sales, what we refer to as pre-consumption processes. What happens during post-consumption processes –i.e., after sales, during consumption of the products, after the product has been discarded by the consumer and at the end of product lifecycle–have largely been ignored by businesses. In case of EEE and e-waste, because of the nature of these products and the presence of various toxic and nontoxic materials, existing approaches of businesses need to be rethought and revamped. In the short term, the dangers may be more for the environment and society, but in the long term the economic effects can be severe for the corporations themselves. The economic impacts could also be in terms of consumer demand and movements for companies and products that are and seen as sustainable. It also has overall implications for sustainable and green supply chain initiatives. Absence of market mechanisms to deal with e-waste in an environmentally sound and safe manner have been behind the several legislations on e-waste introduced in various countries. One of the most common and popular policy instruments has been that of extended producer responsibility (EPR)(Khetriwal et al. 2009; Manomaivibool and Vassanadumrongdee2011; Özdemir, DenizelandGuide 2012). According to EPR, the responsibilities of companies extend till safe disposal of end-of-lifecycle products. The

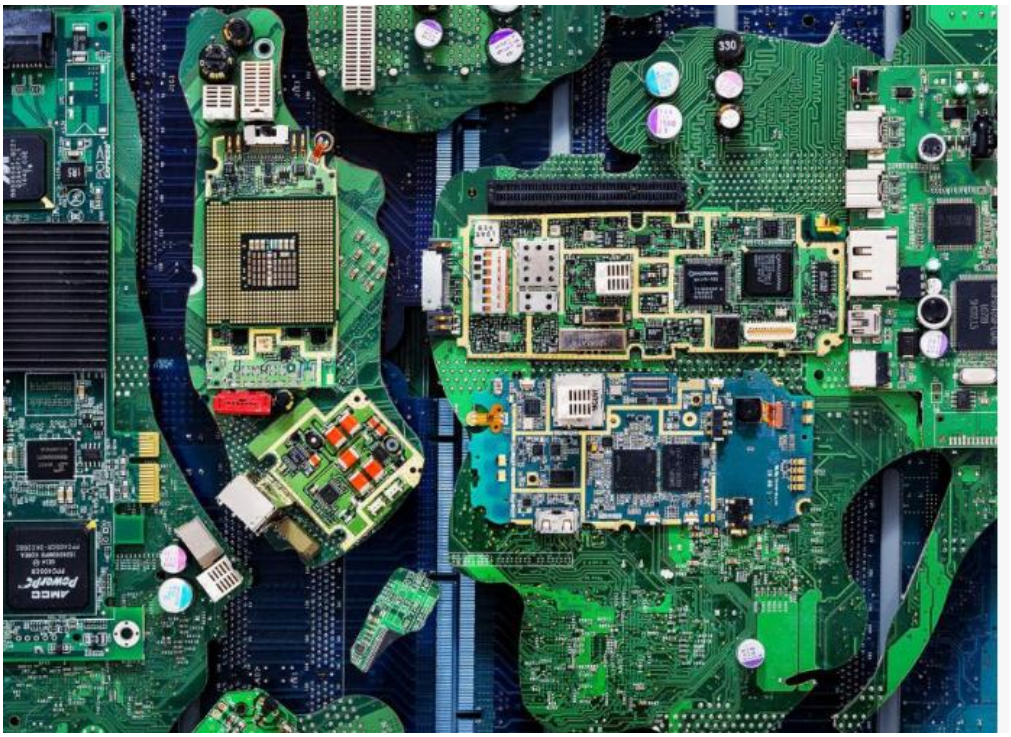
increasing prevalence of EPR points towards the need for businesses to work with the governments and society to jointly address the sustainability challenges arising due to e-waste. Businesses have reasons, the resources as well as the potential to take a leadership position in stewarding the cause of responsible e-waste management.

Government Policies Regarding E-Waste

E-waste (Management and Handling) Rules, 2011 including restrictions on usage of hazardous substances as per global best-practices and to prevent e-waste dumping in the country is a subject which is being dealt by Ministry of Environment and Forest (MoEF). This Department provides technical support to the MoEF in this regard. Union Minister for Environment, Forest and Climate Change, Dr. Harsh Vardhan has said that the Government has amended the E-waste (Management) Rules in a move to facilitate and effectively implement the environmentally sound management of e-waste in India. Dr. Vardhan highlighted that the amendment in rules has been done with the objective of channelizing the E-waste generated in the country towards authorized dismantlers and recyclers in order to formalize the e-waste recycling sector. He pointed out that the collection targets under the provision of Extended Producer Responsibility (EPR) in the Rules have been revised and targets have been introduced for new producers who have started their sales operations recently.

India introduces first e-waste laws:-

India's Ministry of Environment and Forest (MoEF) is to place legal liability for reducing and recycling electronic waste with producers for the first time under the E-waste (Management and Handling) Rules 2011. The rules, which form part of the Environment Protection Act, will come into effect from 1 May 2012.



Manufacturers and importers of computers, mobile phones and white goods will be required to come up with e-waste collection centres or introduce 'take back' systems. 'These rules will apply to every producer, consumer and bulk consumer involved in manufacture, sale, purchase and processing of electronic equipment or components,' an environment ministry official told India newspaper Business Standard. The ministry is granting a one-year grace period for collection centres to be to set up. India currently generates 400,000 tonnes of e-waste annually, of which only 19,000 tonnes is recycled, according to manufacturers' association Mait. It believes around 40% of obsolete electronic products sit unused at home or in warehouses, as people do not know what to do with them and there is no systematic mechanism for dispose of them. Under the new rules, producers will have to issue consumers with information on disposing of equipment after use to prevent e-waste from being dropped in domestic waste, and must make the public aware of the hazardous components present. Commercial consumers and government departments will become responsible for recycling the e-waste they generate, channeling it to authorised collection centers or ensuring it is taken back by suppliers. They will have to maintain e-waste records and make these available to state Pollution Control Boards or other authorities. NGO Greenpeace India welcomes the transition from the current out-of-sight, out-of-mind approach to proper

recycling, but claimed the new legislation 'fails to provide safeguards' against the import and export of e-waste. A provisional rule drafted by the Ministry last year included a ban on import of second-hand electronic equipment for charity or other re-use – much of which passed into the hands of informal recyclers. This clause has been removed from the final rule.

III. CONCLUSION

Industrial ecosystem was equated by him with a living organism which consumes energy and material resource for producing desired as well as undesired externalities like waste. It is pertinent in the whole discussion that if this industry organism keeps on consuming more and more resources than the regeneration capacity of the ecosystem -and also emits more and more waste–then this ecological sink would no longer be in a position to absorb the externalities and the whole system would turn into an out-of-control unsustainable system. Hence, fulcrum of the sustainability needs to be balanced and fine-tuned –keeping the monster of e-waste generation in check -for the larger benefit of societies and citizensof world.

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