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Review

Emerging trends in consumers' E-waste disposal behaviour and awareness: A worldwide overview with special focus on India

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ABSTRACT

E-waste is a complex stream of toxic waste which requires specific handling considerations. Effective and responsible management of E-waste is a global concern today. Considering the depth of the E-waste problem, this paper is an attempt to review two key elements greatly accountable for influencing sustainable E-waste management initiatives: Consumers' E-waste 1) 'Disposal Behaviour' and 2) 'Awareness'. Taking into account the locale specific characteristics of consumers' E-waste disposal behaviour and awareness, we have attempted to perform an extensive review on the global context and identify the measures adopted by the consumers of different countries to dispose off their E-waste. We observe significant differences in consumers' E-waste disposal behaviour not only 'between' the developed and developing countries, but also 'within' these countries. The paper further especially explains the complexities in India's E-waste management system due to its multifaceted socio-economic, cultural and other associated connotations influencing consumers' disposal behaviour and awareness. We conclude that global experiences on consumers' E-waste disposal behaviour and awareness could be helpful for a particular country to devise inclusive E-waste management strategies to adequately address their current E-waste crisis.

Contents

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1. Introduction

Electronic Waste (E-waste) or Waste Electrical and Electronic Equipments (WEEE) has become a major concern in the contemporary world. The rapid growth of E-waste is influenced by fast technological progresses and innovations, rapid changes in information and communication technologies (ICT), economic growth, electrical and electronic equipments (EEEs) becoming a major component of our day-to-day life, increasing versatility of most electronic devices, and the downward trend in prices (Yoshida et al., 2016; Umair et al., 2015; Yla-Mella et al., 2014). For instance, about 5.6 billion mobile phones were in-use in the world as of 2012 (Schnoor, 2012) with the potential for further growth in the near future. Moreover, the rapid advance in technology, consumer demand/attitudes and strong incentives for consumption bring about a drastically reduced lifespan and faster replacement rates of most EEEs, the consequence of which is the rising quantity of E-waste (Gu et al., 2016; Thavalingam and Karunasena 2016; Ozkir et al., 2015; Paiano et al., 2013; Rubin et al., 2014). It represents 1–3% of global municipal waste production of 1636 million tonnes per year (Mallawarachchi and Karunasena, 2012) with a potential to increase by 3–5% every year (Agamuthu et al., 2015). E-waste, today, is a more than $7 billion industry (Grant and Oteng-Ababio, 2012). A joint report by United Nations Environment Programme (UNEP, 2007) and United Nations University (UNU) predicts that by the year 2020, a growth of 500% would be observed in India with respect to E-waste from old computers. During the same time, an overwhelming 7 times and 18 times increase in E-waste production would be observed from discarded mobile phones in China and India respectively (Lu et al., 2015). Likewise, Yu et al. (2010) forecast that by 2016–2018, obsolete Personal Computers (PCs) produced in developing countries will surpass that of the developed countries. E-waste from PCs in developing countries will arrive at 400–700 million units, significantly higher than that of developed countries at 200–300 million units. Such results call for immediate attention from policymakers and research communities of the developing world towards addressing their E-waste problem in an adequate detail.

According to Khetriwal et al. (2009), the deficits in previous studies directly addressing policy makers' concerns makes E-waste management a difficult task. For instance, publics' awareness and their active participation are essential for the success of E-waste management initiatives. While many studies on E-waste issues have been published in the last decade, only a few of them addresses publics' E-waste disposal behaviour and awareness. There is little understanding on how the awareness level affects the disposal behaviour and sustainable management of E-waste in a particular country or community. In India, although local organizational consumers of ICT (in the form of 'bulk' consumers of EEEs) create the majority of E-waste (MoEF, 2008), the factors determining their E-waste decisions (such as when EEEs turn into E-waste, and whether or not it is sent for recycling) are not well understood (Heeks et al., 2014). It is imperative to comprehend consumers' knowledge and awareness levels on their EEEs as they are the ones who eventually become the producers of E-waste in a particular commune (Kwatra et al., 2013). Xu et al. (2014) suggest that legal advocacy, environmental knowledge, consumers' behavioural attitude, their subjective norms, perceived behavioural control and previous recycling experiences directly influence E-waste management activities in a particular city. From this perspective, it is unlikely to have a comprehensive E-waste management initiative without the contribution of 'consumers' who form an integral part of an E-waste management system.

Thus, this paper is an attempt to look into consumers' E-waste disposal behaviour and associated awareness in a global context with special emphasis on India. We try to problematize this issue by addressing queries such as: What are the different modes of E-waste disposal practiced by the consumers of diverse countries? Do consumer's awareness level and disposal pattern differ from one country to another? Do differences exist only 'between' the developed and developing countries or variations also persist 'within' the developed or developing nations? What are the different factors that affect the consumers' behaviour towards E-waste disposal? Does awareness level among consumers shapes their disposal behaviour? What are the different ways or means consumers usually adopt to minimise the problems of E-waste? Is there any socio-cultural/gender difference in E-waste disposal behaviour?

2. Context of the study and methodology

Consumption, disposal behaviour/culture and public awareness coupled with motives for economic development are the main factors influencing E-waste generation in any country (Lu et al., 2015). Understanding consumers' behaviour is central in improving any E-waste collection initiatives (Saphores et al., 2012) and its overall sustainable management. The current literature on consumers' attitudes towards E-waste disposal primarily comprises of literatures investigating the experiences of disposal behaviour which is nothing but the factors that persuade the decision of the consumers whether to store, donate, sell, discard, or recycle an electronic product (Dindarian et al., 2012). In depth researches on the topic have attracted insufficient attention (Song et al., 2012a). A glimpse of the literatures published during the period between 1994 and 2014 best clarifies the reason behind our consideration of the topic. A bibliometric analysis on the trends in global E-waste Research was carried out with 'Scopus' database using different search queries. It has been observed that consumers' E-waste disposal behaviour and awareness have been an ignored area of E-waste research for

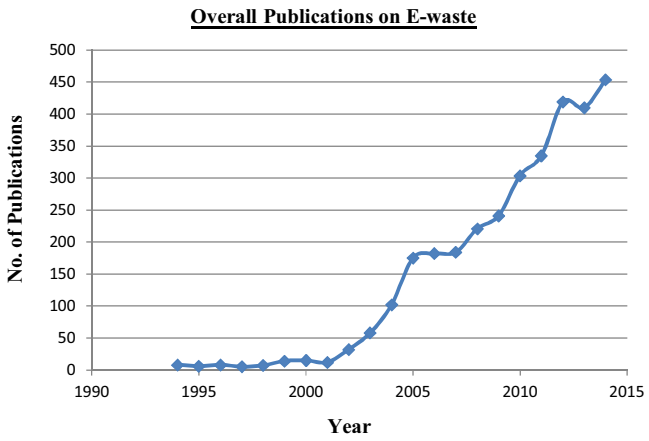

Fig. 1. Graph showing the growth of overall publications on 'E-waste' from 1994 to 2014.
Source: Scopus, 2015

Fig. 2. Graph showing the growth of publications on 'Consumers' E-waste Disposal Behaviour and Awareness' from 1994 to 2014.
Source: Scopus, 2015

a long period of time. The topic has gained research interest and momentum only recently with a number of publications coming up from diverse research groups.

A general investigation in 'Scopus' using a broad search query on 'E-waste' reports 3192 research documents published during the period of 20 years, from 1994 to 2014 (as illustrated in Fig. 1). It has been observed that researches on E-waste has experienced an exponential growth in the last decade with the trend appear to continue in the near future. Whereas a specific search using the query on E-waste with 'Consumer' or 'Awareness' shows 419 research papers published during the same period (as illustrated in Fig. 2). The purpose of using the word 'consumer' instead of phrases such as 'consumer disposal' is to, first, have a wider range of papers so that no paper on the topic is left behind. This broad array of papers is subsequently narrowed down. Therefore, these 419 papers are further individually verified in order to check the authenticity related to our topic of concern by reading at least the abstract (and the full text whenever felt essential) of each paper. It has been observed that although the words 'consumer' and 'awareness' appears in the title, abstract or keywords of a number of papers on E-waste; the overall issues addressed in those papers do not serve our purpose of identifying researches on consumers' E-waste disposal behaviour and awareness.

After thorough investigation of the individual papers, only 52 papers are found to have satisfactorily dealt with consumers' E-waste awareness and disposal behaviour in diverse countries (see Table 1). Thus, a relative lack of adequate research interest on the topic has been observed as compared to other E-waste issues such as recycling of E-waste, chemical analysis and pollution studies, microbial studies, lifecycle assessment, health impact studies of E-waste constituents and so on. Such an inadequate consideration on this important aspect of E-waste management has been a motivation for us to explore the consumers' E-waste disposal behaviour and awareness on a global scale with special focus on India. Fig. 3 shows the countries considered for this paper with their respective per capita E-waste generation (Table 2).

3. Consumers' E-waste *disposal behaviour and awareness*: evidences from some countries

It is essential to identify consumers' E-waste disposal behaviour in a particular country in order to spot relevant weaknesses existing in the system which facilitates in designing management solutions and awareness-raising campaigns (Perez-Belis et al., 2015). Most European or North American consumers who recycle believe that they are reversing or at least mitigating environmental degradation by recycling their goods (Dauvergne and LeBaron, 2013). However, with financial profits playing a major part, incentives for participating in recycling activities in developing economies like India and China are entirely different from that of developed countries. Thus, scenarios vary across countries and it is essential to assess consumers' disposal behaviour and awareness in individual countries in order to address the global E-waste crisis adequately and effectively.

3.1. The Asian context

3.1.1. China

A preferable disposal habit among the Chinese consumers is to sell their obsolete electronic appliances due to the 'norms of viewing these products as tradable properties and the prosperity of second-hand markets' (Chi et al., 2014:91). The study by Li et al. (2012) on the behaviours of urban residents towards discarding E-waste in households in Baoding, China reveals that most often E-waste is sold to the hawkers omnipresent in the area from where these obsolete electronics are directed into the secondhand marketplace to be refurbished, and eventually resold. This is a common practice in the whole country (Chi et al., 2014) with collection and recovery enterprises its key actors (Mo et al., 2009). Accounting for 52% of total disposals, 'malfunction' is observed to be the major reason for discarding of EEEs. Unlike European and North American countries where products once discarded are considered 'waste' having no value, "waste" is considered very valuable in China. Consequently a large informal and formal waste processing market exists in the country with aims to 'capture any value that is present in what people and companies throw away' (Veenstra et al., 2010:451). A general reluctance exist among Chinese consumers to pay for disposal services and waste recycling or for extra consumer responsibility, particularly when consumers can be financially benefitted by selling their out-of-use EEEs (Hicks et al., 2005).

3.1.2. Japan

The legal situation in Japan on E-waste is analogous to the conditions in the European Union to a certain extent (Zoeteman et al., 2010). From the year 2001, policymakers in Japan propagated a comprehensive array of laws, rules and regulations to convert E-waste into resources (Oguchi et al., 2008; Kirby and Lora-Wainwright 2015). The Home Appliance Recycling Law (2001), for instance, allows consumers to return their obsolete EEEs to manufacturers for recycling (Oguchi et al., 2012). E-waste is largely collected by retailer shops from the consumers and subsequently transported to selected stockyards. In other cases, consumers

Table 1
Articles focused on Aspects of Consumers' E-Waste Disposal Behaviour and Awareness.

Reference	Aspect Addressed		Location
	Consumer Disposal Behaviour	Public Awareness	
Tsamo (2014)	•	•	Cameroon
Yu et al. (2014)		•	China
Yla-Mella et al. (2014)	•		Finland
Kwatra et al. (2013)	•	•	India
Xu et al. (2014)	•		China
Ercan and Bilen (2014)		•	Turkey
Zhong et al. (2014)	•		China
Massawe et al. (2014)	•		USA
Shumon and Ahmed (2013)	•		Malaysia
Cruz-Sotelo et al. (2013)	•		Mexico and Spain
Edumadze et al. (2013)	•	•	Ghana
Tocho and Waema (2013)	•	•	Kenya
Chibunna et al. (2013)	•	•	Malaysia
Dixit and Vaish (2013)	•		India
Ciocoiu et al. (2013)	•		Romania
Kaushal and Nema (2013)	•		India
Milovantseva and Saphores (2013)	•		USA
Dwivedy and Mittal (2013)	•	•	India
Anuj et al. (2013)	•		India
Afroz et al. (2013)	•	•	Malaysia
Ho et al. (2013)	•		Malaysia
Hanafi et al. (2013)	•		Indonesia
Achillas et al. (2012)		•	Greece
Subramanian et al. (2012)	•		India
Li et al. (2012)	•		China
Lee and Sundin (2012)		•	Sweden
Song et al. (2012a,b)	•		Macau
Dindarian et al. (2012)	•		UK
Agarwal et al. (2012)	•		India
Rode (2012)	•		India
Fraige et al. (2012)	•	•	Jordan
Chen and Yee (2011)		•	Malaysia
Hanafi et al. (2011)	•		Indonesia
Koloseni and Shimba (2011)	•		Tanzania
Gutierrez et al. (2011)	•		Spain
Ciocoiu et al. (2011)	•		Romania
Lozano et al. (2010)	•		Spain
Jang and Kim (2010)	•		Korea
Ansari et al. (2010)	•	•	Bangladesh
Gutierrez et al. (2010)	•		Spain
Kahhat and Williams (2010)	•		Peru
Davis and Herat (2010)		•	Australia
Nnorom et al. (2009)	•	•	Nigeria
Kunacheva et al. (2009)		•	Thailand
Davis and Wolski (2009)	•		Australia
Tanskanen and Butler (2007)	•		Finland and US
Abeliotis et al. (2006)		•	Greece
Papaoikonomou et al. (2006)		•	Greece
Huang et al. (2006)	•	•	China
Peralta and Fontanos (2006)	•		Philippines
Cairns (2005)	•		USA
Darby and Obara(2005)	•	•	UK

directly get their E-waste to the designated stockyards or to the municipalities close-by, where, municipalities are accountable for the transportation of E-waste to the stockyards (Menikpura et al., 2014). All these initiatives result in Japan being only second to the EU in absolute volumes of E-waste recycled, achieving a 70% recovery of households' E-waste generation (Zoeteman et al., 2010). Nevertheless, one of the major reasons behind half of the out-of-use home appliances in Japan being exported as secondhand items was observed to be the fact that the consumers are obliged to pay the recycling and transportation costs when they discard their obsolete electronics. Consumers can avoid paying the recycling and transportation expenses if they sell their obsolete home appliances to exporters (Shinkuma and Huong, 2009). Such recyclable resource's outflow can weaken Japan's domestic system for recycling (Sugimura and Murakami, 2016).

3.1.3. Korea

Consumers in Korea are responsible for the collection fee of their E-waste and have two options: (1) paying no collection fee if the consumer decides to buy a new replacement product, in this case the retailers, producers or suppliers collect the E-waste (Jang, 2010), or (2) paying a collection fee to the local government collection system (Kahhat et al., 2008). Some municipalities or local governments initiated the collection of E-waste from households at designated areas or curb side collection containers or door-to-door free of charge (Kim et al., 2013). On a weekly basis, local E-waste transporters, contracted and authorised by the local governments, collect E-waste and dispatch it either to private E-waste recycling facilities, off-site treatment facilities, producer recycling centres, or local reuse centres. There are approximately 60 E-waste storage centres across the country established by several importers

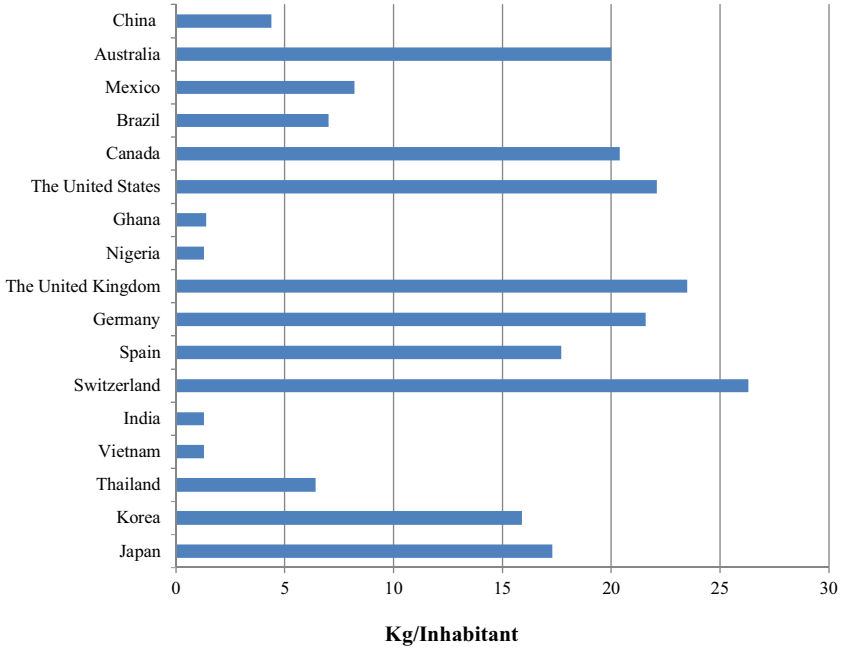

Fig. 3. Countries Considered and Their Respective Domestic E-waste Generation in the Year 2014.
Source: Baldé et al. (2014)

Table 2
A Comparative Analysis of the Countries Considered.

Sr. No	Country	Obsolete EEEs Considered as		Dominance of Sector		Presence of Specific E-waste Legislation	
		'Waste'	'Valuables'	Formal	Informal	Yes	No
1.	China		√		√	√	
2.	Japan	√		√		√	
3.	Korea		√	√		√	
4.	Thailand		√		√		√
5.	Vietnam		√		√		√
6.	India		√		√	√	
7.	Switzerland	√		√		√	
8.	Spain	√		√		√	
9.	Germany	√		√		√	
10.	UK	√		√		√	
11.	Nigeria		√		√		√
12.	Ghana		√		√		√
13.	USA	√		√		√	
14.	Canada	√		√		√	
15.	Brazil		√	√		√	
16.	Mexico		√		√		√
17.	Australia	√		√		√	

and manufacturers of consumer EEEs (Jang, 2010). Nevertheless, some obsolete electronics are often viewed as potentially valuable resources by residents in Korea and thus, many of them are stored at the household level. An estimated 28 million obsolete and used mobile phones were kept stored in Korean households as of the end of 2006 (Jang, 2010).

3.1.4. Thailand

Complementing a major characteristic of emerging economies in Asia, in Thailand too, more than half of the households simply keep stored their end-of-life EEEs at home in the absence of a proper collection mechanism. 11% of the population dispose of E-waste together with other waste and 35% perform some sorts of source-separation wherein unused EEEs are sold, given away, or traded in (Manomaivibool and Vassanadumrongdee, 2011). The primary reason for many Thais keeping their obsolete electronics in storage is their perception of its remaining value (Manomaivibool and Vassanadumrongdee, 2012). 'Donation' is a significant channel for disposal of obsolete items which complements the Buddhist concept of good deeds and thus, largely practiced across the country (Manomaivibool and Vassanadumrongdee, 2011).

3.1.5. Vietnam

Nguyen et al. (2009) observed that owing to the difficult past of the country as a war-torn nation, people in Vietnam traditionally keep their E-waste (which they consider valuable) at home. As a consequence, there is a delay in obsolete EEEs entering the E-waste stream and the amount of waste generated has always been quite small. In Vietnam, the producers have responsibility only for the E-waste from the production line but not for the appliances discarded by consumers. In the country, apart from a few announcements or declarations, presently no laws, rules and regulations exist

to exclusively deal with E-waste (Pariatamby and Victor, 2013), contributing largely to the success of the informal handling system.

3.2. The European context

3.2.1. Switzerland

Switzerland is the earliest country in the world to establish a formal management system for E-waste and today, is a leading country in E-waste collection (Duygan and Meylan, 2015). The pioneering Swiss E-waste management system is based on the principles of EPR—both operationally and legally (Sinha-Khetriwal et al., 2005), placing the financial and physical responsibilities for the eco-friendly E-waste recycling, treatment and disposal processes on EEE manufacturers and exporters (Wath et al., 2010). The fundamental reason for the success of E-waste management initiatives in the country has been its responsible, environmentally conscious and law abiding consumers who return their discarded appliances to the designated retail-outlets or collection points or directly transport E-waste to the recyclers at regular intervals. Further, SENS and SWICO (as the two Producer Responsibility Organizations in Switzerland), are the core of Swiss E-waste take-back system (Hischier et al., 2005) with over 90% of the E-waste from private consumers is collected and treated under the control of one of these two take back schemes (Savi et al., 2013). Financed by an Advanced Recycling Fee (ARF) that the consumers pay while purchasing their EEEs, comprehensive take-back and recycling systems have been established by both SENS and SWICO (Hischier et al., 2005). ARF is more of a consumer rather than a shareholder sponsored system, where a buyer is considerably keener on paying a small cost at the time of purchase of a product than paying for the discarding of an item that is worthless (Khetriwal et al., 2009).

3.2.2. Spain

Prior to the implementation of European Directive on WEEE (2003), 75% of large household electronic appliances in Spain were collected by retailers when consumers purchased a new model. The remaining 25% went to collection points or entered municipality take-back system and were subsequently transferred to the metal managers (Queiruga et al., 2012). A study by Perez-Belis et al. (2015) finds out that 67.1% of consumers dispose of their electrical and electronic toys alongside other waste portions in their domestic wastebins. Only 32.9% discard them at designated recycling points as per the WEEE Directive. Thus, light-weight and small EEEs are taken to selected collection outlets, transferred to metal managers or often just discarded at municipal solid waste containers and subsequently landfilled. As of 2010, Spain has a E-waste collection rate of only 3.3 kg/inhabitant/year, a figure that is way behind those of its European counterparts such as Norway (28.1 kg/inhabitant/year) or Switzerland (16.6 kg/inhabitant/year) (Perez-Belis et al., 2013). In Spain, Royal Decree (RD) 208/2005 on E-waste management transformed the European Directive into a national legislation (on February 25, 2005), thereby conveying that for all new EEEs, the producers are required to establish and finance individual or collective waste management systems to ensure that all products on the market were collected and recycled appropriately, without added cost to consumers (Queiruga et al., 2012).

3.2.3. Germany

In Germany, taking the obsolete electronics to designated collection locations is considered a household's statutory duty (Manomaivibool and Vassanadumrongdee, 2012). Else, the consumers have to pay in order to get their E-waste collected (Sthiannopkao and Wong, 2013). Nevertheless, Dimitrakakis et al. (2009) argues that the E-waste collection system in Germany is yet to be entirely successful in convincing consumers to handover their used EEEs through dedicated routes meant for addressing the E-waste crisis in the country. This often brings the whole E-waste collection schemes into question. For instance, in spite of the obligation for separate collection and sorting, analyses reveal that E-waste (especially small obsolete electronics) compose from 0.4% w/w up to 1.5% w/w of the household residual waste stream. In Germany, the EAR project (Elektro-Altgeräte Register Projektgesellschaft b.R.) acts as a E-waste clearing house between municipalities and producers, warranting monitoring and compliances so that producers accomplish their compulsions under the German Elektro Geräte Act (Widmer et al., 2005).

3.2.4. The United Kingdom (UK)

Working on consumers' behaviour in the UK, Dindarian et al. (2012) question the widely-held belief that E-waste is caused by a desire for the latest technology or innovation. Most of the consumers in Sharston and Manchester, for instance, expressed their willingness to purchase products with the same functionality once they dispose their faulty electronics. Many discarded EEEs are either in perfect working condition or have only minor defects. Nevertheless, those disposing their still operational products are willing to purchase updated products. Consumers are observed to have little knowledge of disposal routes for E-waste other than public recycling facilities. The EU's WEEE Directive (2003) was transposed into a UK law, 'WEEE Regulations 2006'. After the execution of this law, EPR regime has been stringently implemented in the country. For instance, under this regulation, the seller (irrespective of the product being sold directly or by internet, mail order or telephone) must provide a way for their customers to dispose of their old household EEEs when the seller sell them a new version of the same item.

3.3. The African context

3.3.1. Nigeria

In Nigeria, there is no well-established collection, separation, storage, transportation, recycling, disposal facilities and appropriate E-waste management program at present (Alabi and Bakare, 2011). E-waste handling system in the country is largely informal. Residents are found to be willing to support and pay for sound E-waste management in Okigwe and Isuikwuato towns (Nnorom et al., 2009). Consumers with higher income are observed to be more likely to participate voluntarily in E-waste recycling programs (Van Beukering and van den Bergh, 2006).

3.3.2. Ghana

In Ghana, consumers dispose of their E-waste through informal scrap collectors. E-waste collectors (mostly youth) execute door-to-door collections from different consumers such as private homes, institutions etc. Previously the collectors did not have to pay anything for obsolete EEEs which have changed with increasing competition fuelled by increasing youth unemployment and the entrance of collectors with more potential. As a result, today, the waste has begun to attract a competitive price with primary observations suggesting that a collector has to pay $1–2.5 for an obsolete desktop computer (Oteng-Ababio, 2012). Further, at Agbogbloshie in Accra (a globally infamous E-waste dumping site) heaps of inoperative old EEEs are continually being dumped without any consideration to the environmental hazards and threats to the people living in the vicinity (Asante et al., 2011). In a survey, Ghanaian participants displayed same level of awareness of the adverse environmental and health impacts of the current E-waste management practices in Agbogbloshie (Greater Accra), Koforidua (Eastern) and Kwadaso (Ashanti) irrespective of age, occupation or level of education attained (Agyei-Mensah and Oteng-Ababio, 2012). Edumadze

et al. (2013) observed that male students are more environmentally aware than their female compatriot in Ghana.

3.4. The North American context

3.4.1. The United States

In the US, E-waste generated at the household is considered, legally, a non-hazardous waste with its management remains largely a municipal responsibility and a state affair (Wagner, 2009). Storage remains the preferred method to manage end-of- life household electronics in the country, followed by disposal with only a small portion recycled (Lepawsky, 2012). More than 70% of obsolete consumer electronic devices are kept in storage on an average for 3–5 years (Kang and Schoenung, 2005). The financial accountability for management of E-waste is entrusted to the consumers, rather than to the producers (Lepawsky, 2012). As a consequence, 'extended consumers' responsibility (ECR)' is endorsed instead of EPR. The US Environmental Protection Agency's data shows that about 80% of US consumers are willing to pay a fee of less than $5 for recycling of obsolete electronics (Kang and Schoenung, 2006).

California (as the first state in the country to pass E-waste laws in 2003) requires a fee paid directly by the consumer in order to treat their obsolete electronics (Li, 2011). In an attempt to overturn this situation of allotting financial responsibility to consumers, Maine in 2004 became the first state in the US to adopt a household E-waste law with a producer responsibility provision by adopting a modified EPR approach. Maine's program is based on a shared responsibility in which all three primary stakeholders—the producer, the generator (the households or other consumers), and the municipality—share the E-waste management (primarily transportation and recycling) costs (Wagner, 2009). Although the U.S. consumers are offered a significant number of options to manage their E-waste, the approaches are not consistent with respect to the E-waste types accepted or by location (Townsend, 2011). For instance, computers and cell phones are often accepted at multiple drop-off locations, whereas, power tools, fans, and vacuum cleaners may have much fewer, if any, drop-off locations. The significance of 'convenience' and 'familiarity' with recycling are important factors determining consumers' behaviour in the country. People living in more than 5 miles distances away from the closest collection/drop-off center are less likely to recycle. 'Familiarity' with recycling paper, glass, plastics, or metal boosts the willingness to recycle E-waste (Saphores et al., 2006). Further, the gaps in regional and national policies puzzle the EEE producers and consumers and prolong potential detrimental environmental and human health impacts of hazardous E-waste management.

3.4.2. Canada

In Canada, both 'product stewardship' programs and ECR (Lepawsky, 2012) are used for E-waste management. ECR allocates financial responsibly of E-waste management mainly to its consumer citizens. Legislated environmental fees and/or public funds are generally utilized as a funding-base under a product stewardship program and it usually don't assign producers the financial responsibility (ECCC, 2013). Electronics Product Stewardship Canada (EPSC) had established this product stewardship programs in eight Canadian provinces— Quebec, Nova Scotia, PEI, British Columbia, Saskatchewan, Ontario, Manitoba, and Newfoundland and Labrador—in association with the Retail Council of Canada (RCC). Further, Alberta has an Electronics Recycling Administrative Policy under which an Advanced Disposal Surcharge (ADS) is collected on eligible EEEs sold to consumers. Each provincial program in Canada, excluding Ontario's (which let producers decide if such fees are hidden or visible), necessitates a system of consumer–citizens paying a visible fee to finance the E-waste recovery plans (Lepawsky, 2012).

3.5. The Latin American context

3.5.1. Brazil

Often obsolete computers with their peripherals are collected from the households, offices etc of consumer-citizens (de Oliveira et al., 2012). The most preferred method of E-waste disposal among Brazilian consumers in the city of Belo Horizonte-Minas Gerais was found to be 'donation' (Franco and Lange, 2011). Some take back and recycling programs are initiated by Motorola, Dell etc. In Brazil, the key complexity related to the execution of E-waste recycling practices is the collection system. It is because its efficacy depends not merely on the education plus support of the citizens, however also on collaboration amongst industrial waste producers, distributors and the local/national governments (Araujo et al., 2012).

3.5.2. Mexico

In Mexico, there is no formal E-waste collection program because of the absence of legal assurances on the liability of government, manufacturers/distributors, and the general public (Garcia et al., 2012). The immense majority of the 2443 Mexican municipalities do not have the human or economic means or legal infrastructures to tackle the urban solid waste crisis (de Oliveira et al., 2012), thereby making E-waste management a major challenge in the country. The study by Garcia et al., 2012 observed that there are 125 obsolete computers stored per 1000 houses with 99,000 obsolete computers stored in the study area of Northeast Mexico alone. The survey reported that obsolete computers have been stored for a mean of 1.8 years with a maximum of 8 years. Only 19% of the houses have disposed obsolete computers. Further, computers deemed obsolete by bulk consumers are important assets for internet kiosks and cafes that provide internet access to consumers with limited needs. Obsolete computers are not always disposed of for economic incentives. Instead, 'donation' of computers to friends and family members is a popular end-of-use management option with 20–36% of computers is donated in the country (Estrada-Ayub and Kahhat, 2014). Some corporations donate or sell old EEEs to schools, employees and other organisations.

3.6. Australian context

Australian National Television and Computer Recycling Scheme (NTCRS), a major outcome of National Product Stewardship Scheme, builds on existent recycling endeavours by local councils, charitable and other organisations to facilitate consumers (especially small businesses and householders) to drop-off their redundant computer products and televisions at certain collection locations free of charge across Australia. By 2021–2022, the NTCRS expects upto 80% enhancement in the recycling rate. There are more than 40 drop off points available in Queensland, Australian Capital Territory, Western Australia, South Australia, Victoria, and New South Wales since the NTCRS commenced in May 2012 (ABS, 2013). In Australia, there is a recycling fee applied when consumers buy new products. Consumer can recycle their EEEs through local municipalities and private collections organized by business association to collect E-waste. EPR and ARF are the most preferred finance scheme for consumers towards funding E-waste management (Davis and Herat 2010, 2008). Lack of awareness on E-waste was observed among Australian citizens (in 29 councils in Queensland) on issues about E-waste. Over 80% of the respondents from the councils indicated that they believed the public were only 'slightly aware' (40%) or 'not at all aware' (40%) of the problem (Davis and Herat, 2008).

4. Consumers' E-waste *disposal behaviour and awareness* in India

It is approximated that 75% of obsolete EEEs in India are stored due to ambiguity about how to manage them properly (Ramachandra and Varghese, 2004). A pervasive view of E-waste as a commodity causes a reluctance to dispose it off immediately (Sinha, 2008). As majority of consumers prefer to store their E-waste at home rather than returning it to the producers, it limits the successful implementation of reverse logistic approaches (Dixit and Badgaiyan, 2016) or EPR module. Dwivedy et al. (2015) argue that as consumers in India expect some kind of financial benefits while discarding their E-waste, the EPR model is likely to be unsuccessful since it inflicts cost to consumers. A study in the IT hub of Pune observed computer waste being stored for up to 14 years. Resulting in a longer average life, obsolete EEEs often changes many hands (frequently finds secondhand and even thirdhand users) in India before finally getting disposed off (Borthakur, 2014).

Nevertheless, most of the E-waste in India is disposed of either through auction (usually a route adopted by and limited to various Government establishments) or sold to the scrap dealers (kawariwalas) which in turn are sold to the recyclers in the informal sector (Raghupathy and Chaturvedi, 2013). Scrap dealers or 'kawariwalas', collect E-waste from diverse individual or bulk consumers and pass them to the recyclers. In contrast to developed countries such as Switzerland, where consumers pay a recycling fee, in India it is the waste collectors or the kawariwalas who pay consumers a positive price for their obsolete EEEs (Sinha-Khetriwal et al., 2005). This acts as an incentive for consumers to dispose their obsolete electronics through informal waste collectors. Informal collection of E-waste in India leads to higher collection rates and several social and economic benefits to the poor strata of the country (Pariatamby and Victor, 2013; Pandey and Govind, 2014).

Regarding the awareness, considerable fraction of middleclass population of Delhi, for instance, is still unaware of E-waste. However, on receiving information they could associate the repercussions of inappropriate E-waste management practices with harmful health outcomes (Kwatra et al., 2013). Unaware of the methods of disposal, many households and other institutes dispose their E-waste with regular household wastes in India (Borthakur, 2015). A significant portion of the E-waste produced in the Mumbai Metropolitan Area is disposed off in the regular bins which call for effective E-waste awareness campaigns among manufacturers and consumers (Rode, 2012). The study by Kwatra et al. (2013) observes the willingness of EEEs users in New Delhi to pay extra cost for appropriate E-waste management in the city with proper sharing of costs between consumers and producers. They believe that equal responsibilities rest on the shoulders of producers, consumers and governments for effective E-waste management in the city. For instance, even if government takes initiative to construct E-waste recycling facilities, existing literatures reveal that without appropriate consumers' awareness, a recycling system never achieves its utmost efficiency (Sarath et al., 2015). Thus, effectiveness of E-waste recycling is subjected to consumer participation, technical capacity, various national legislations etc (Li et al., 2015). The current E-waste situation in India necessitates the constructive involvement of its various stakeholders in terms of consumers' attitude and awareness, local governance, infrastructural capacity, dominance of the informal sector and so on.

5. Discussion

Significant differences exist in consumers' E-waste disposal behaviour and awareness across diverse countries. Understanding these dynamic and locale specific characteristics are fundamental in improving any E-waste management initiative. Nevertheless, considering the involvement of a large number of stakeholders (in the form of manufacturers, retailers, consumers, scrap dealers, recyclers etc) in the entire E-waste management process, an appropriate analysis of consumers' disposal behaviour and associated awareness is rather exigent.

5.1. Waste vs. valuables

Unlike developed countries, where products once discarded are considered 'waste' having no intrinsic value, 'waste' is considered valuable in developing countries. People in India, for instance, are reluctant to discard their obsolete electronics immediately without any financial incentive as E-waste is still considered a worthy commodity. Here electronic products often find different users before finally getting disposed off. It could be viewed on a positive light from environmental and health risk prospective as it delays the entry of E-waste into the toxic waste stream and contributes to waste minimization. The door-to-door scrap collection, where consumers are paid a decent price for their obsolete electronics, is a common practice in India. This leads to the growth of a large informal sector in the country where 95% of E-waste generated is taken care of (Chatterjee, 2012). On the contrary, considering their population size, the per capita E-waste generation is large in developed countries as compared to its developing counterparts (See Fig. 3). It says a lot about the disposable approach or culture of the people in some throwaway societies. Thus, the E-waste is observed differently in different countries, which in turn, are instrumental in shaping consumers' disposal behaviour.

5.2. Financing the E-waste management initiatives: the payment models

Not only between the developed and developing countries alone, variations concerning E-waste management initiatives are ubiquitous within the developed countries or within the developing countries as well. One such variation involves the allocation of responsibility to finance E-waste management programs. Currently, there are two main financial models adopted for E-waste management around the world: 'consumers pay' and 'manufacturers/producers pay' (Chi et al., 2014). EPR is widely practiced in developed countries such as Japan, Korea and EU member countries. However, ECR is extensively exercised in another set of developed countries such as the US and Canada where legislations around E-waste place financial responsibility for waste management chiefly on consumers and not on producers. Nevertheless, these two models have the potential to overlap with each other. In Switzerland, for instance, ARF is charged on all new appliances in order to finance the collection and recycling of E-waste. Therefore, although the Swiss system of E-waste management largely depends on EPR, consumers still pay the ARF. Further research in this area needs to be undertaken in order to establish or delineate these two payment models. Contrary to these two models, scrap dealers or 'kawariwalas' largely pay consumers a positive price for their obsolete electronics in countries such as India and China. This acts as an incentive to the consumers' to sell their discarded electronics to the scrap dealers and earn some financial profit. Such diversities in financing E-waste management initiatives by respective countries depict an interesting picture and calls for adequate addressing by the research community to identify appropriate policy for different countries.

5.3. The omnipresent ambivalence

Our analysis shows an omnipresent ambivalence towards sustainable management of E-waste across the globe. For instance, it

is estimated that 70–75% of obsolete electronic items are stored in countries like the US and India due to uncertainty of how to manage them appropriately. Mexico and India record E-waste being stored up to 8 years and 14 years respectively. The study by Yla-Mella et al. (2015) reveals that high consumer awareness in Finland on E-waste is yet to be translated into responsible recycling behaviour with 55% of respondents have two or more unused mobile phones at homes. Thus, perplexity on E-waste disposal is not confined to the developing nations alone and ubiquitous across countries. In such scenarios, effective implementation of E-waste management policies remains highly uncertain and challenging.

5.4. Factors influencing E-Waste disposal behaviour and awareness

One of the primary reasons behind the inadequate collection responses of E-waste by local governments is the lack of public awareness about the significance of proper E-waste disposal. The recycling attitudes of consumers are influenced by socio-cultural-economic conditions, having appropriate knowledge, facilities and opportunities recycle. For instance, Switzerland is considered a model for successful implementation of EPR regime and a sustainable E-waste management case. Despite undertaking similar initiatives, Spain records that 67.1% of its consumers dispose of their electrical and electronic toys together with other waste portions in domestic wastebins. In Spain, the per capita collection rate of E-waste is also far lower than its several European counterparts. Thus, consumers' awareness and access/opportunity to recycle determine their recycling behaviour (Baxter and Gram-Hanssen, 2016), which in turn, can be a challenging endeavour considering the time/efforts required and consumers' often prevalent out-of-sight-out-of-mind attitude (Mozo-Reyes et al., 2016). While some developing countries are engaged in extracting maximum financial benefits from their obsolete electronics, consumers in Thailand, Brazil and Mexico prefer 'donation' is a preferable mean to dispose their E-waste. Thus, consumers' behaviour is dynamic across countries and influenced by factors such as ideology of consumers, familiarity/convenience of recycling activities, age, gender, income and education among others. High educational level emerges to be currently the most significant factor in raising the potential of a household's willingness to pay for E-waste treatment in Baoding, China. Nigerian experience indicates that consumers with higher income are more likely to participate voluntarily in recycling programs. However, participants displayed same level of awareness of the adverse environmental and health impacts of the current E-waste management practices in Ghana irrespective of age, occupation or level of education attained. Although a study in Ghana indicates that male students are more environmentally aware than their female colleagues, some scholars concluded no meaningful relationships between environmental attitudes and gender. 'Convenience' (mainly in terms of distance) and 'familiarity' with recycling are important factors shaping consumers' behaviour in the US. Therefore, one pertinent option to boost consumers' recycling attitude is to increase the number of E-waste collection centres at close intervals. There is an ideological aspect involved with E-waste disposal too. While most European or North American consumers believe that they are mitigating environmental degradation by engaging in recycling activities, such an attitude is predominantly absent in countries like India or China. In these developing countries financial attributions largely determine consumers' E-waste disposal attitude. This makes E-waste management initiatives especially challenging for the developing world. Fig. 4 shows various economic, socio-cultural and infrastructural factors accountable for responsible E-waste disposal behaviour.

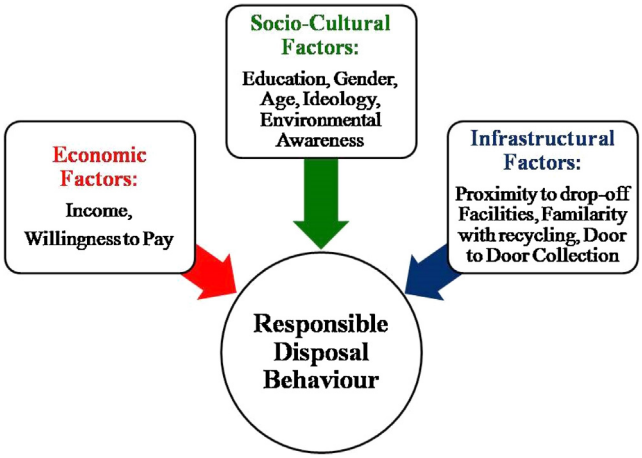

Fig. 4. Factors Affecting Consumers' E-waste Disposal Behaviour.

6. Conclusions and policy implications

In this review on consumers' E-waste disposal behaviour and awareness worldwide with special focus on India, we attempted to provide a comprehensive overview on the current global E-waste scenarios. It emerges that consumers' disposal behaviour and awareness are central to any successful E-waste management interventions without which no reuse/recycling efforts would be fully functional and satisfactory, no pollution abatement initiatives would be entirely successful, no policy instruments could be satisfactorily implemented, no detrimental health/environmental consequences of E-waste could be addressed sufficiently and chaotic dubious E-waste management processes would progress towards an erratic fate. Therefore, it is important to take into account the diverse global experiences and attempt to develop inclusive agendas to address the E-waste crisis of a particular country effectively. India's E-waste dilemma, for instance, has its own specific characteristics. The diverse socio-cultural, economic, political, technological, infrastructural and environmental considerations among its citizens pose serious challenges in formulating one, widely accepted and explicit E-waste management strategy. It is not at all possible to effectively imitate and reproduce a foreign country's E-waste management experience and implement it in Indian context. Nevertheless, India can learn from the individual country's E-waste experiences and formulate a comprehensive plan for sustainable E-waste management. For instance, learning from the US's experience and taking advantages of Indian consumers' 'familiarity' with recycling (the country has a long history of practicing recycling of glass, paper, metal, plastics etc), establishing E-waste drop-off centres at regular intervals for better 'convenience' has the potential to ensure responsible disposal behaviour. Further, a minimum ARF for new EEEs may be introduced in India based on the existing socio-economic status of the country. Paying an ARF in turn will encourage the producers to exercise EPR in the country. Learning from the Chinese experience where the laws on E-waste are increasingly executed stricter, it is important for India to stringently implement its existing E-waste (Management) Rules, 2016.

Consumers' E-waste disposal behaviour and awareness are dynamic across countries. Considering the complexity of the current global E-waste crisis, we propose that further research in this area in both developed and developing countries are essential in order to address the existing E-waste management problem in an adequate detail.

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