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PERCEPTION, ATTITUDE AND KNOWLEDGE ON E-WASTE MANAGEMENT:A STUDY AMONG RECYCLERS IN TAMIL NADU

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ABSTRACT

e-Waste means waste electrical and electronic equipments, whole or in part that are not fit for their original intended use and are destined for refurbishment, dismantling, recycling or disposal, it also includes scrap rejects from the manufacturing process of electrical and electronic equipments. E-Waste recycling is the process of recycling worn-out electronic and electrical equipment into new and useful products. If handled cautiously, E-Waste recycling helps in keeping our environment green. The Informal Sector plays a major role in collection and segregation. Recyclers may also facilitate collection and transportation to recycling facility from bulk consumers and other collection agencies. Hence, it is a felt need to conduct an empirical study on the perception, attitude and knowledge of recyclers on e-waste management and present article is an outcome of one such modest attempt done in Tamil Nadu.

INTRODUCTION

One amongst the world's largest and growing manufacturing industry is electrical and electronic industry. Discarded electronic and electrical equipment with all of their peripherals at the end of life is termed as e-waste. Solid waste management, which is already a mammoth task in India, is becoming more complicated by the invasion of e-waste. E-waste consists of ferrous and nonferrous metals, plastic, glass, ceramics, rubber etc. E-waste is valuable source for secondary raw material but harmful if treated and discarded improperly as it contains many toxic components such as lead, cadmium, mercury, polychlorinated biphenyl etc. The presence of lead, mercury, arsenic, cadmium, selenium and hexavalent chromium and flame retardants beyond threshold quantities in e-waste classifies them as hazardous wastes.

The mammoth generation of e-waste has created a new e-waste stream in the country containing obsolete, end of life electrical and electronics equipments

discarded (EEE) after their intended use.The major impediment in management of e-waste is about collection of such waste and unauthorized recyclers in informal sector. Current e-waste management practices in India are beset with numerous weaknesses, such as the difficulty in inventorisation of generated e-waste, unhealthy conditions of informal recycling, inadequate capacities, lack of information among generators of e-waste. Only 3% of total E-waste generated is recycled properly in India. The rest of it is handled by workers who work with bare hands, without masks under unhygienic conditions, informally recycling tons of e-waste for about 12-14 hours a day.The situation is alarming as India generates about 2 lakh tones of e-waste annually and almost all of it finds its way into the informal sector as there is no organized alternative available at present. It is true that the e-waste spectrum is broad, but IT companies are the single largest contributors to the growing mountains of it. This is because one-third of their equipments are rendered obsolete every year. Reason being is that the life cycle of some electronic goods as short as about 15-20 months.

CONCEPTUALISING e-WASTE

Electronic waste (e-waste) or Waste Electrical and Electronic Equipment (WEEE) comprises of a wide range of electronic appliances such as refrigerators, air-conditioners, stereo systems, computers, cell phones discarded by their users. However, e-waste has been defined as “any electronic and electrical equipment that has lost value to its owner” and has become obsolete for any functioning. Innovations in the technological sector take place at a very high rate and it also translates into fast technological obsolesce. This leads to an alarming rate of the production of e-waste. This gives rise to both waste management issues and also throws up business opportunity for general public.

In fact, e-waste include metals to the tune of approximately 60 percent like iron, copper, aluminum, gold; and plastic material accounts for about 30 percent and the hazardous pollutants about 10 percent of the total e-waste. The global level estimates report that 50 million tons of e-wastes are produced annually leading to a growing tsunami of e-waste pollution. Further, electronic industry is the world’s largest innovative industry and tons of electronic items are produced annually, however, after their usage, they soon become a complex waste matter.

The e-waste consists of 1000 different substances that can be categorized into hazardous and non-hazardous categories. This includes many hazardous heavy

metals, acids, toxic chemicals and non-degradable plastics consequently creating serious environmental problems. Much of it is dumped, burnt or exported to recycler which produces smoke and dust particle containing carcinogens and other hazardous chemicals leading to severe inflammations and lesions including many respiratory and skin diseases. Moreover, these electronic circuits are burnt to extract the valuable metals such as gold, platinum, cadmium. In addition, the wire coat of the electronic product consists of PVC and PCB, producessmoke, and carbon particles which are highly carcinogenic and may lead to severe lung, skin and other health diseases

REVIEW OF LITERATURE

Maphosa and Maphosa (2022) have highlighted that in most developing countries e-waste management is not considered as a serious problem therefore no formal or separate facilities are not arranged to take-back the obsolete E & E equipments and indeed e-wastes are treated informally as equivalent to municipal wastes. The workforce involved in handling e-wastes are with lack of awareness on the hazardous of improper handling of it and seldom provided of safety amenities.

It was argued by Anwesha Borthakur (2022) that while designing e-waste policies in countries like India an integration between the actors – government, producers, consumers, policy advocates, inclusion of informal section in policy making, more clarification on the provisions included in the existing e-waste policies, sharing of unambiguous data on e-waste collection, coordination between both – formal and informal – sectors involved in e-waste management, and periodical sensitization programmes for the public needs to be adopted and implemented.

Mohamed Ali and Selva (2022) have emphasized that recycling of EEE especially the metals irrespective of precious and non-precious is the safe method in eWM which in turn has to be fully supported by EPR. Further, it was put forth by the authors that instead of punishing informal recyclers who involved in violations incentive schemes for adoption of appropriate means in handling e-wastes and providing training for collection, handling and recycling as well, achieving public, bulk consumer, and producers' cooperation also can solve the issues in eWM in India.

It was pointed out by Lynda et al (2021) that most of the studies on e-wastes conducted in Australia, India, China, Malaysia, and Indonesia have concentrated on

E&E equipment modeling and estimation on the generation of e-wastes, legal aspects of e-wastes and its effective implementation, inflow analysis, recovery potential, best practices of management, EPR, recycling, justifying means and management systems, and social, environment, and health impacts and have emphasized for an unified system to address the issues upturned in e-waste management.

NEED FOR THE STUDY

India now a BRICS economy is growing at a faster rate, and in the last two decades, the demand for electronic products has increased exponentially. Moreover, the Indian electronics industry is one of the fastest growing industry, and as a result, the life span of electronic products is very short. India, contributed 2MT of e-waste 2016 but the irony is that 90 percent of e-waste is managed by the informal sector by using unscientific methods that cause harm not only to the environment but also to the human health. All the collection centers, dismantling units and recycling units are also supposed to register with State Pollution Control Boards and comply with their norms also. Moreover, the e-waste collection centers are supposed to maintain a record of the e-waste collected, dismantled and sent to the recycler but unfortunately 90 percent of electronic waste in India is still managed by informal sector. The Central Pollution Control Board (CPCB) reports that the maximum e-waste generation in India comes from ten states, which are Maharashtra, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab. Therefore, it is a felt need to conduct an empirical study to evaluate the present status of e-waste management and hence the present study is one such attempt to evaluate e-waste management practices adopted by recyclers with special reference to Tamil Nadu.

OBJECTIVES OF THE STUDY

The present evaluative study on e-waste management among recyclers in Tamil Nadu was carried out with the following objectives:

- To elicit the recyclers' perception and attitude on e-waste management;
- To explain recyclers' awareness on e-waste management rules;
- To understand the e-waste handling behaviour of recyclers;
- To suggest ways and means to manage e-waste to influence management policies.

METHODOLOGY

To achieve the objectives of the present study narrative research design was used. The required primary data were obtained through field survey from a total of 10recyclers who were selected randomly by using a structured questionnaire**.** The collected data are processed properly for discussion and interpreted by applying descriptive means of analysis. To support the discussion diagrams are also prepared and presented wherever the data necessitates. The findings achieved through data analysis are presented hereunder in summary form along with important findings.

SUMMARY AND FINDINGS OF THE STUDY

Profile of Recyclers: A total of 10 recyclers have been selected for the present study in which an equal (30.0%) per cent of them involved in collection and dismantling of e-wastes, each respectively while the remaining are associated with metal recovery (20.0%), trading/sales & purchase (10.0%), and refurbishing (10.0%) of e-wastes. Half (50.0%) of the total recyclers are in e-wastes recycling business for 6-10 years while another two-fifth (40.0%) are for five years whereas the remaining 10.0% are for more than a decade. Two-fifth (40.0%) of the recycling units are operating in 100-150^2 yards while the remaining recyclers having 150 – 200^2, 150 – 200^2, and 25 – 50^2 yards operating space and their percentage in the total is 20.0%, each. As far as the maintenance of EW documents for verification and compliance of collection targets is concerned only 30.0% of the total recyclers have maintained while the remaining large majority (70.0%) are not.

Documents Maintained for Verification and Compliance of Collection Targets: While no recyclers maintain weigh bridge receipt and pictures of the vehicle showing their registration number as proof of transportation of e-waste (100.0%), and E-bay Bill (100.0%) it is 66.7% each with respect to copy of destruction certificate issued to producers, Form-6: E-Waste Manifest (Pink copy), Form-2 for maintaining records of E-Waste handled, dismantled and recycled, details of different items (Category wise) after segregation, transaction details of funds as proof that dismantled e-waste, authorisation certificate in original, consent to operate in original, and Authorization under Hazardous and other Wastes; however, it is noteworthy to note that all (100.0%) the recyclers have pass book in original.

Challenges in Handling e-Wastes: Due to lack of technical support, practice of hiring labour / vehicle as per requirement, being with the attitude that to create later if it is mandatory, difficulties in separation of WEEE and in maintenance of article-wise documents, and many of the waste EEE needs formal authrorisation the recyclers are not able to maintain w-waste documents. It is found through the present study majority (70.0%) of the recyclers did not obtain consent to establish (CTE) and consent to operate (CTO); only 30.0% in the total have obtained both CTE and CTO.

Profile of Workforce Involved in Recycling: Collection, dismantling, segregation, category-wise pooling, reassembling, refurbishing, and cleaning are the most common work pattern in e-waste recycling and of which females are engaged in cleaning, category-wise pooling, and segregation while few in collection of e-wastes similarly transgender in collection and category-wise pooling. It is to be noted that invariably all recycling units have engaged less than 20 workers. Table 1 reveals the gender-wise work pattern prevailed in recycling of e-wastes.

Table – 1:Gender-wise Work Pattern in Recycling of E-Wastes

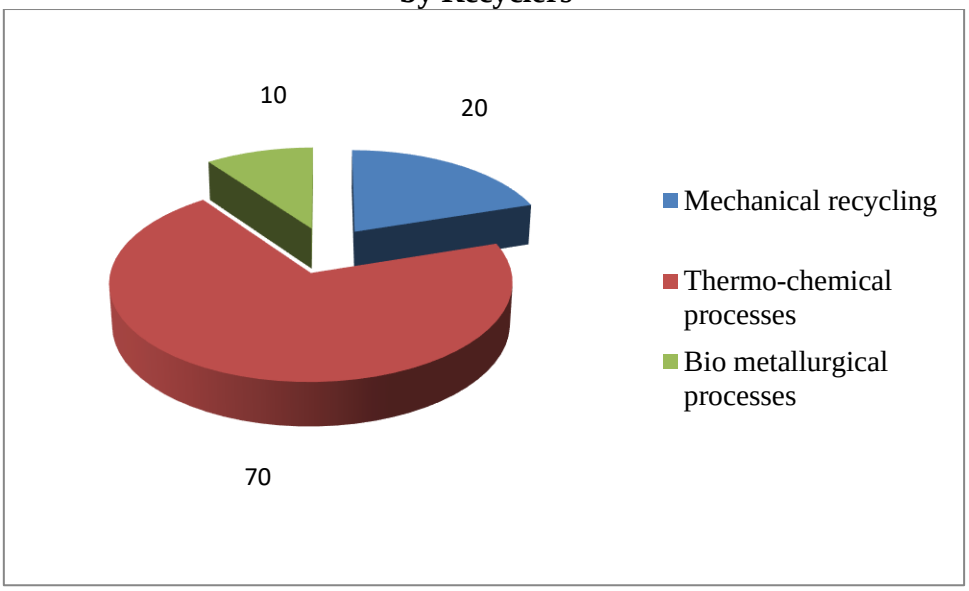
Work Pattern	Gender Pattern (N = 10)						Grand Total
	Male		Female		Transgender		
	Yes	No	Yes	No	Yes	No	
Collection	7 (70.0)	--	2 (20.0)	--	1 (10.0)	--	**10 (100.0)**
Dismantling	10 (100.0)	--	--	--	--	--	**10 (100.0)**
Segregation	4 (40.0)		6 (60.0)	--	--	--	**10 (100.0)**
Category-wise pooling	3 (30.0)	--	6 (60.0)	--	1 (10.0)	--	**10 (100.0)**
Reassembling	10 (100.0)	--	--	--	--	--	**10 (100.0)**
Refurbishing	10 (100.0)	--	--	--	--	--	**10 (100.0)**
Cleaning	2 (20.0)	--	8 (80.0)	--	--	--	**10 (100.0)**

All (100.0%) the recyclers engaged in metal recovery and recycling and two-third (66.7%) of the dismantling only using occupational safety guards (OHG) whereas none of the recyclers engaged collection, trading/sale-purchase, and refurbishing use OHG. Using gloves and apron are common among the workers engaged in e-waste recycling while mask, eye glass, shoes, and helmet is provided to

very few of them. As stated by the employers, it is the responsibility of the workers to bring by themselves, workers' disinterest to deduct the cost for OHG from their wage, and poor maintenance by the workers, and to off-load owners' burden the workers are not provided of OHG. Despite of the reasons mentioned above a significant proportion of the recyclers have made provision for providing mast, helmet, gloves, eye class whereas apron, shoes are by very few of them.

Categories of e-Wastes Handled: It is found that all the recyclers have dealt with categories like TV, computers, printers & their parts, Mobiles, Electrical motors, transformers & other parts, AC, refrigerators, washing machines & their parts, CFLs, Cables & wires, Solar panels, batteries, and whatever they consider as waste EEE. Both informal dealers and individual consumers are the prime sources for majority of the recyclers while industries and bulk consumers to a significant proportion whereas formal dealers and thrown away materials are the source to few recyclers. Burning is the most preferred mode of operation for handling of particular kinds of waste EEE while acidic and manual is preferred by a significant proportion of the total recyclers. As far the technique adopted in the metal recovery from e-waste (MREW) is concerned a large majority of the recyclers have adopted thermo-chemical processes (70.0%) followed by mechanical recycling (20.0%), and metallurgical processes (10.0%). Figure 1 portrays the technique adopted in the metal recovery from e-waste (MREW) by recyclers included in the present study.

Figure – 1:Technique Adopted in the Metal Recovery from e-Waste (MREW) by Recyclers



Process of Recycling: Only a small proportion (30.0%) of the total recyclers adhering step-by-step process –collecting and transporting, shredding and sorting,

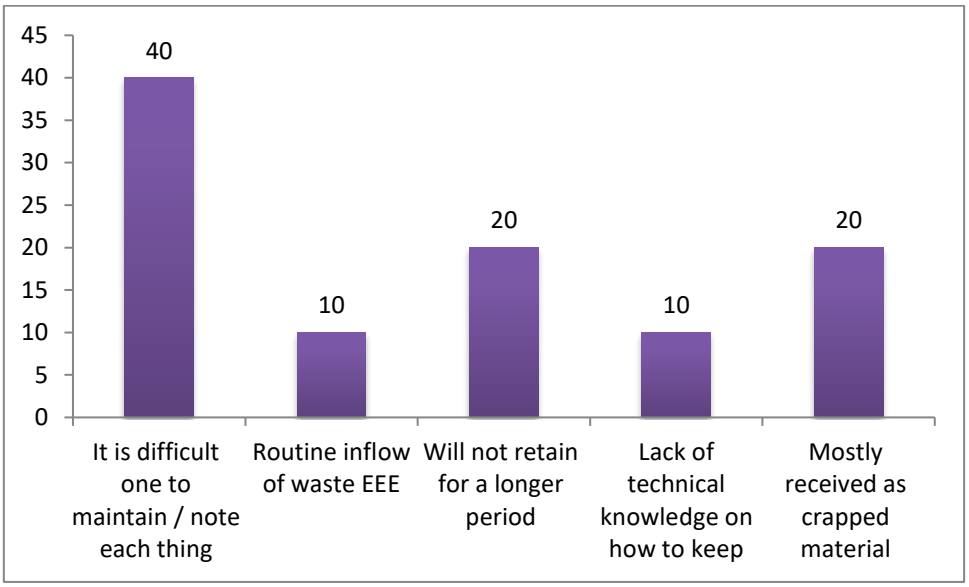
dust extraction, magnetic separation, water separation, purification of waste stream, and preparing recycled materials for sale – while the remaining large majority (70.0%) are not. The grouping of recyclers according to the output they made shows that three-fifth (60.0%) of the total recyclers' output is less than a ton, per day/week while more than 2 ton, per day/week output is by the majority 60.0% in the total. Indeed, the category-wise e-waste output is ranged from a day to week. Half (50.0) of the total recyclers have only one unit for the entire e-waste recycling operations while another 20.0% have two units and the remaining 30.0% have three units.

While all (100.0) recyclers are aware of that there is change in the quantity of material flow after 2016 90.0% and 70.0% of the recyclers have stated that no shifting of their units to other place after the enactment of E-waste (Management & Handling) Rules, 2016 since they are not aware of the E-waste (Management & Handling) Rules, 2016, respectively.

Three-fifth (60.0%) of the total recyclers have an intention to recover copper, followed by aluminium (30.0%), ferrous metals (20.0%), gold, and silver (10.0%), while 30.0% attempt to recover all the above mentioned metals. It is found that the recyclers' preference to approach with the recovered metal is scrap metal merchant (80.0%) specialist waste disposal companies (40.0%), smelter (30.0%), and manufacturers (20.0%) and however, to a huge majority of them the price availed is the prime concern. It is to be noted that nearly three-fourth (70.0%) of the recyclers have overtly accepted that they are exposing health hazards like reproductive issues, skin ailments, asthmatic bronchitis, muscle weakness, damage to the nervous system, while dealing with e-wastes.

Adherence of Best Practices in Recycling: While probing the best practices adhered by recyclers in e-waste management it is found that none (100.0%) of the recyclers maintain a record (Form 2) of e-waste collected, dismantled, and recycled, and do not file e-waste annual returns on time in every year whereas only 20.0% aware of the disposal of hazardous wastes like toxic substances, mercury, lead, and cadmium and ensuring proper dispose of the residue generated during recycling process, each respectively whereas 50.0% of the recyclers collect/accept waste EEE or components which are not listed in Schedule I. Figure 2 reveals the reason for non-maintenance & submission of Form 2, as stated by the recyclers.

Figure – 2: Reason for Non-Maintenance & Submission of Form 2



Only 30.0% of the total recyclers have an interaction with EEE manufacturers with the intention to share information about the collected craps. It is the responsibility of the producers to deal with e-waste in India and globally as perceived by majority (50.0%) of the recyclers while consumers, law makers, and collectively is stated by the remaining 50.0% in the total. The practical difficulties in maintaining the details of each thing, short duration of retaining the material, crapped nature of the material, lack of technical knowledge on how to keep, and routine inflow of waste EEE are the important reasons as stated by the recyclers for non-maintenance & Submission of Form 2.

SUGGESTIONS TO MANAGE E-WASTES

Handover of e-wastes directly to e-waste collectors, avoiding the practice of throw away of e-wastes on streets or other public spheres/places, not using domestic waste pins to dump e-wastes, change in the attitude of getting money while discarding each and every WEEE, and developing concern towards society while throw away WEEE were suggested by recyclers to manage e-wastes effectively in our country. Fixation of standardised and uniform rate to each category throughout the country, providing separate space for e-WM in all industrial estates, simplifying the procedures for operating / handling of e-waste ventures, providing training of advanced dismantling techniques, taking effort for the development of simplified means of dismantling, and making available of the materials / tools required for dismantling and recycling of WEEE at SPCB / CPCB at affordable cost were

suggested by the recyclers included in the present towards further streamlining and strengthening of e-WM practices.

FURTHER RESEARCH

It is to be noted that the present study is an attempt to elicit the recyclers'' perception, attitude and awareness in relation to e-waste management. A comparative study can be conducted on all dimensions of e-waste management practice by having update e-WM Act/Rulesat regional level, if possible covering all the districts of the State in order to bring out the difficulties in existing e-WM practices and hence solutions can be provided to solve them. Similarly, inter-state level studies also can be planned and conducted in future. Here, the attempts were made by the researcher to test the significance of selected socio-economic and demographic variables. Therefore, a macro level study can be planned both to include and test all the possible independent variables' influence on the level of awareness, perception and attitude on e-waste management by including all the sections of the society.

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