JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A Detailed Study On E-Waste Management In Bangalore City

Ashfia Fathima S[1], Umesh M V[2], Krishna Rubigha[3]

[1]Masters in Technology, Technology Management, Kumaruguru College of Technology
[2]Assistant Professor, Department of E&I, Kumaruguru College of Technology
[3]Sustainability Consultant, Ampere Voltage Consulting Pvt. Ltd.

Abstract : A significant difficulty is quickly emerging in the effective handling of electronic trash (E-Waste). Beyond grave health concerns, if it is ignored, it will have a terrible effect on the ecosystem. The handling of e-waste in Bangalore is discussed in this study in detail. Focus groups, participant observations and extensive fieldwork serve as its foundation. The report also details how formal and informal institutions are managed, as well as the bad habits that have harmed public health and urban ecology and the regulations for better e-waste management. Based on factors including the city of Bangalore's (India) rapidly expanding waste stream, resource waste, the presence of hazardous materials, and the city's low recycling rate, the management and recycling of E-waste have been evaluated. The project intends to increase understanding of the collection, flow, and recycling of e-waste as well as to minimise the harmful consequences of poor e-waste management on the environment and public health. E-waste has been succinctly characterised by numerous researchers, writers, government agencies, and international organisations. It offers clearer explanations and insights on e-waste. In order to help readers better comprehend the idea of e-waste, several definitions are presented in this study. Bangalore in the State of Karnataka has been chosen as the target demographic for this study. The present study primarily focuses on the effects of e-waste on human health and the environment, as well as the institutions and current laws that support e-waste treatment. This study also highlighted the effects of e-waste on people, while also educating businesses about these issues and soliciting public input on how to properly dispose of e-waste in Bangalore and other Karnataka cities.

IndexTerms **- E-waste, informal and formal sector, health hazard, regulations, management, Bangalore.**

I. NTRODUCTION

One of the waste sources with the fastest global growth is e-waste. According to Greenpeace, a global environmental organisation, the global disposal of electronic items has increased over the past few years, with 20 to 50 million tonnes produced annually. Despite the lack of a consensus definition, the word "e-waste" is the one that is most frequently used to refer to electronic garbage globally. One of the biggest issues in the globe, especially in urban areas, is managing the enormous amount of E-Waste that is produced. E-Garbage draws the informal and disorganised sectors involved in waste disposal due to the existence of valuable and recyclable components. The way they dispose of their electronic waste poses serious risks to both human health and the environment.The production of e-waste reached 53.6 million metric tonnes (Mt) in 2019 and is expected to increase to 74 Mt by 2030. E-waste is primarily produced in developed nations like the USA, Europe, and Australia. Due to the simple accessibility of open area for dumping and the low cost of labour for recycling reasons, these E-wastes are subsequently transferred to developing nations like India, China, Ghana, Pakistan, Nepal, Bhutan, and Vietnam. Most e-waste in underdeveloped nations is handled incorrectly using informal recycling techniques, sometimes known as "backyard recycling" or "informal recycling," while e-waste from large corporations and the government is professionally collected and processed by formal recyclers. The formal recycling industry follows regulations and laws while handling e-waste, but the unofficial industry is not aware of scientific procedures and disobeys regulations and laws. In Germany, for example, only 17.4% of all e-waste is recycled in a formal setting; the remainder is undocumented and is therefore either discarded, exchanged, held, or recycled at a lesser grade. The informal sector provides employment for e-waste workers, but doing so exposes them to serious health risks. Because a significant amount of E-waste is handled improperly by a population of ignorant individuals in the informal sector, new legislation and recycling facilities have been suggested for effective treatment. Facilities and transportation have virtually stopped operating during the COVID-19 period . As a result, all aspects of the E-waste chain, including collection and transportation, have been negatively impacted. For instance, the amount and frequency of E-waste collection were impacted, as were worker availability and safety, and there was an increase in layoffs.Therefore, there is an urgent need to address the problem of managing E-Waste, particularly in developing countries. The IT industry concentration in developing nations and the emergence of the middle class in nations like China and India are just the beginnings of this process. 65 cities in India account for more than 60% of all E-Waste production. Mumbai is first among the top 10 cities that produce e-waste, followed by Delhi, Bangalore, Chennai, Kolkota, Ahmedabad, Hyderabad, Pune, Surat, and Nagpur.

II. LITERATURE SURVEY

The growing danger of global warming is a result of consumer-oriented growth, rapid product obsolescence, and technical advancements."ElectronicsWaste" or "E-waste" made up of outdated electronic devices electronic gadgets. The complicated combination of Ag, As valuable metals, AU, Pb, and Pt; Cu, Al, Ni, Si, Zn, and Hg, Be, Cd, Cr (VI), As, Sb, and Bi as base metals; Fe as metals that should be avoided due to their toxicity as well as combustibles and halogens (plastics, flame retardants) of which many are harmful (Hagelüken 2006). Due to the toxic materials they contain, e-waste has been a significant challenge for the government and the general people. (Cui 2003). E-waste should be treated in a hierarchy that prioritizes reuse of the entire piece of equipment, remanufacturing, and upgrading, followed by material recovery through recycling, and as a last resort, disposal through cremation and land filling. Landfilling E-waste, however, may cause lead to leak into the groundwater. When the CRT is broken and burned, poisonous gases are released into the atmosphere. (Ramachandra 2004).

All electronic devices have printed circuit boards, which are dangerous because to the lead (in solder), brominated flame retardants (which are normally present in amounts of 5 to 10 percent by weight), and antimony oxide (which is also used as a flame retardant) that they contain (typically 1-2 percent by weight) (Devi 2004). Recycling electronic waste takes care of waste treatment and valuable material recovery, thus it is relevant from an ecological and financial standpoint. Due to their chemical stability and strong conduction qualities, precious metals recovered from e-waste are used extensively in the production of electronic appliances as contact materials. Analyzing the socioeconomic and environmental effects of e-waste reveals a range of advantages and disadvantages. (Alastair 2004).

(Shelton, 2015) sought to better understand electronic garbage (E-waste) and its impact on health and the environment globally, identifying the need for change and offering an alternative to the current subpar disposal practices. The ability to consider the effects of inadequate recycling efforts has been made possible by conducting study on E-waste. The amount of pollution will rise if global reform is not made. More dumping of chemicals and dangerous materials will harm the ecosystem. Options for bridging the gap between the formal and informal divides in E-waste management in India were offered by (L Raghupathy, 2013). These possibilities are being developed, put into practise, and evaluated as part of numerous studies and projects with funding from India, Europe, and bilateral agreements that concentrate on Delhi, Bangalore, Pune, and Kolkata. The investigation's findings indicate that higher order recycling operations may be centred in the formal sector, whereas non-hazardous E-waste fractions should be collected, separated, and dismantled primarily in the informal sector. They provide additional examples of the model's components using different Indian initiatives.

(Saha 2014) method was used to evaluate the state of E-waste management both globally and in India while taking into account the current legislation and standards. It is also a truth that a sizable portion of the recycling of e-waste is handled by the unofficial sector, which has little to no awareness of the effects of exposure to dangerous compounds. The idea of EPR (extended producer responsibility) will be useful if the legislation include monitoring and penalty clauses to address the problem of managing e-waste in a sustainable way. The difficulties in managing E-waste in India have been identified by (Dey 2014). It also outlines a few recent attempts that were undertaken to resolve the difficulties and identifies a few issues. A quick word about the conclusions: The pilot survey found that scrap was the primary source of e-waste.In order to make the E-waste management business lucrative, (Chatterjee 2009) developed an outsourcing model where equal involvement of the formal and non-formal sector is ensured. Non-formal operators' primary driving force is to remove precious metals (gold, silver) from printed circuit boards (PCB) using illogical, unclean procedures that are bad for the environment, the employees, and the workers' health.According to (Victor S P 2011), the expansion of the electronics industry and the rapid advancement of technology have led to an increase in consumer production of trash electrical and electronic equipment, much of it still in working order. Many people store outdated equipment in their homes or throw it away as typical trash since there is a lack of a cohesive infrastructure for recycling and reuse.

(Okoye A 2014) investigated how well-informed the population was about the law, how they disposed of their electronic waste, and whether they were aware of the risks associated with careless handling and disposal of garbage. Distribution of 247

thoughtfully constructed questionnaires served as the primary method for gathering the study's data. For the analysis of the respondents, the Likert Scale was used. Results showed that awareness is alarmingly low. Despite varying degrees of environmental awareness among the respondents, the bulk of them dispose of their electronic waste with regular trash without considering the consequences. Sensitization campaign's awareness approach was created.

III. E-WASTE

Electronic items nearing the end of their "useful life" are referred to as "e-waste" informally. Electronic products that are often used include computers, televisions, VCRs, stereos, copiers, and fax machines. Many of these items are recyclable, reusable, or may be repaired. Unfortunately, the fastest-growing component of our country's waste stream is electronic garbage.

Due to two main characteristics, e-waste has grown to be a crisis-level issue:

1. E-waste poses a risk: A range of harmful materials are present in the enormous amount of computers, televisions, mobile phones, and other devices that are discarded every year. When electronics are dumped in landfills, or when the waste is incinerated, contaminants and toxic chemicals at an alarming rate are generated and released into the ground or air. Given the enormous amount of e-waste produced annually, the issues that these poisons create multiply exponentially as they gradually contaminate the environment and pose a threat to infiltrate the food chain.
2. How e-waste is produced Due to the extraordinary rates of obsolescence caused by the quickly advancing technology, there is a significantly higher amount of trash produced compared to other consumer goods.

Electronic waste is generated by three major sectors

- Individuals and small businesses
- Large businesses, institutions, and governments
- Original Equipment Manufacturers (OEMs).

3.1Effects of E-Waste

In many places around the world, disposing of e-waste is a specific issue. When computer garbage is dumped, it creates toxic leachates that eventually affect groundwater. When computer chip acids and sludge are dumped on the ground, the earth becomes more acidic. To meet the needs of the population, water is now being shipped from distant towns. The incineration of electronic garbage can release harmful gases and chemicals into the air, contaminating it. Landfills that aren't properly inspected can harm the environment. When some electronic components, such as circuit breakers, are broken, mercury will leak. Similarly, polychlorinated biphenyls (PCBs) from condensers are true. Polybrominated diphenyl ethers (PBDE) and cadmium may both leak into the soil and groundwater when polymers that are either cadmium- or bromine-containing are landfilled. According to research, large amounts of lead ions are dissolved from shattered lead-containing glass, like the cone glass used in cathode ray tubes, when it comes into contact with acidic waters, which is a regular occurrence in landfills. Not only does mercury leaching presents particular issues, but the vaporization of metallic mercury and di-methylene mercury, both of which are found in waste electrical and electronic equipment (WEEE), also raises questions. Furthermore, landfill fires may start uncontrollably, which could happen frequently in many nations. When exposed to fire, metals, and other chemical substances, such as dioxins and furans (TCDD tetrachloro dibenzodioxin, PCDDs-polychlorinated dibenzodioxins), Polybrominated dibenzo-dioxin (PBDDs) and poly chlorinated dibenzo furans (PCDFs) can be released from PCB-containing condensers and halogenated flame retardant products. The open-air burning of plastics to recover copper and other metals is the riskiest method of burning electronic waste. The highly poisonous consequences of open-air burning influence both the local ecosystem and larger global air currents, depositing themselves in numerous locations all over the world..

3.2 Regulation of E-Waste

In response to a number of restrictions, the Ministry of Environment and Forests developed more comprehensive laws, and for the first time, E-Waste management standards were announced. The manufacturers are responsible for recycling and lowering the amount of E-Waste in the nation under the E- Waste(Management and Handling) Rules, 2011. On May 1, 2012, the regulations went into effect. The Environment Protection Act applies to the rules. To maintain segregation at the source, the laws mandate the creation of collection facilities, take-back programmes, equipment handling awareness campaigns, and the use of booklets. Bulk consumers are in charge of recycling E-Waste and transferring it to authorised collection facilities. Records related to the production of E-Waste must be kept and made available to the State Pollution Control Boards. Those records and the recommendations they contain will ultimately be submitted annually to the Central Pollution Control Board and the government.

IV. STUDY AREA AND METHODOLOGY

Bangalore, in southern India, is a major location for the IT industry worldwide. The computer software business in Bangalore began to boom with the liberalisation of the economy in the early 1990s, which also raised need for diverse support resources. Although there were beneficial effects that contributed to tremendous economic growth, there were also negative effects on lifestyles that put enormous strain on the environment and resources (such as energy). Data were gathered for the study from both primary and secondary sources. The Pollution Control Board, NGOs, processing units, and formal entities provided secondary data, while key informants provided the primary data. Through surveys, questionnaires, research papers, municipal reports, and interviews, data was gathered. Bangalore was completely covered and represented in the study. Because they had not kept any records of the amount of garbage they processed, the frequency with which they suffered health issues, etc., the respondents were unable to provide an accurate response. We identified E-Waste dumping sites and the potential influence on the local environment and human health with a view to understanding the impact on urban ecology. Long-term consequences would necessitate a more thorough investigation

V. E-WASTE IN BANGALORE- A CURRENT STUDY

Public e-waste generation has increased in recent years, but Bengaluru's thriving IT industry is escalating the issue and making it more difficult for the government, businesses, and private organisations engaged in recycling to reduce environmental pollution. The Karnataka State Pollution Control Board (KSPCB) estimates that only IT companies in Bengaluru are responsible for the majority of the state's monthly e-waste output, which is roughly a thousand tonnes on average. Only a tiny fraction of this, though, is in the hands of recyclers who have the proper authorization to do so. Instead, a sizable percentage of this e-waste is allegedly being diverted to a vast unregulated recycling industry that utilises acids to extract valuable metals and disassembles electronic devices in random, extractive ways. An important threat to Bangalore's already failing ecology is the rise in e-waste, one of the more recent effects of the IT boom. E-Waste has been accumulating nearly unchecked as one of the most critical management concerns in recent times, despite the general public having little understanding of the severity of the issue. E-Waste needs to be disposed of safely because experts have issued warnings about its potentially negative effects. Bangalore is one of the cities with the highest risk of E-Waste contamination and is home to more than 1,200 international and domestic technology companies. Bangalore City is beginning to choke on the E-Waste produced as IT continues to inundate India's technology capital. The informal sector has been resistant to efforts to persuade it to recycle responsibly. Even after 10 years of e-waste rules enforcement, the formal sector's share is still only 10-15%. This is due, in part, to consumers selling their e-waste to unofficial recyclers for quick cash because it is quicker and easier, as well as a lack of awareness about the dangers of improper e-waste recycling. E-waste auctions held by IT businesses are to blame for the issue. The rule states that IT firms must verify that bidders are permitted recyclers, but in practise, the highest bidders are typically unauthorised dismantlers. There are two types of e-waste: products from the IT sector and general electronic waste, which includes public consumables such as household appliances that have recycling value. At the end of the day, every business is a money-making venture, but the informal sector is primarily concerned with the extraction of precious components and is unconcerned about the environment. Another issue is that the formal recycling sector lacks the capacity to handle these volumes of e-waste

5.1 Generation Of E-Waste

Conversations with Karnataka State Pollution Control Board officials revealed that the amount of E- Waste generated is determined by the obsolescence rate of computers in the IT industries. According to E-Parisara, Bangalore generates 12,000 tonnes per year and India generates 3,30,000 tonnes per year. The secondary market for used computers is worth 40 tonnes per hour. Every year, manufacturers and assemblers generate 1800 tonnes of electronic scrap. IT companies, the public and private sectors, hospitals, factories, commercial establishments, computer retailers, manufacturers, and households are all sources of E-Waste.

5.2 Flow of E-Waste

E-Waste has its own production chain and cannot be treated simply as waste. The nature of the production chain varies from formal to informal sectors. Informal recyclers handle 95 percent of E- Waste (E-Parisaraa 2009, Sinha-Khetriwala 2005). This process is confronted by the dynamics and dilemmas commonly associated with what some researchers refer to as the "informal" economy. Toxic Link, Basel-convention, note that E-Waste has only been classified as hazardous by law in India since 2008.
Two factors are of particular importance. First, there are no scientific landfills, and formal E-Waste treatment plants are relatively new in India.
The informal sector is generally characterized by a lack of social and environmental awareness and responsibility, low wages, a variety of health risks, and is primarily driven by decentralization and outsourcing of production. Thus, informalisation allows large corporations, both domestic and international, to profit from "labour arbitrage" (low wages and avoidance of social security provisions imposed by labour unions or governments) and "regulatory arbitrage" (avoidance of environmental regulation, pollution control etc.). However, when viewed from the bottom up, the interpretation of the informal sector shifts: In developing countries, E-Waste recycling is a lucrative business that employs a large number of people. Thus, the question is whether these people have genuine alternatives to informal recycling, or if they are forced to accept environmental and health risks out of economic necessity. This requires that government intervention in the informal E-Waste sector be carefully planned in order to address both livelihood and environmental issues.
The current dynamics and infrastructure of the E- Waste sector are impediments to such interventions and must be considered: To begin, E-Parisaraa only accepts E-Waste from large corporations due to domestic and international obligations. Formal disposal of E- Waste has recently become mandatory in Karnataka, reducing the flow of E- Waste to the informal sector. However, the law faces some constraints due to the formal sector's capacity to absorb large amounts of E- Waste and the numerous ways to avoid such regulations. You are paid to dispose of E-Waste in India because there is a much larger market for reuse and recycling, and the price offered is higher in the informal sector than in the formal sector.

5.3 Informal E-Waste Recycling

Informal E-Waste recycling occurs in certain pockets of Bangalore that are highly congested and densely populated by minority communities with low income. For example, they pool their investments to purchase E- Waste from companies, process it, and share the profits, or they set up individual businesses by establishing small business enterprises and employing labour to process the E- Waste. The informal recycling process is managed at several levels. Small waste dealers sell some of the waste to the public as secondhand goods, while the remainder is diverted to the open market. Scrap flows from waste dealers to the service industry as parts for the repair and maintenance of old computers. Again, some residuals in the service industry are returned to the open market, whereas the rest is sold to large waste dealers. It is channelled from large waste dealers in three ways: (1) recycling of specific parts, (2) sale of specific waste to specific individuals, and (3) sale of specific parts on the open market. At the other end of the chain, there is a network of dealers operating from major cities such as Mumbai and Delhi via agents, intermediaries,

and company agents. They all approach large dealers to acquire scrap either directly or through the open market. A flow chart in Fig 1and Fig 2 can help you better understand the process. There are only a few formal recycling units (originally six, now 16). The informal recycling industry is unorganised, with small and large-scale dealers doing brisk business in their backyard recycling units where materials such as gold, copper, and other precious metals are recovered using hazardous chemicals and non-scientific processes.

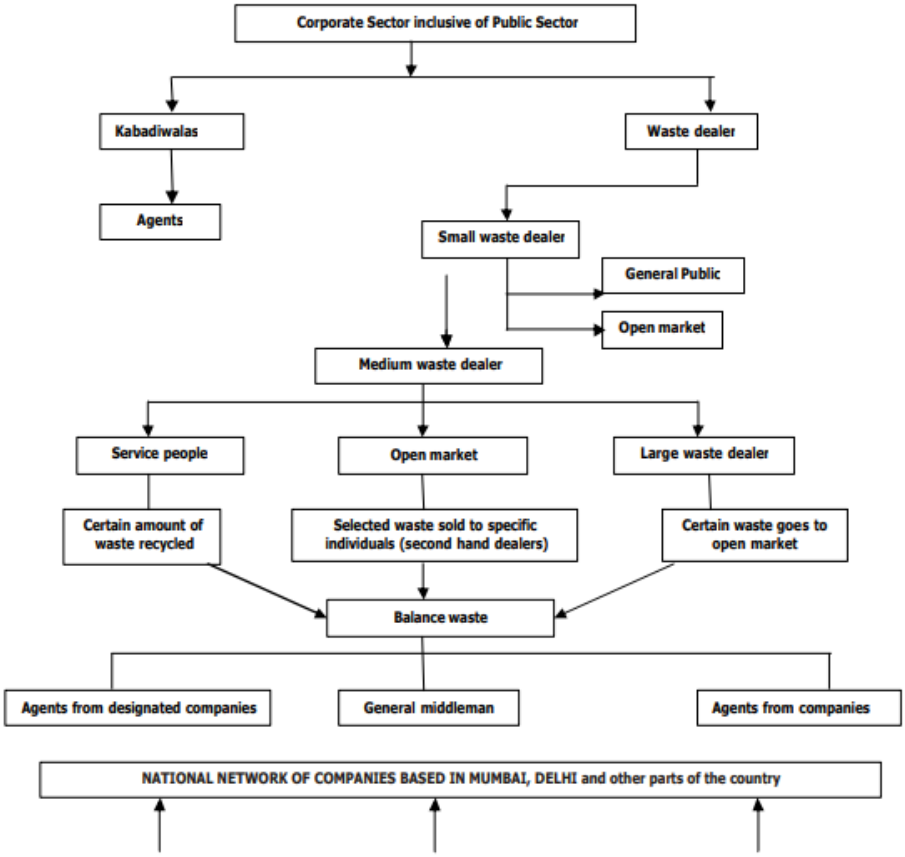

Fig -1: Informal E- Waste recycling process in Bangalore

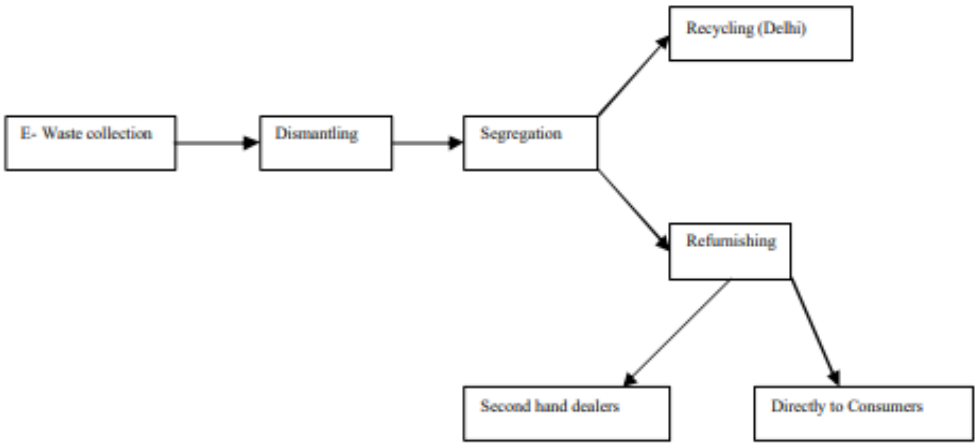

Fig -2: Informal E- Waste recycling process in Bangalore

5.4 Formal E-Waste Recycling

Formal recycling of E- Waste from source to recycling centre and finally to disposal site accounts for less than 5% of total E-Waste generated. Authorized dealers collect E-Waste from corporations for scientific recycling. During the E- Waste collection period, Bangalore had six authorised recycling units. Recycling (Delhi) Dismantling Second hand dealers Directly to consumers at the time of the study, but currently there are 16. The organised recycling companies are equipped to process E- Waste to varying degrees of excellence. However, in order to ensure accountability, formal recycling must be implemented. The processes can always be improved. Apart from processing E- Waste, formal recyclers are also involved in awareness campaigns in collaboration with NGOs and schools. Formal recyclers are required to follow rules and regulations when processing E-Waste, including employee safety.

VI. MANAGEMENT OF E-WASTE

In industries, E-waste management should begin at the point of generation. In industries, waste reduction entails inventory management, production-process modification, volume reduction, and recovery and reuse.

6.1 Inventory Management

Proper material control during the manufacturing process is an important way to reduce waste generation. This can be accomplished in two ways: by establishing material-purchase review and control procedures and by implementing an inventory tracking system. The first step in establishing an inventory management programme is to review procedures for all material purchased. Another inventory management procedure for waste reduction is to order only the necessary quantity of a material.

6.2 Production-process Modification

Waste reduction techniques are classified into three types: improved operating and maintenance procedures, material changes, and process equipment modifications. Improving standard operating procedures can optimise the use of raw materials in the manufacturing process and reduce the possibility of material loss due to leaks and spills. A strict maintenance programme that emphasises preventive maintenance can help to reduce waste caused by equipment failure. Hazardous materials used in product formulation or manufacturing can be replaced with less hazardous or non-hazardous materials. Waste can be significantly reduced by installing more efficient process equipment or modifying existing equipment. New or upgraded equipment can make better use of process materials, resulting in less waste. Tweaking existing process equipment can be a very cost-effective way of reducing waste generation. The amount of wastes can be significantly reduced by limiting the number of parts that must be reworked.

6.3 Volume Reduction

Methodologies which can be used to decrease waste-stream volume can be splitted into two general types: source segregation and waste concentration. Waste segregation is a simple and cost-effective waste reduction technique in many cases. The concentration of a waste stream may increase the possibility of the material being recycled or re-used. A manufacturer of electronic components, for example, can use compaction equipment to reduce the volume of waste cathode ray tubes.

6.4 Recovery and Reuse

Waste can be recovered on-site, at an off-site recovery facility, or through inter - industry return. This method could remove cost of waste disposal, reduce cost of raw materials, and bring in revenue from repairable waste. Reverse osmosis, electrolysis, condensation, electrolytic recovery, filtration, centrifugation, as well as other physical and chemical techniques are available to reclaim waste. Moreover, recycling dangerous substances has little benefit to the environment because it simply transfers the hazards to secondary products, which must eventually be disposed of. Recycling is a poor solution except if the primary objective is to revamp the product to use non-hazardous components.

6.5 Sustainable Product Design

The following factors should be considered when minimizing hazardous waste during the product design stage-

- Reconsider product design
- Use of renewable energy and materials
- Use of less hazardous nonrenewable materials
-

VII. Role of Institutions in Managing E-Waste in Bangalore

The blame game will continue unless the roles and duties for managing E-Waste are clarified. Most people who use electronic trash are ignorant of how it affects our environment and health. According to the industry's consensus, the government should control the junk trade through authorized dealers. Extended Producer Responsibility (EPR), on the other hand, is a more significant issue where producers are required to assume responsibility for the secure disposal of their products. The Central Pollution Control Board (CPCB) is a separate entity that reports to the Ministry of the Environment. The principles and ideas guiding German development strategy are developed by the Federal Ministry for Economic Cooperation and Development. The SECO, which serves as the Swiss Confederation's Competence Center for all fundamental economic policy concerns, launched the Knowledge Partnerships programme in E-Waste in 2003. The EMPA is a neutral, impartial organisation for transdisciplinary research on designing sustainable systems and materials. With the primary goal of preventing the unrestricted dumping of electronic waste in Bangalore, the E- Waste Agency (EWA) was established by IT businesses, NGOs, and the KSPCB. As a unified organisation that represents all the businesses working in the city, the Electronics City Industries' Association (ELCIA) was established in 1992 by the industries situated in Electronics City Bangalore. The primary goal of ELCIA is to organise waste sensitization campaigns in addition to offering an E- waste management system for safe disposal. In order to make organisations from the informal sector authorised recyclers, the EWA is currently training them in eco-friendly treatment of E-waste.

VIII. Results and Discussions

In Bangalore, there is a clear need to explore methods for sustainable handling of e-waste in order to prevent serious dangers to the environment and public health. To better manage the various e-waste generation, collection, transportation, and disposal operations, institutional arrangements should be made. Numerous solutions were presented in numerous studies that we came across, but it is crucial that these options be put into practise.

- **Regulations** - Governments should be in charge of creating appropriate regulations, administrative rules, and laws for the management of hazardous waste. To properly manage and dispose of hazardous wastes and implement E-Waste rules, extensive legislation is necessary. The agencies should be given the authority to oversee, control, and legislate the pertinent operations of government agencies under such a legislation. Included in the details should be toxicity and any possible negative effects. Eliminate or minimize risks associated with the production, processing, distribution, usage, and disposal of electronic waste. Establish programmes to encourage businesses and citizens to recycle, and promote the positive reuse of E-Waste and business activities that use E-Waste.
- **Governance**: All stakeholders should share responsibility for managing e-waste. Any organization, firm, or institution should be required to abide by a set of rules and regulations regarding the disposal of electronic waste. For E-Waste to be disposed of scientifically and affordably, enabling environments that promote cooperation with manufacturers and merchants are crucial. It is important to significantly streamline the infrastructure development process for household E-Waste collection, which has only been undertaken by NGOs. Toxic waste disposal fees from manufacturers and consumers should be subsidized by the recycling and disposal sectors, together with incentive programmes for trash haulers and the general public to collect and turn over E-Waste. Creating and enforcing occupational health and safety standards connected to recycling E-waste are currently mainly reserved for the formal sector. Planning needs to be done for research and development on establishing and standardizing hazardous waste management, environmental monitoring, and the control of hazardous waste-disposal through recurring environmental audits.
- **Raising Understanding** - It's important to encourage participatory governance models in order to raise people's awareness of how present activities affect both the environment and public health. Effectively implementing awareness programmes for the general public and kids on the effects of e-waste is necessary. To detect environmental risks and enable correct management and disposal of E-Waste, labelling should also be made required for all computer monitors, television sets, and other household/industrial electronic devices having hazardous substances. The informal E-Waste processors and the general public have thus far exhibited very low awareness levels, if any at all. To safeguard the environment's and people's health, these measures must be stepped up.
- **Formalizing the Informal Sector**: For many low-income households, processing e-waste provides a means of subsistence. They ought to receive official training in processing E-Waste and be given permission to do so. It should take the least amount of time and follow the simplest processes available to receive such training and authorization. It's crucial to bring them together to develop an action plan with the help of the authorities and businesses. To further minimise the "social necessity" of unauthorised recycling and dumping of E-Waste, suitable alternative sources of income should be developed. Since harbours are one of the primary sources of unauthorised recycling, it is particularly pertinent in this context to conduct a scenario analysis of the difficulties the Customs Department faces in various Indian ports.
- **Reuse**: Reuse is already a reality. However, extending a product's lifespan with the right safeguards could further fortify it. Reusing outdated computers in workplaces and schools is something that many businesses and non-profit organisations have been pushing. Manufacturers like Sony, Panasonic, and Sharp pay specific recyclers to handle the devices that customers purchase at statewide collecting events. To put it briefly, a formal system should be developed to encourage the reuse of electronic waste, with awareness-building as a component of the functioning system.
- **Extended Producer Responsibility (EPR**) is a concept that encourages producers to prevent pollution and consume less energy and resources throughout the life of the product. This covers both downstream effects like product use and disposal as well as upstream effects resulting from material selection and manufacturing processes. Take-back programmes for products must be combined with laws requiring the phase-out of e-toxics.
- **Recycle**: Hazardous product recycling is bad for the environment, human health, and even local communities. Beyond promoting environmentally friendly product designs made of non-hazardous materials, it would be more pertinent in this context to rethink the items.
- **Role of Citizens:** Perhaps more favoured than any other waste management strategy, including recycling, is waste prevention. Electronics donated for reuse have a longer shelf life and are kept out of the waste management system for longer. However, care should be taken to ensure that the donated things are in usable condition. Reuse has social advantages in addition to being an environmentally superior solution. Schools, charities, and low-income families can use technology that they otherwise couldn't buy by giving used devices. Never dispose of electronic wastes in the same trash can as ordinary household rubbish. This needs to be separated on site and sold or donated to different charities. Instead of purchasing new equipment, customers should choose to upgrade existing computers or other electronic devices to the most recent models.

IX. CONCLUSIONS

In conclusion, Bangalore's approach to managing e-waste is still mostly unorganised and in its early phases of development. Given the severity of the issue and the lack of accountability, there are no precise estimates of the amount of E-Waste produced and recycled. However, the study outlined a number of crucial elements of Bangalore's E-Waste management that are anticipated to enrich the body of knowledge and database as well as provide strategies for E-Waste processing. Due to numerous types of pollution, Bangalore's urban environment has been severely hampered. The repercussions could be severe given how quickly E-Waste is becoming a concern. In this study, we have included the improper disposal practises used by informal recyclers in Bangalore, followed by a description of the potential effects of e-waste on the environment. Since it takes more time to comprehend the impact on urban environment, it is impossible to pinpoint the precise evidence without lab testing of soil, water, and air sample. Conversations with responders, however, show that Bangalore is facing major issues with E-Waste disposal if they are not resolved quickly. The conclusions have also raised fresh research questions that are crucial to the management of e-waste. For instance, no research has been done to examine the effect that processing e-waste has on the health of informal workers. Similar to this, there is practically any actual data to support a thorough explanation of how e-waste affects the urban environment. Adoption of primitive recycling techniques without consideration for the environment reflects reality. Roles and duties for controlling e-waste need to be clearly defined because they are now ambiguous. The e-waste disposal methods prevalent in the advanced countries today are heavily dependent on the non-recyclable parts being dumped into the developing

countries. In developing countries, the disposal and recycling systems suffer from an inherent lack of proper regulations and monitoring systems. A sustainable solution for e-waste disposal and recycling systems should consider the interests of all the stakeholders.

REFERENCES

[1]. Alastair, I. "Mapping environmental justice in technology flows: Computer waste impacts in Asia." Glob. Environ. Pol. , 2004: 76-107.
[2]. Chatterjee, Kumar. "Effective electronic waste management and recycling process involving formal and non-formal sectors." International Journal of Physical Sciences. Vol.4(13), 2009: 893-905.
[3]. Cui, J. and E. Forssberg. "Mechanical recycling of waste electric and electronic equipment: a review." J. Hazard. Mater, 2003: 243-263.
[4]. Devi, B.S., S.V. Shobha and R.K. Kambla,. "E-Waste: The hidden harm of technological revolution." J. IAEM, 2004: 196-205.
[5]. Dey, Dipankar. "Managing E-waste in India: Challenges, initiatives and concerns." 2014.
[6]. Hagelüken, C. and S. Art. "Recycling of e-scrap in a global environment-chances and challenges." Indo-European Training Workshop, Bangalore and New Delhi, 2006.
[8]. L, Raghupathy. " E-Waste Recycling In India Bridging the formal and informal sector." 2013: 86-98.
Okoye A, Odoh C. "Assessment of the level of awareness of E- waste management and concern for the environment amongst the populace in Onitsha, Southeastern Nigeria." Journal of Environmental protection. Vol.1(5), 2014: 120-134.
[9]. R, Shelton. "E- waste recycling. Innovation and Empowerment :SNU." Tulsa Research Journal, Volume 3, Issue 1, 2015: 87-91.
[10]. Ramachandra, T.V. and V.K. Saira. "Environmentally sound options for waste management." Environ. J. Hum. Settl, 2004: 2 - 11.
[11]. Saha, Ram Krishna and. " EWaste Management in the UAE." www.wsforum.org, 2014
[12]. Victor S P, Kumar S S, Sanjeeve S. "Chasing The Mirage : The Plc of an Electronic waste." International Journal of Computer Science and applications. Vol 1 Iss 2, 2011.
[13]. EEE Explanatory Notes, EU 1999
[14]. MoEF (2008). Environmentally Guidelines for Sound Management of E- Waste. New Delhi: Ministry of Environment and Forest (MoEF), and Central Pollution Control Board.