Tackling of E-waste for Effective Swachh Bharat

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Abstract: E-waste is going to pose a huge challenge before Swachh Bharat Abhiyan(SBA) in ensuring a clean India due to the rising necessities of the citizens. With e-waste quantity increasing at an exponential rate, this could have devastating effects on the environment and ultimately on the people. This paper studies the various aspects of e-waste problem and makes a case for solving this problem before it assumes dangerous proportions. Here four dimensions of E-waste problem namely Method, Material, Human and Regulatory are enumerated and the problems arising due to them are dealt with. The problems in each dimension are explained and curative as well as preventive steps are proposed to eliminate those problems.

Keywords : *E-waste, Swachh bharat Abhiyan, e-waste disposal, hazardous substances, LED, computer.*

I. INTRODUCTION

Swachh Bharat Abhiyan (SBA) is a flagship campaign of Govt. of India to ensure cleanliness and public hygiene by actively engaging all stakeholders of the society. It aims at promoting effective municipal waste management and total sanitation by 2019. But the one important aspect that SBA does not deal with is the E-waste. As per the CPCB (Central Pollution Control Board, India) Guidelines, 2008, E-waste is defined as 'Waste generated from used electronic devices and household appliances which are not fit for their originally intended use and are destined for recovery, recycling and disposal-waste also known as Waste Electrical & Electronic Equipment, which comprises of computers, phones, TVs, ACs, refrigerators, bulbs, wires etc. is going to pose a huge challenge for SBA in the coming years especially in the face of growing income and aspirations of Indians. According to a UN report, India was the 5th largest E-waste emitter in the world with 1.7 million tons (2014) [1]. By 2020, the usage of computers would have grown 5 times and mobile phone usage by 18 times. This makes it imperative to take preventive and curative steps to deal with the problem of e-waste. This paper deals with the various dimensions that contribute to e-waste and the effects it would have on SBA and ways to tackle them.

II. DIMENSIONS OF E-WASTE AND INTERVENTIONS

A. Methods:

The Environment which SBA seeks to protect stands vulnerable to the hazards from the improper disposal of e-waste. The problem is that just 1.5% of e-waste generated goes to the institutional disposal canters, 8% of e-waste goes to landfills or incinerators and the remaining 90.5% ends up in the hands of the unorganized firms [2]. The methods and techniques adopted by unorganized firms are questionable. Also cheap but hazardous methods of disposal like land filling, incinerating or refurbishing are adopted by the unorganized firms instead of recycling or dismantling to save costs. Improper disposal leads to soil, water and air pollution by the hazardous substances contained in them which results in damage to the environment, wildlife and humans (see table No-2). The gravity of the situation can be judged from the fact that E-waste contributes 40% of lead and 70% of heavy metals in landfills [3].The most hazardous electronic equipment being the computer. Computers contain elements like Lithium, Mercury, Cadmium which contaminate the soil and water bodies which lead to carcinogenic.

TABLE I. HOW MUCH WASTE IS IN 1 COMPUTER?

Hazardous component	Weight
Plastic	12.64 Pounds
Lead	3.16 Pounds
Cadmium	0.006 Pounds
Chromium	0.0038 Pounds
Mercury	0.001264 Pounds

One pound=0.4536 Kilograms

Table II. Listed in table below are the harmful elements in the compositions of electrical and electronic appliances that can be hazardous to health and environment. [4]

Chemical element(Atomic Number - symbol)	Source of Electronic Products	Hazardous for Health
Antimony(51-Sb)	CRTs, Printed circuit boards, fireworks, paints, glass, cable sheathing, Antimony alloys for solder	Temporary contact with antimony by human breath results in effects on the eyes and skin. Human and animal studies have reported respectively cancer and lung tumors. Breathing effect like Inflammation of the lungs, chronic bronchitis and chronic emphysema.
Arsenic(33-As)	Used for making Transistors, LED	Contact with arsenic in drinking water can cause cancer in the skin, lungs, kidney and bladder.
Barium(56-Ba)	Front panels of CRTs, X-ray diagnostic work, sparkplugs, fluorescent lamps	Temporary contact with barium metallic element could lead to brain swelling, muscle weakness, damage to heart, spleen and liver. Studies have reported increased blood pressure in animals.
Beryllium(4-Be)	Used to make Motherboards of computers, electrical contacts, spot-welding electrodes, on-sparking tools	Causes lung cancer and breathing the fumes and dust can cause chronic beryllium disease and skin disease such as warts.
Cadmium(48-Cd)	Used to make chip resistors and semiconductors, Battery, Television picture tube, electroplating	It is toxic. The toxicity affects the kidney, respiratory system and the skeletal system.
Chlorofluorocarbons (CFCs)	Used as a coolant in older fridges and coolers	Causes ozone layer depletion and greenhouse gas effect. Direct contact with CFCs can also cause breathing difficulty, confusion, coughing, drowsiness, dry skin, eye redness, pain and sore throat.
Cobalt(27-Co)	Used as a Rechargeable batteries and coatings for hard disk drives	Harmful in case of breathing and consumption. It is an irritant of the skin. Repetitive contact can produce organ damage.
Copper(29-Cu)	Used as a conductor in power and control cable	Very harmful if consumed. It is an irritant of the skin and toxic to lungs.
Dioxins(8-O2)	Produced when electronic circuits are burnt in open mid-air	Extremely toxic and can cause reproductive and developmental problems, damage the immune system, obstruct in hormonal functioning and cause cancer.
Gallium(31-Ga)	Integrated circuits(ICs), optical electronics and optical cable	Harmful to skin (may produce burns) and eyes. Over exposure can result in death. It is toxic for lungs. Continual contact can damage the target organs.
Hexavalent chromium	Used as a oxidization protection of raw and galvanized steel plates	Continual contact causes asthma and irritation of the skin, liver and kidney damage, eye injury and lung cancer.
Indium(49-In)	Used as a LCD screens	It can be absorbed into the body by breath or injection.
Lithium(3-Li)	Used as a Rechargeable batteries	It is dangerous and an irritant of the skin and eyes.
Lead(82-Pb)	Used as a soldering agent in printed circuit boards , Gaskets in computer monitors and glass panels	It harmful to central and peripheral nervous system, kidneys and blood system. It is toxic for various body system, including the neurological, intestinal, heart, hematological and renal system.
Mercury(80-Hg)	Printed circuit board, Alkaline batteries, mercury wetted switches	It is toxic for various body systems, including the central and peripheral nervous system.
Nickel(28-Ni)	Rechargeable batteries (NiCd or NiMH), electron gun in CRT	Slightly harmful if contacts with skin, ingestion or breathing.
Phthalates	Used to soften Plastics	Disturbs the endocrine system, reproduction, fertility and birth. It is toxic for various body systems and is linked to liver cancer and effects on the brain, nervous system and immune system.
Polybrominated diphenyls Ethers(PBDEs)used in brominated flame retardants(BFRs)	Plastic housing of electronic equipment's	PBDEs are of apprehension because of their high lipophilicity and high opposition to the degradation processes. BFRs have an effect on levels of thyroid stimulating hormone and cause genotoxic damage, causing high cancer risk.
Polychlorinated	Insulating materials of electronic	Interconnected to reproductive failure and

biphenyls(PCBs)	products	dominance of the immune system.
Polyvinyl Chloride(PVC)	Power cable ,control cable and computer housing	When PVC is burnt it produces dioxins; causes reproductive and developmental problems.
Silver(47-Ag)	Television, Mobile and computer's circuit board, electrical contacts	Very harmful if gets in contact with eye, ingestion and breathing. Severe over-exposure can result in death.
Thallium(81-TI)	Semiconductors, Batteries	Very harmful if gets in contact with skin and eye. It is toxic for kidneys, liver and heart and may cause birth defects.
Tin(50-Sn)	Used as a lead free solder in electrical circuits	Contact with eyes and skin can cause irritation, reduced sperm metabolism
Zinc(30-Zn)	Used as a plating material.	Contact with eyes can cause irritation, powdered zinc is highly flammable, causes cough, diarrhoea and vomiting.

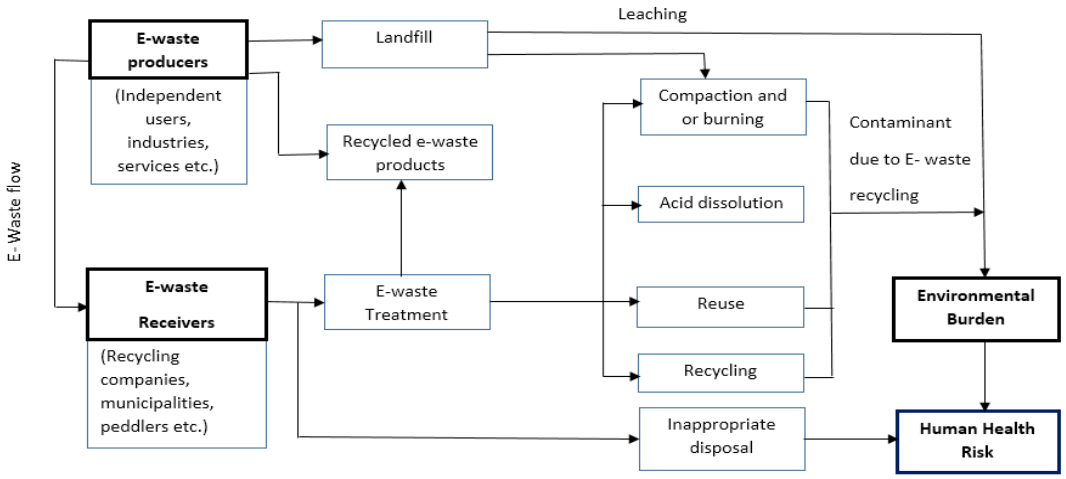


Fig.1: E-waste Route in India [5]

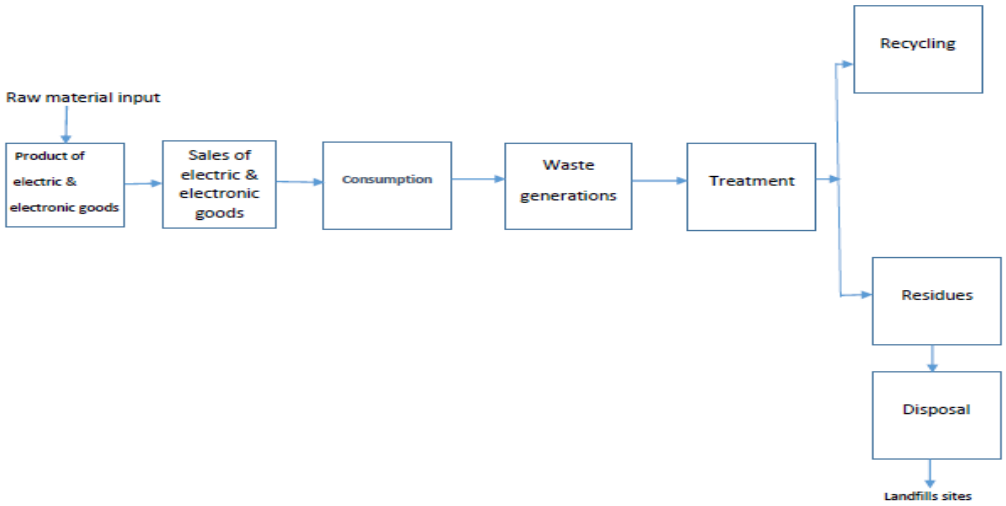


Fig.2: Life cycle of E-waste[6]

Diseases in humans [7]. These elements persist much longer in the environment, so it is imperative that these elements be recycled instead of dumping. Incandescent bulbs and Compact Fluorescent Lamp (CFL) contain mercury. Electrical wires are made up of PVC which is carcinogenic. But there are just 138 Central Pollution Control Board(CPCB)recognized E-waste collection centers (as of 2014) across India with a combined annual capacity of nearly 0.35 million tones[8], some of them are operating below capacity, which are clearly not enough to tackle the problem of dumping. Then there is the problem of refrigerant gases like CFCs and HCFCs which are used in refrigerators, ACs etc. which cause global warming and ozone depletion. Upon dumping the remnant gases can dissolve in ground water that can be toxic in concentrated form. So E-

waste can seriously dent the environment which is one of the objectives of SBA.

B. Material and technology

Another important dimension in which E-waste can adversely affect SBA is the material and technological composition of E-equipment. The commonly used Compact Fluorescent Lamp (CFL) and Incandescent lamps contain Mercury which can cause various diseases. So these lamps should be substituted with Light Emitting Diode (LED) lamps which are relatively environment friendly, more efficient and much longer lasting than the former. The refrigerators in India use Hydro Fluoro Carbons (HFCs) as refrigerants and ACs have Hydro Chloro FluoroCarbons (HCFCs) as refrigerants. While some countries like US, UK have already started using Hydro Fluoro Oxygenated(HFO) based refrigerants which are environment friendly and do not require to be refilled time and again, thus increasing the duration of usage. Similarly hazardous and less efficient components of computers, phones, TVs etc. Should be replaced with components which are environment-friendly and have longer shelf-life, thus eliminating the need to dump the equipment. For example Liquid Crystal display (LCD), Cathode Ray Tube (CRT), Plasma TVs are being substituted with LED TVs which have much longer lifespan of about 66% more than the former. But these substitutions should weigh in the factor of generating e-waste due to outdated technology and substitution only be done where the cost of environmental damage outweighs the cost due to outdated technology. These technological changes should be done taking affordability into consideration in order to generate considerable demand among the consumers.

C. Human

Another important dimension of generation of E-waste is the human element involved in it. Rising incomes and aspirations of the people have led to consumerism which results in unnecessary generation of e-waste which adversely affects SBA. Also excessive and improper usage of electronic gadgets leads to lowering of their lifespan. For instance unnecessary usage of bulbs can lower their lifespan by nearly 30%. Also there is lack of awareness among the people about the proper disposal of e-waste which ultimately affects SBA. People should follow proper usage and disposal procedures of electronic equipment's. Sometimes people choose products which are less efficient and have lower lifespan for economic reasons which aggravate the problem of e-waste. People should be convinced that the higher initial cost of high-performance gadgets is offset by the lower operating and maintenance costs.

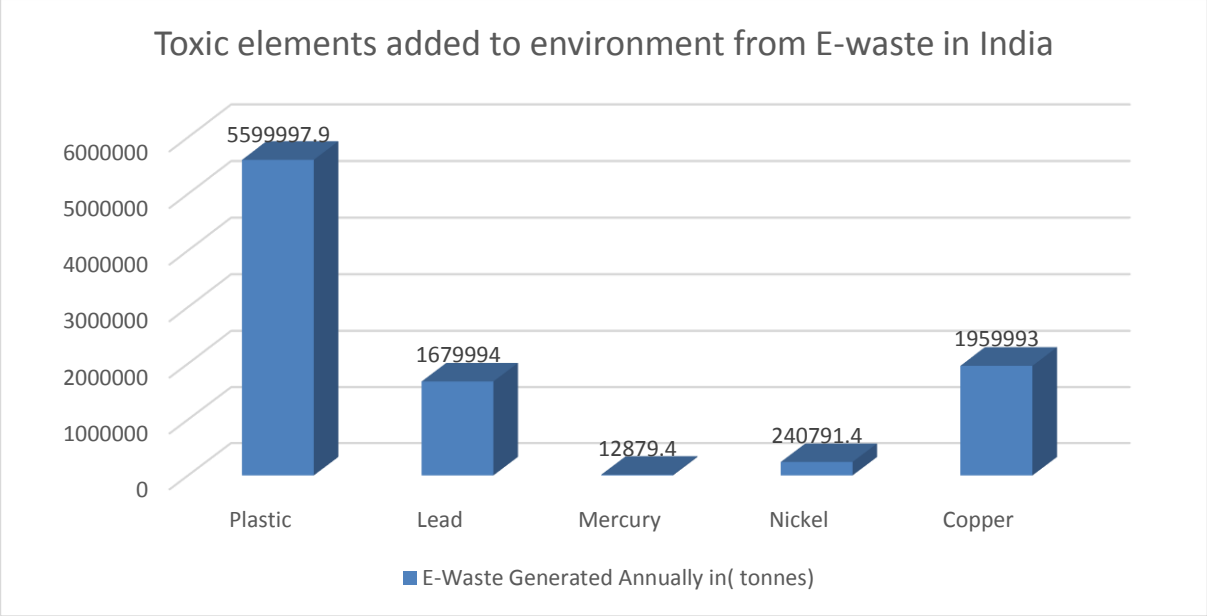
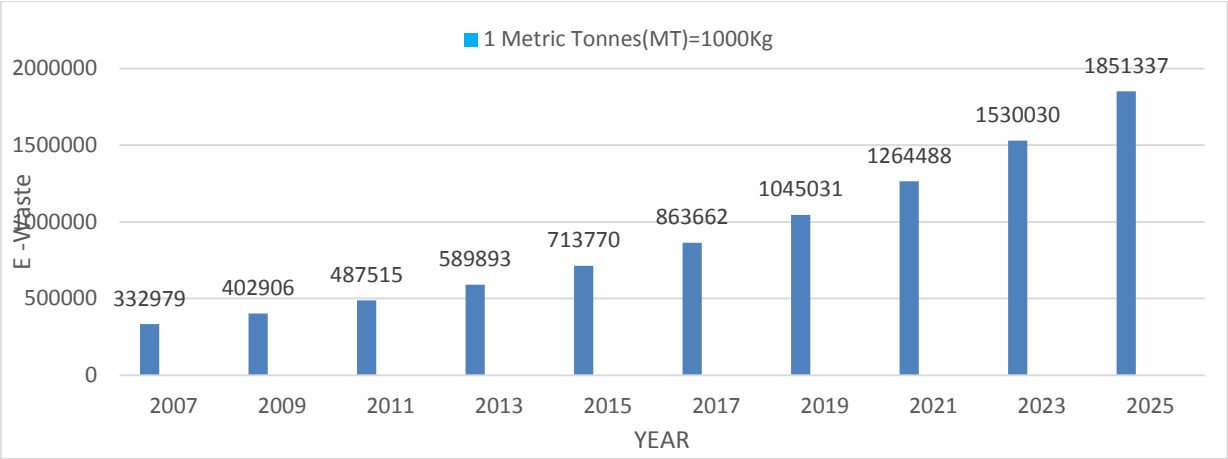


Fig.3: Forecast of e-waste estimate in India [13]



D. Policy

The Policy & Regulatory decisions of the Govt. form another crucial dimension of the E-waste problem. The policies and regulations should be enacted after thoroughly going through the pros and cons. For instance, DELP, a program launched by Govt. of India in 2015 to encourage mass usage of LED lamps instead of incandescent or CFL lamps. But this would cause a massive generation of E-waste, which again could pose a problem, if not handled properly. Also the program of Digital India, which envisages creating a digitalized nation, will result in a huge demand for computers & phones. This is bound to create a huge problem of e-waste in the future if gadgets having longer lifespan are not used. Then there exists the problem of improper formulation and implementation of rules. The Montreal Protocol that banned usage of CFCs and HCFCs as refrigerants in refrigerators, since 2010, is a major step in combating environmental pollution due to gas leakage. This should have been extended to ACs as well. Even the regulations in place are violated. A study conducted by the organization Toxics Link named 'E-waste management in India-Role of State Agencies' highlights that the 'E-waste (Management & Handling) Rules' (2011) have not been properly implemented by most states. [9]. the study also points to the lack of efforts and actions made by most state pollution control board and committees. This shows that the E-waste rules are not properly implemented in the country [10]. So, Govt. should ensure a firm implementation to deal with the violators. Kerala has a well-developed e-waste collection procedure in place. Other states should follow suit. There is a huge problem of collection, dismantling, recycling and disposal of E-waste. The Govt. should step in and set-up more e-waste centers to solve this problem otherwise this could defeat the very purpose of SBA. Industrial firms are reluctant to manufacture efficient, long-performing, non-hazardous gadgets due to economic costs and low demand. Govt. should step in to subsidies the firms to invest in R&D so that products can be made with desired requirements as well as

TABLE-3, QUANTITY OF WEEE (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT) GENERATED IN INDIAN TOP TEN STATES [11]

State/UT	WEEE(Kilogram)
Maharashtra	20270590
Tamilnadu	13486240
Andhra Pradesh	12780330
Utter Pradesh	10381110
West Bengal	10059360
Delhi	9729150
Karnataka	9118740
Gujarat	8994330
Madhya Pradesh	7800620
Punjab	6958460

being affordable to consumers. Maharashtra has taken the lead in this by stressing for greener and hazard-free electronics in its IT policy-2003. Govt. public and private sector account for 70% of e-waste in India [12]. Therefore they must take the onus of ameliorating the problem of e-waste. Lack of awareness among the people regarding the proper usage and disposal of electronic equipment is a problem that the Govt. should deal with by making citizens aware that the repercussions of

generating E-waste would ultimately affect them and so they should follow the necessary rules. NGOs can also be roped in for this. Another problem is the lack of comprehensive and coordinated information about e-waste generation & inventory possessed by the Central & States Govt.Which cannot deal with the complex and dynamic e-waste sector. This problem can be solved by introducing GPS or RFID based technology to tag equipment, manufacturers, dealers, collectors, e-waste centers as per the requirements.

E. Fish bone diagram for tackling of e-waste for effective swachh bharat

All the constraints which ultimately result into Swachh Bharat effect on E- waste are categorized as per the standard practice product quality, Short lifespan of product, Defects in manufacturing, Outdated technology, Cost consideration over quality, Use of hazardous material, people parameters like Lack of awareness, Low priority, Improper disposal, Poor maintenance, Cost consideration over quality , method in to Material/Technology, People, Method and Regulatory/Legal. The constraints responsible for each category and sub category are represented on the fish bone diagram. For example material /technology constraints like improved parameters like Improper disposal, Costly methods of disposal, regulatory constraints like Lax regulations, Poor implementation of rules, Lack of policy encouragement, Improper policies, Lack of information, Low priority.

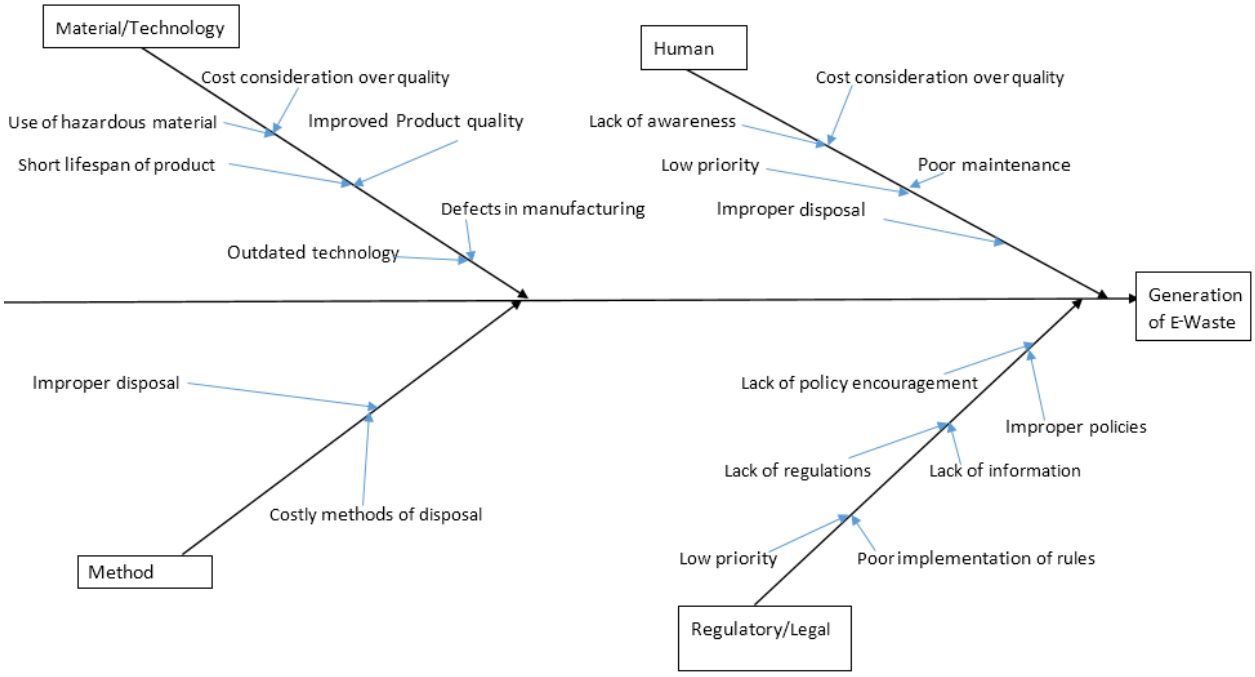


Fig.4: Fish bone diagram of tackling of E-Waste for effective Swachh Bharat

III. CONCLUSION

This paper has explained the various factors and the extent to which e-waste adversely affects the SBA. This paper has also discussed the means to combat those problems. This paper would help in formulating policies on E-waste and its allied activities. It would also make people aware about the various dimensions of the E-waste problem and adhere to necessary actions to reduce the extent of the problem. This paper does not deal with the exact financial costs of taking on the E-waste problem, but, the costs incurred would be offset by gains in the long-term. It is clear that no single step alone can reduce E-waste, but rather a multi-pronged approach is required which involves all the stakeholders of the society in creating the perfect weapon against E-waste. With programs like SBA and Digital India already underway, this is the right time to deal with the problem of E-waste on a war footing otherwise the very purpose of SBA would be defeated.

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