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Electronic Waste: Concerns of Metals in Jharkhand

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Abstract: ***The unprecedented growth of electronic equipments in name of automation and development has lead to a situation where we are sitting on pool of devastation and degradation effecting human kind, environment and the place where we are living in. The growth of technology is not one sided, it eases on one hand but one has to pay heavy price for it. The development without checks and bounds are bound for devastation. Every product or thing has a life and after it is used to maximum extent it has to perish and particularly in case of Electrical and electronic products the end of life situation i.e. disposal will need equally technological disposal. The passing on of burden of development in name of help to lesser developed nations has become state of art. The hazards and toxicity of the disposal of manmade development will not be limited to the boundary what man has set in name of nations. The nature and environment is the best judge and will do justice to the human kind. Development of sustained approach for growth and truthfulness to self and environment will create a situation where others hazards will be treated as hazards to human kind. The joint approach for tackling the degradation because of elements/ substances whether natural or manmade is need of hour. The situation of Jharkhand is day by day becoming alarming. The awareness for the EPR, buy back, exchanges and proper regulations vis-a-vis legislations needs to be created. The awareness about hazard, drawbacks of automations and options for saying good bye to old unsafe technological products has to be taken up seriously.***

Keywords : Elements, buyback, exchange, hazard, environment, electronic equipments, sustained development, Transboundry shipment.

I. INTRODUCTION

The technological development has lead to a situation where every day is witnessing new era of emergence of new Electrical Electronic Equipments (EEE). The additions leads to multiple situation like accumulation of old usable EEE, obsolete EEE, tranboundary shift of EEE, socio economical transition, growth of recycling / reuse industries, development of areas where the end of life products are buried or destroyed or dismantled i.e. disposed. The disposal of EEE is a complex process as the EEE are made up of many constituents which are elemental, metals, manmade substances etc. Each substance has a value to mankind and environment. The extraction of valuable to whatever extent is taken up from the residual substances which are left in the disposable EEE and these are left uncared and get mixed to the texture of soil, ground water via landfills etc. The manmade and natural substances when burnt in uncontrolled manner lead to fumes and orders which pollute the environment and lead to degradation of atmosphere and living area where we live in.

Generally when we talk of EEE we mean by electronic products which ranges from entertainment to communication to automation and computerization. The life spans of basic electrical equipment are longer and contribution of these to electronic wastes (e waste) may be voluminous but lesser compared to electronic items. The life spans of electronic items are limited and are seeing very frequent changes and transformation. The popular EEE have life span as mentioned herein in table1 and its graphical representation in figure 1.

Table 1

Product	Life expectancy	Average life in yrs
Mobile	1 to 2 years	1.5
Camera	1 to 3 years	1.5
PC & Printers	5years	5
Laptops	3 years	3
DVD/Players	3 years	3
Audio systems	1-3 years	2
TV	5 years	5
Microwave	5 years	5
AC	3-5 years	4
Refrigerator	10 years	10

Washing machine	5 years	5
Electrical fans motors etc	5 years	5
IT accessories	Very fast	0.5

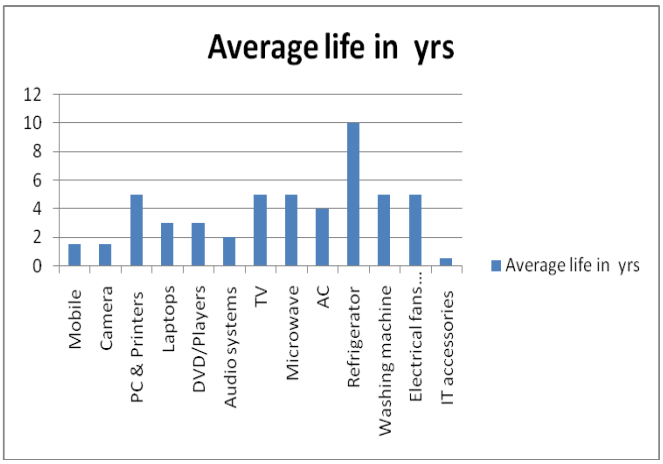


Fig. 1 showing average life span of EEE

It may be observed that the growth of e waste and contaminations i.e. environmental degradation are the two major objectives one is looking for. The disposal of e waste is done thorough formal sector but unfortunately the disposal is possible to an extent of 95 % through informal sector only. Till date the regulatory authorities and the agencies that are to look after such affairs have not given proper attention towards this. The development of proper buy back system in terms of extended buyers responsibility (ERP) or regulatory responsibility has not taken place till date. The world wide efforts are on towards this. The European Union (EU) and developed nations have tried to develop collection centers and recycling & disposal centers but the developing and underdeveloped nations are far behind the responsibility. The intense population increase in purchasing power and tendency to match with the have ones have led & compelled the masses to get the products of even shortened lifespan of EEE as the used ones. The nearer to end of life products are reaching them in name of sophistication and automation.

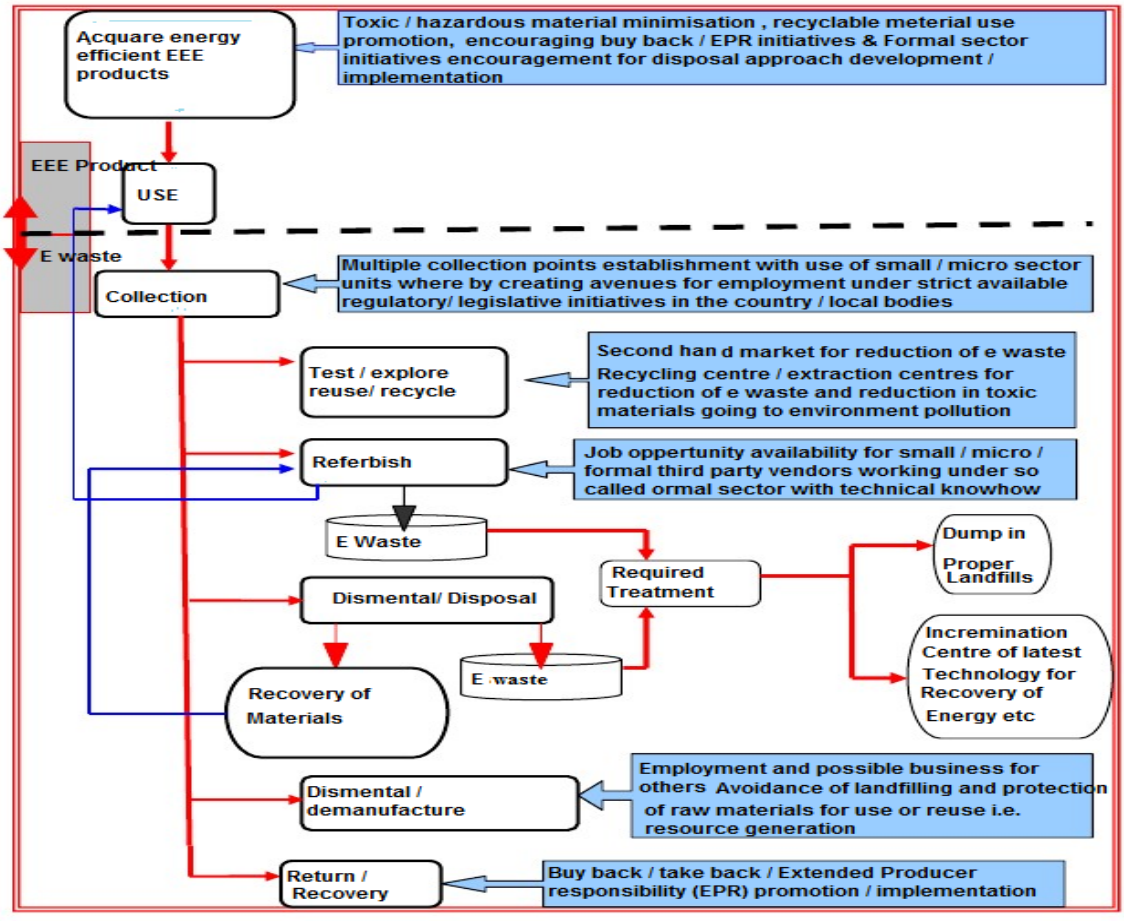
The ERP or the buyback initiatives are bit expensive as producers or the buyback authorities charge for collection at time of legitimate purchase itself. UNEP survey shows that annually 20 to 50 million tones of e waste are getting added up every year. [2].

As already pointed out that the EEE generation and e waste have toxic and non toxic constituents, the efforts for lessening the use of non toxic material in EEE production has already been initiated by many nations for preservation of environment at time of disposal of e wastes. Still the old products 2/3 rd population is in circulation and will lead to toxcification of environment when they will be disposed off. When these old 2/3 rd product will be disposed, then it will register further toxicity to the situation. The ongoing procurement and manufacturing of EEE will also lead to disposal thus careful selection of ingredients for manufacturing becomes judiciously important. In this connection one can think of the strengths, weakness, opportunities and threats of the different sectors involved in it. A brief idea of such can be listed as here under in table 2. Figure 2 shows a model for minimization of resources, extension/recovery of e waste. This also gives an idea of technology involvement, its impact and relevance for optimal and sustainable development and use in such activities.

Table 2

SWOT	**Formal scenario**	**Informal scenario**
Strengths	Metal recovery efficiency higher. As recent technologies are put in practice /employed.	Collection efficiency high Manual sorting and dismantling in practice resulting in lesser labor cost . No need of input in machinery of high cost. Avoidance of pre processing steps.
Weakness	Collection with reduced efficiency as adherence to mechanized preprocessing is required.	Lesser recovery in dismantling and sorting . The preprocessing will result in higher gains but it is avoided so low gains Enhanced effect on environment and humans.

Opportunities	Improved efficiency of collection . Improve,emt in technology hence less maintenance requirements in preprocessing	Skill development in sorting , identification and dismenteling results in Improvement of efficiency. Alternative models or improvement in skill enables interface between informal and formal sector in enhanced manner for better yields.
Threats	Fear of involvement of unregulated / Informal activities in e waste collecting etc dismantling the regulations	Involvement of corrupt /bad practice like bribery, cherry picking / anarchy or disputes among the workers for valuables may result. Uncared disposal of remains & lack of regulators support resulting litigations.



Model for E Waste minimisation and extraction / recovery from e waste in e waste management

SWOT analysis of the e-waste recycling disposal in formal vrs informal scenarios

Fig. 2. Model for minimization & extraction / recovery of e waste management

and extension of recovery of materials for better e waste management for reduced toxicity and hazardness in the near about when we go for disposal. The situation of existing toxicity and hazardness of the situation in the backward areas & otherwise wealthy area of Jharkhand needs to be looked in. The situation of major cities of Jharkhand shows a typical levels of dissatisfaction and alarmingly high pollutions. The recovery rates of the valuables from the e wastes and EEE are higher but one has to pay for the advancements by the degradation of environment and nearby areas toxicity.

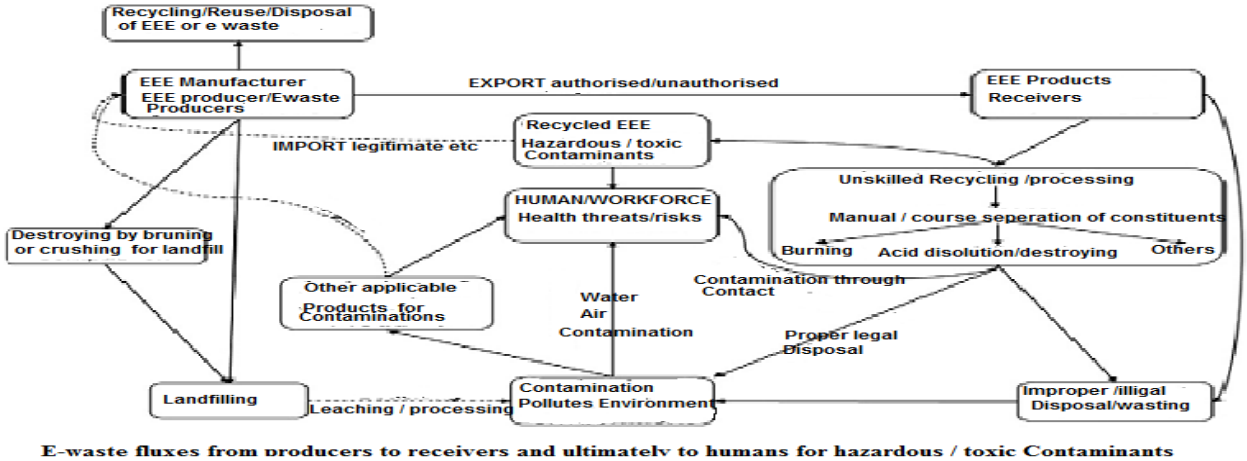
The hazardous e-wastes irrespective of the source they are inducted has to be seen irrespective of legal or illegal recycling / disposal activity. These are subjected mostly through informal unregulated small workshops. These workshops lacks needed knowhow, technology and facilities for proper disposal or recycling and protection from ill effects of the hazards and toxicity during these operations. As discussed only 5 to 10 % e-wastes are treated in the formal sector which has government / regulating agencies authority sanction / permission for such activities. These can be

equipped with proper facilities as per their knowhow. Most of the formal recycling / disposal units are located larger cities or metros in India. The use, maintenance, reuse , recycling and even disposal activities are carried out in almost all parts of nation, irrespective of whether they are taking place in formal or informal ways. In effect e-wastes to a maximum limit of 20 % are transported to nearby larger cities or metros leaving remaining 80 % e-wastes to be dealt in the slum areas by local waste collectors popularly known as "kabariwalas" who have their own ways and means of extraction of components for reuse, recycling means and even disposal or treatment. These kabariwalas after getting the valuables throw / dump remains in the nearby. Worst environmental ill effect of degradation due to these toxic and hazardous waste constituents from the e-wastes can be witnessed in crude disposal form near the slums or dumping areas.

The e waste coming from whatever means has many fold operation in terms of collection and use and actual wastes. Collection of e waste itself is varied irrespective of development. In EU only 25 % ,US 20 % , China 15 % and in India around 10 % get collected. The remaining figures are uncared and unattended left for spreading contamination of life, environment, near about etc.

The major towns such as Jamshedpur, Ranchi, Dhanbad, Bokaro, Deoghar, Hazaribagh, Giridih, Ramghar, Medninagar and Chirkunda whose population is more than 100000 as per census of 2011 has been considered for evaluation of hazadness because of e waste as these areas are the principal areas of domination in Jharkhand and will give clear picture of semi economical developed regions and awareness for e waste and adherence to the regulatory / legislative pursuits.

A typical out line of recycling / reuse/ disposal of contaminants from sources to its flow with an aim for depicting the approach of possible means and approaches for minimization of degradation by accounting all stake holders has been outlined in figure 3 here.



E-waste fluxes from producers to receivers and ultimately to humans for hazardous / toxic Contaminants

Fig. 3.

II. PRESENCE OF METALS IN E WASTE, STOCK & E WASTE SENARIO

The EEE has many constituents and main among these are plastic, metals, semiconductors, manmade substances etc. The e waste generally is said to Consists of Ferrous & Non-ferrous Metals Plastics, Glass, Wood etc. The details can be outlined as :Iron & Steel - 50% , Plastics - 21%, Non-ferrous metal - 13%,Mercury, Arsenic, Lead etc. In India one can say that out of total E-Waste volume available in India the composition will be Television - 68% Desktop, Server - 27% Imports - 2% Mobile - 1% etc. As per reports available from various sources it is estimated that more than 50MT E-Waste is generated globally every year. Generation of E-Waste in 2012 in India is 8 lakh tons with annual growth rate of E-Waste generation as high as 10% . The handling of e waste is complex as most of the constituents are hazardous and toxic. Among the developing and developed countries India ranks among the largest waste importing countries in the world with e waste generation rate of 350000 tons per year and imports of 50000 tons annually [3].

Manufacturers Association of Information Technology, Toxic link, GTZ and various other reports have accounted e-waste stock in 2005 as 146000 tons which grew to 400000 tons by 2010 and further increased to 800000 tons by 2012 and is expected to further grow, when extrapolated, with similar growth rate to 500 % by 2020 in India [4] .

The EEE and e waste has many metals and these can be classified as per their merits and demerits in three categories as per characteristics affecting human health. The table 3 [5] shows details of it.

Table 3

Non beneficial metals	Essential Metals for health	Possible beneficial metals
Aluminum Antimony Arsenic Barium Beryllium Cadmium	Cobalt Chromium Copper Iron Manganese Molybdenum	Boron Nickel Silicon Vanadium

Lead Mercury Silver Strontium Thallium	Selenium Zinc	

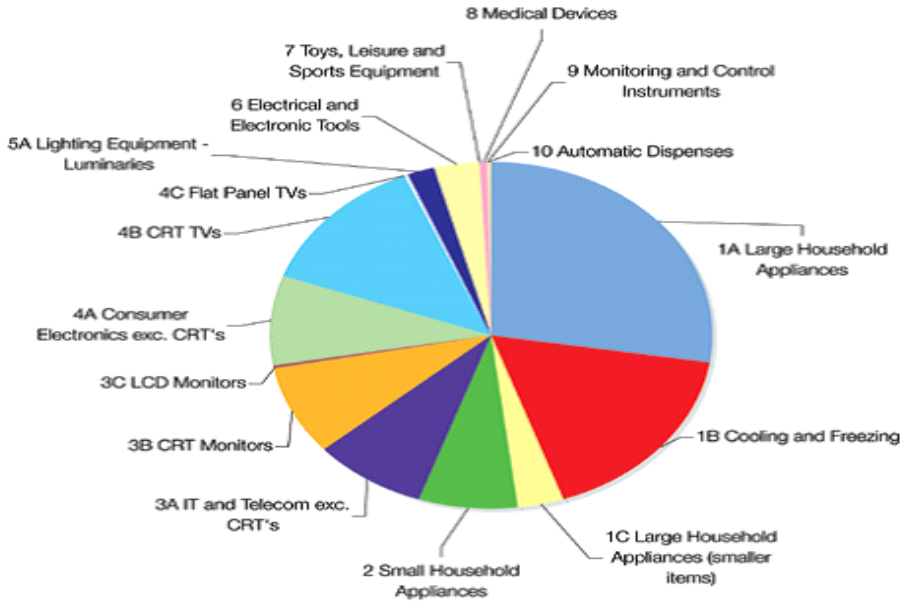


Fig. 4

Figure 4 shows a typical layout showing the typical representation of different EEE and principal causes of e wastes. It may be observed that in absence of formal centers the processing of obsolete computers, monitors, television, mobile, washing machine, electronic gazettes , electric mixiees, electronic toys, electric motors, fans, regulators and similar EEE products find their way in informal agencies in general and local vendors or markets in particular where manual works of needed winding or extraction is carried out [4]. The recycling and disposable EEE's dismantling takes place in home places termed as small workshops/tiny industries. The remains of the e-wastes are gathered and dumped to lonely places for want of employment and are burnt by dwellers for extraction of metals and valuables left out, if any. Chlorofluorocarbons (CFCs) are used as blowing agents despite it faces ban for depleting ozone layer internationally. The use of CFCs and polyurethane causes deadly hazards in long term contamination at the sites of burning of these e-wastes.

For remote and backward areas where there is no facility of extraction but awareness for environment is present the e wastes finds their way to nearby metros. Collection centers have to be organized and we frequently see that local centers in the cities are small actors in themselves for accumulation and when sizable quantity is gathered they are deported to metros. It is expected and in reality some of the states have their own recycling and recovery centers where dismantling and, disassembling and retrieval of valuables from old obsolete EEE are done. Mainly reusable materials extracted out are isolatable metals like copper, aluminum and other metals which can be directly taken out or taken out domestically by treatment or can be separated from plastic by burning in open. This unskilled work, is mostly carried out by workers of tender age i.e. children and are most severely affected by the hazards as they work without protective equipments. The extraction is normally carried out by rudimentary tools. The return , what work force get is very meager to the tune of Rs 80-120 per kg for copper against steep price of copper in original market. The technically sound methods such as solder recovery, acid leaching or plastic shredding for metal recovery from printed circuit boards (PCB) and other electrical circuits is in practice in semi and formal recovery and recycling centers in India.

The different metals present /applicable in the EEE and e wastes etc can be summarized with their briefs of texture, health hazards [15] in the table 4.

Table 4

Metals	Texture properties etc	Health Hazardous
Aluminum	Soft lightweight, dull silvery appearance, nontoxic in itself metal, nonmagnetic and non-sparking metal. Has property of formation of thin insulating oxide layer when exposed to air suitable for MOS electronic products.	The water-soluble ions form causes harmful effects. Excessive intake through food, breathing or by skin contact can cause damage to central nervous system, loss of memory, dementia, listlessness or severe trembling. Pulmonary fibrosis and lung damage (Shaver's Disease) by inhalation.

Antimony	Element is available in semi metallic and non metallic form. It is hard bright poor conductor of heat and electricity. In pure form it is for making semi conductor diodes and infrared detectors, alloys are used in batteries, low friction metals, cable sheathing .	It can cause irritation of the eyes, skin and lungs, lung diseases, heart problems, diarrhea, severe vomiting and stomach ulcers, sometimes cancer and reproductive failure. It can damage lung, heart, liver and kidney.
Arsenic	It is available in yellow, black and grey allotropic forms. The silver-gray form is stable one. The brittle crystalline solid tarnishes rapidly in air. The availability is in metallic and non metallic forms. The non metallic form is less reactive and dissolves in strong oxidizing acids and alkalis easily on heating.	The AsH_3 Arsine gas available on heating/ burning is highly toxic. It is a deadly poison, its intake of more than 0.01 mg/day intake adversely affects human and animals equally. The main health effects are irritation in the stomach and intestines, skin changes and lung irritation, can cause cancer of skin, lungs, liver or lymphatic. It can cause infertility and miscarriages with women, skin disturbances, declined resistance to infections, heart disruptions and brain damage in both men and women. It is capable of damaging DNA and nerve injury.
Barium	Available in silvery-white metal. Barium is commonly used in barium-nickel alloys for spark-plug electrodes in vacuum tubes, drying and oxygen-removing agent, fluorescent lamps.	Barium exposure can cause breathing difficulties, changes in heart rhythm, nerve reflexes changes, increased blood pressures, stomach irritation, muscle weakness, swelling in brains, liver, kidney etc.
Berylliu m	It is a steel gray, strong, light-weight toxic bivalent element. Commonly used as hardening agent in forming alloys. It is nonmagnetic oxidation resistant material having good thermal conductivity. It is extensively used as heat transfer fins in vacuum tubes lasers, CPUs and power transistors, magnetrons, ceramic windows.	Its breathing causes damage to Lungs (berylliosis a persistent and dangerous lung disorder) and may cause pneumonia. Hypersensitive persons may develop allergic reactions and Chronic Beryllium Disease (CBD) . It can even cause cancer and change DNA.
Bismuth	It is white, crystalline, brittle pinkish tinge diamagnetic having high thermal conductivity high electrical resistivity showing highest Hall effect metal. It finds use in manufacturing of low melting solders, fuse, synthetic fibers and rubbers.	On inhalation and ingestion it has effect such as cause kidney damage, serious ulceration stomatitis, develops vague feeling of bodily discomfort, albumin or other protein substance in the urine, diarrhea, skin reactions, serious exodermatitis.
Cadmium	The silver-white, ductile, very malleable lustrous metal has bluish tinge. It is so soft that it can be cut with a knife. It finds extensive sue in Ni Cd cell for EEE	The exposer and intake can cause / damages Diarrhea, stomach pains, severe vomiting kidney by damaging its filtering mechanism. central nervous system, immune system, Psychological disorders, DNA damage or cancer development. Reproductive failure.
Chromium	Silver gray colored lustrous, brittle, hard metal finds use in manufacturing alloys such as steel, metal ceramics, to provide corrosion resistance. The Chromium (IV) form in oxide (CrO_2) is used to manufacture magnetic tape	Contamination may cause Impaired heart conditions, disruptions of metabolisms and diabetes. It can cause nose irritations and nosebleeds. Other health problems include Skin rashes, ulcers stomachs upset, Respiratory problems, Weakening of immune systems, Kidney and liver damage , Alteration of genetic material even Lung cancer, etc.
Cobalt	It is Silver white texture, hard ferromagnetic, brittle textured element.	*H*igh concentrations intake can damage human health. The high content for breathing / intake may result in asthma and

	Cobalt060 radioactive isotopes mostly find use in medical treatment and for food preservation. As part of vitamin B it is beneficial for humans.	pneumonia, Vomiting and nausea, Vision problems, Heart problems, Thyroid damage, Hair loss, etc.
Copper	Reddish malleable, ductile extremely good conductor of both heat and electricity metal has many beneficial effects and find extensive use in EEE.	The excessive intake can cause variety of problems which may include Copper contagion leading to metal fever, Irritation of the nose, mouth and eyes, Headaches, stomachaches, dizziness, vomiting and diarrhea. Liver and kidney damage, Wilson's Disease, characterized by a hepatic cirrhosis Brain damage, demyelization, renal disease, Copper deposition in the cornea etc.
Gallium	Is It a blue-gray / stunning silvery metal. It has semi conductor property. Widely used in EEE as LED, photodetector, Opto devices etc.	Acute exposure to Gallium (III) chloride can cause throat irritation, difficulty in breathing, chest pain, even fumes can cause pulmonary edema and partial paralysis.
Germanium	A hard, lustrous, gray-white, brittle metalloid used mostly as semiconductor for electronic devices.	Germanium byproducts such as Germanium hydride, germanium tetra hydride are extremely flammable and explosive when come in contact to air. Inhalation of these can cause abdominal cramps, burning sensation, cough, skin redness & pain, eyes redness & Pain ,irritation to eyes, skin and respiratory tract.
Indium	It is soft, ductile, malleable, lustrous metallic silvery white coloured metal	*The* small doses can stimulate the metabolism. All compounds are highly toxic. These are capable to damage the heart, kidney & and liver, even it may be teratogenic.
Lead	A poor conductor, resistant to corrosion, bluish-white lustrous soft, highly malleable, ductile are the identity of lead. These find extensive use in battery.	Higher exposer or intake can cause Disruption of the biosynthesis of hemoglobin and anemia, rise in blood pressure, Kidney damage, Disruption of nervous systems, Brain damage, Declined fertility of men through sperm damage, Diminished learning abilities of children, Behavioral disruptions of children, such as aggression, impulsive behavior and hyperactivity etc.
Lithium	It is lightest solid soft , silvery white metal.	The exposer can cause Burning sensation, Laboured & shortness of breathing, Sore throat, Skin Redness & burns with Pain, Blisters, Redness in Eyes, Severe deep burns, Ingestion, Abdominal cramps, Abdominal pain, Burning sensation, Nausea, Shock or collapse, Vomiting and Weakness.
Mercury	The only liquid conductor available which finds extensive use in fluorescent tubes, tilt switches, conducting electronic tubes, other control solid state devices and flat screen monitors etc	The exposer can cause dermatitis, sensory impairment, memory loss, weakness in muscle reduced fertility causing slowing of growth and development etc.
Molybdenum	Extensively used in circuit inks for circuit boards, microwaves devices and heat sinks for solid-state devices.	It is highly toxic and can cause liver dysfunction with hyper bilirubinemia, Signs of gout can be evident on infected person, Joint pains in the knees, hands, feet ca be result of exposer, Auricular deformities, erythema, and edema in the joint areas can also be witnessed.
Nickel	Mostly finds use in Ni-Cd batteries in	The large exposer quantity can cause

	the EEE.	Sickness and dizziness, Lung embolism, Respiratory failure, Asthma and chronic bronchitis, Heart disorders, Birth defects, Allergic reactions , cancer, larynx cancer and prostate cancer can also be seen as extreme effects.
Selenium	An excellent photovoltaic and photoconductive material finds extensive use in photo cells and photo devices in electronic devices	The extreme higher exposure or over exposer to fumes may cause accumulation of fluid in the lungs, garlic breath, bronchitis, pneumonitis & bronchial asthma, nausea, chills, fever, headache, sore throat, conjunctivitis, vomiting, abdominal pain ,diarrhea , enlarged liver.
Silver	Excellent electrical conductor extensively find s use in EEE.	High concentrations exposer may cause dizziness, breathing difficulty, headaches or respiratory irritation. staggering, confusion, unconsciousness, brain, coma or even death. Large doses may damage liver, Kidney , Eye, Lungs and result in Cardiac abnormalities etc.
Sulphur	A non metal multivalent substance.	The exposure can result in Neurological, behavioral, hormonal metabolism dermatological changes, Disturbance of blood circulation, Heart damage, Suffocation and lung embolism, Effect eye and eyesight, damage to liver and kidney functions, Reproductive failure, Stomach and gastrointestinal disorder, In environment it can be source of formation of Sulphuric Acid in humid and wet conditions which can have catestrophic affects.
Tin	Mostly find use super conducting magnet formation in EEE. It is good conductor.	Larger exposer can lead to Eye and skin irritations, Sickness and dizziness , Severe sweating, Headaches, Stomachaches, Breathlessness, Urination problems, Liver damage, Malfunctioning of immune systems, Chromosomal damage, Shortage of red blood cells , forgetfulness Brain damage , Depressions, sleeping disorders, etc
Vanadium	Soft , ductile gray white effective in making good alloys material.	It has a history of causing severe eye, nose and throat irritation, cardiac and vascular disease, Inflammation of stomach and intestines, Damage to the nervous system, Bleeding of livers and kidneys, Skin rashes, Severe trembling and paralyses, Nose bleeds and throat pains, Weakening, Sickness and headaches, Dizziness, Behavioral changes etc.
Yttrium	Mostly finds use in making TV picture tube , fluorescent lamps, energy-saving lamps and glasses	The exposer can cause lung embolisms, cancer in humans, as it enhances chances of lung cancer, threat to liver when it accumulates in the human body.
Zinc	Mostly finds use in making batteries . It is essential element for humans.	The extreme exposer can result in stomach cramps, skin irritations, vomiting, nausea and anemia, damage to pancreas, disturb the protein metabolism, and cause arteriosclerosis.

Metals used have their own texture and limits of hazardness and toxicity. The reports reveals the limits [6] as presented in the table 5 and the logarithmic conversions of maximum exposer per day has been graphically expressed in figure 5 and figure 6.

Table 5

Metals	Max Exposure µg/day	log of max exposer	USP Limit, µg/g	USP Parenteral Limit, µg/g
Thallium (Tl)	4	0.6021	0.4	0.04
Arsenic (As)	15	1.1761	1.5	0.15
Mercury (Hg)	15	1.1761	1.5	0.15
Antimony	20	1.301	2	0.2
Cadmium	25	1.3979	2.5	0.25
Beryllium	100	2	10	1
Indium (In)	100	2	10	1
Iridium (Ir)	100	2	10	1
Ocmium (Os)	100	2	10	1
Palladium	100	2	10	1
Platinum (Pt)	100	2	10	1
Rhodium (Rh)	100	2	10	1
Ruthenium	100	2	10	1
Chromium	150	2.1761	15	1.5
Molybdenum	250	2.3979	25	2.5
Selenium (Se)	250	2.3979	25	2.5
Tungsten (W)	375	2.574	37.5	3.75
Copper (Cu)	500	2.699	50	5
Lithium (Li)	600	2.7782	60	6
Cobalt (Co)	1000	3	100	10
Nickel (Ni)	1000	3	100	1
Manganese	7000	3.8451	700	70
Boron(B)	10000	4	1000	100
Iron (Fe)	15000	4.1761	1500	150
Zinc (Zn)	15000	4.1761	1500	150
Strontium (Sr)	30000	4.4771	3000	300
Tin (Sn)	30000	4.4771	3000	300
Aluminum	50000	4.699	5000	500

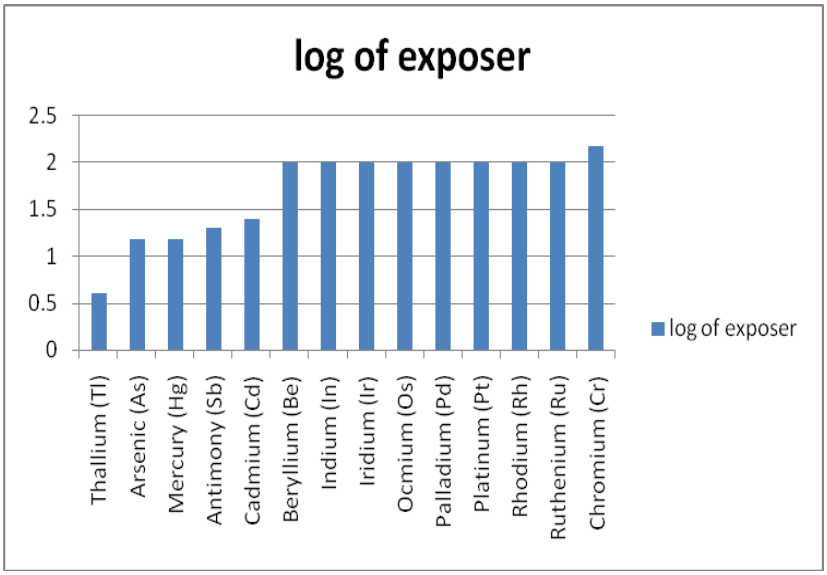


Fig. 5

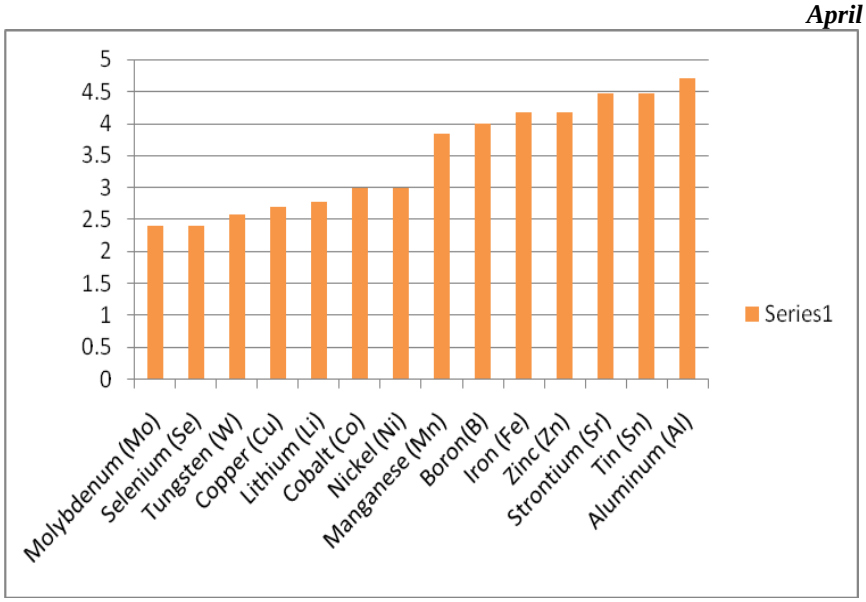


Fig. 6

III. SURVEY & SAMPLING

Jharkhand is the bifurcated state from Bihar. The area is mineral rich and has eminence potential of metals and elements. The purchasing power and the wealth is limited to handful persons. The industrial belt and the automation in almost all spheres can be witnessed. The EEE inflow from all possible ways can be seen. The different strata of social setup exist and this enables to see a mini India and globe here. Population, demography and varied geography makes it suitable for the detailed study of study for the toxification and hazardness due to development of EEE, changes in EEE and resulting e wastes. To have a complete representative view the state has been divided in ten zones and since the e wastes are developed mostly in cities and towns where literacy rate is high and at least it is assumed that people are aware of regulatory and legislative measures. The EPR, buy back and take back of items in name of exchange and transportation is possible. The ten are areas identified are Jamshedpur, Ranchi, Dhanbad, Bokaro, Deoghar, Hazaribagh, Giridih, Ramghar, Medninagar and Chirkunda. In all the areas dealers or facilitators of almost all EEE products are available for supply end and the municipal and local bodies entitled for collection centers as per regulations are feasible. The slum areas and areas where wastes in general and e wastes in particular are dumped by the "ruddiwalas" can be witnessed. The open burning, local level disposal and shipments of e wastes to metros and high end dealers can be seen persisting. The worst affected areas of the slums are identified and samples in multiple numbers of equal quantities are gathered and sealed and packed in the properly cleansed and rinsed glass containers. These samples are forwarded to the testing sites and for arriving at data and further analysis.

To know the awareness of regulations and facilities the developed questioners cum information collection forms were circulated/ dispatched / handed over and responses were received / collected / obtained and noted. The information so collected was further summarized to get opinion and valuable data for arriving at conclusion were exercised.

IV. DATA OBTAINED AND ANALYSIS

The samples collected were properly examined and the results of the existence of elements were obtained and ascertained. The details are compared to the safe limits developed by the global ad hoc committee for ascertaining these. The available **d**etails of constituents regarding elements in the EEE / ewsate was obtained from the samples of the ten cities namely Jamshedpur (JSR), Ranchi (RNC) , Dhanbad (DHN), Bokaro (BKO), Deoghar (DEO), Hazaribagh (HAZ), Giridih (GRI), Ramghar (RAM), Medninagar (MED) and Chirkunda (CHI) whose population is more than 1 lacs as per 2011 census across Jharkhand are as presented in table 6 herein. The examination reveals that the areas rich in industrialization have higher values of elements than the limitations suggested. The variations are few percent variations to multiples in the limits. The worst affected areas are the old industrial cities whose purchasing power is higher than the cities which have lesser have ones.

Table 6

Elements in EEE / e waste	Safe limits in µg/day	JSR in µg/day	RNC in µg/day	DHN in µg/day	BKO in µg/day	DEO in µg/day	HAZ in µfg/day	GIR in µg/day	RAM in µg/day	MED in µg/day	CHI in µg/day
Lead	**10**	**23**	**34**	**45**	**31**	**8**	**21**	**19**	**43**	**18**	**26**
Arsenic	**15**	**12**	**14**	**18**	**7**	**5**	**8**	**18**	**17**	**16**	**12**
Mercury	**15**	**14**	**16**	**14**	**13**	**12**	**15**	**4.5**	**7.1**	**6.2**	**6.9**
Antimony	**20**	**14**	**21**	**41**	**15**	**12**	**6**	**8**	**9**	**11**	**7**
Cadmium	**25**	**21**	**29**	**27**	**26**	**17**	**9**	**7**	**26**	**23**	**14**
Beryllium	**100**	**78**	**142**	**23**	**15**	**35**	**67**	**89**	**59**	**65**	**39**

Indium	**100**	**166**	**132**	**181**	**158**	**78**	**116**	**114**	**89**	**78**	**75**
Chromium	**150**	**142**	**243**	**312**	**197**	**92**	**131**	**133**	**67**	**79**	**83**
Molybdenum	**250**	**340**	**327**	**378**	**391**	**38**	**266**	**142**	**217**	**183**	**179**
Selenium	**250**	**263**	**268**	**216**	**296**	**69**	**258**	**279**	**165**	**196**	**199**
Silver	**400**	**291**	**871**	**759**	**768**	**312**	**296**	**392**	**305**	**295**	**396**
Barium	**500**	**417**	**873**	**892**	**672**	**412**	**728**	**280**	**481**	**245**	**189**
Copper	**500**	**1065**	**1456**	**1713**	**1276**	**417**	**1397**	**1756**	**985**	**791**	**982**
Bismuth	**800**	**159**	**723**	**654**	**658**	**614**	**352**	**237**	**589**	**478**	**492**
Gallium	**800**	**613**	**817**	**218**	**412**	**489**	**316**	**416**	**217**	**298**	**312**
Cobalt	**1000**	**1128**	**1956**	**1887**	**894**	**578**	**626**	**427**	**389**	**727**	**592**
Nickel	**1000**	**6000**	**1204**	**1197**	**2323**	**379**	**921**	**826**	**931**	**1045**	**938**
Vanadium	**1000**	**2193**	**3293**	**892**	**2411**	**287**	**3186**	**2528**	**984**	**1173**	**926**
Yttrium	**1000**	**1853**	**1812**	**945**	**791**	**719**	**994**	**1651**	**659**	**278**	**289**
Germanium	**1500**	**2401**	**2194**	**1981**	**2627**	**1135**	**1231**	**1027**	**985**	**693**	**593**
Manganese	**7000**	**10231**	**9312**	**4217**	**6132**	**2581**	**7157**	**4193**	**3298**	**4306**	**5619**
Zinc	**15000**	**34329**	**56124**	**29523**	**23185**	**9278**	**22461**	**23157**	**28387**	**19321**	**14921**
Tin	**30000**	**69632**	**41126**	**61093**	**12665**	**19467**	**32821**	**21167**	**19828**	**14619**	**9174**

Table 6

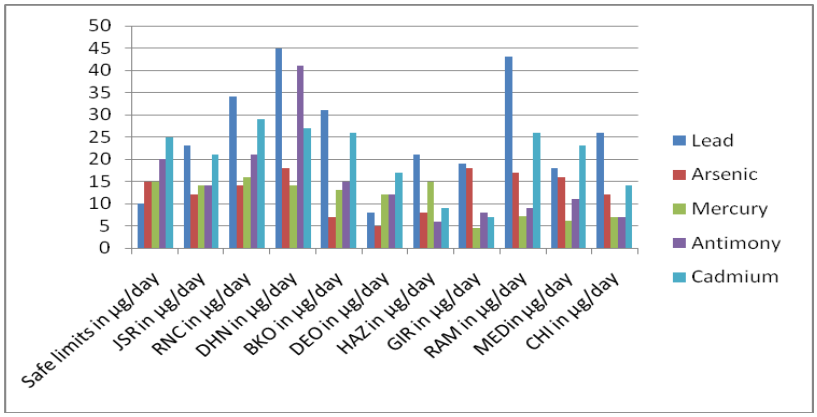


Fig. 7

The figure 7 clearly shows that the content of lead is higher in almost all the samles. The contents are highest in Dhanbad and Ramghar. Dhanbad is the oldest city and industrial rich center hence the work of batteries and related ones are highest in this area. This situatio is same for the Ramghar also. The presence of Arsenic , the deadly posioneous constituents is verey well present making the ground water also polluted. This gives rise to various healt and ralated problems. The situation for mercury , antimoney cadmium can be well seen in the dipictions itself. Deoghar, Hazaribagh and Giridih shows the situation in limits.

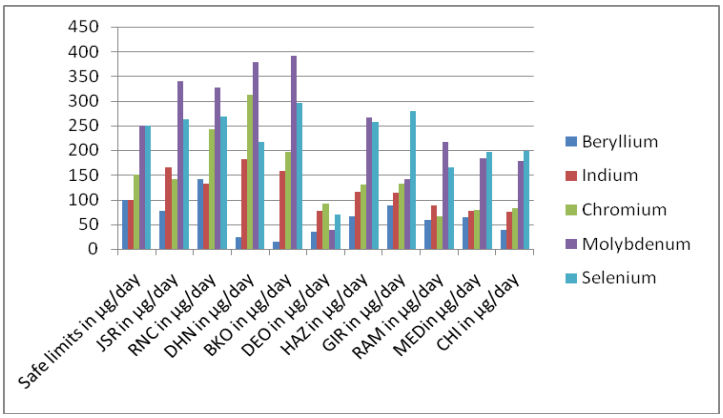


Fig. 8

Figure 8 shows the situation of Beryllium, Indium, Chromium, Molybdenm and Seleneum. The situation of variation of the elements can be well noticed and this also tells the industrialisation situation only. The prensence of Molybdenm is high in JSR , RNC , DHN and BKO. The presence of Seleneum can be seen on boundry of the limit only. The toxic effects of almost all the constituents are following he pattern .

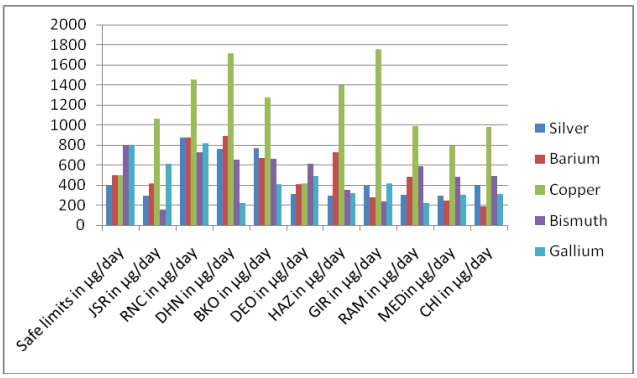


Fig. 9

The level of copper in almost all the areas can be seen perhaphs because of its high us . For Barium the areas of MED and CHI seem to be safe. The content of silver is rich in industrial cities. Barium and other elements taken up for graphical are as per represented here.

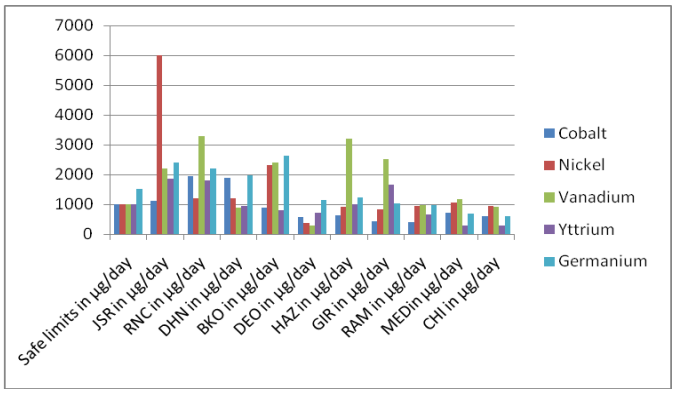


Fig. 10

The situation of Nickel in figure 10 is noticable in JSR though it is at high note in other samples. Cobalt has also registered its presence in all the samples but its level is wel with in limits except of DHN. The germanium has shown its prominance because of increadsed use of semiconductor devices. All the remaining materials haave registered there presence some at high note and few at lower levels.

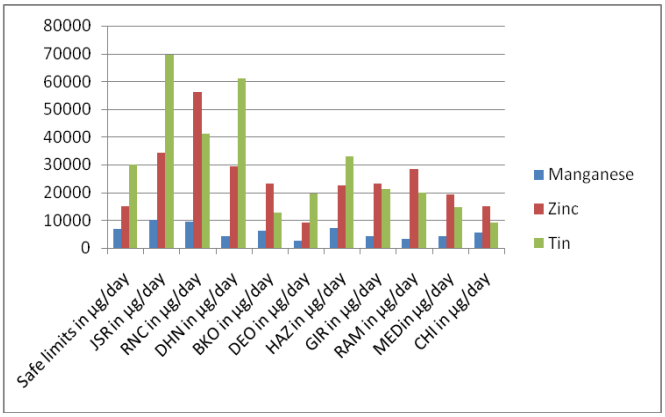


Fig. 11

The figure 11 shows the dominance of Tin in JER, DHN followed by RNC and HAZ. The level of Zinc used in the batteries and as expected its level is higher in all the samples. The presence of Manganese is noticeable in JSR, RNC, HAZ and cool at remaining samples.

Thus we see that the graphical representations of all the constituents available and measured in the samples are varied in nature depending on the city and site. The variation may vary as per suitability of selection of sample sites. The sites selection has been done on visual estimation of degradation and imaginary idea of having worst effected situation in the area of study.

Information regarding the extended producer's responsibility (EPR) / buy back (BB) or exchange (Ex) available in the area was focused. !00 questioners to each area dividing the population in uniform demographic sections were made. The received questioners details were listed and statistical operations were performed to get the representation of available facilities in the area. The details obtained in the survey study have been summarized in the table 7 and the graphical representations pertaining to these have been obtained from the responses and placed for discussion in figure 12.

Table 7

Samples	Questioner Sent	Questioner Received	Computer EPR/ BB/Ex	TV EPR/ BB/Ex	Batteries EPR/ BB/Ex	Refrigerator EPR / BB/Ex	Printer EPR/ BB/Ex	Gazettes EPR/ BB/Ex	Other EPR/ BB/Ex
JSR	100	79	25	72	71	67	7	11	8
RNC	100	89	57	67	82	52	12	12	12
DHN	100	65	26	35	56	43	15	10	5
BKO	100	78	46	58	67	45	18	9	17
DEO	100	71	35	46	61	25	23	11	12
HAZ	100	45	34	33	34	23	21	21	16
GIR	100	37	24	28	35	21	23	11	9
RAM	100	57	23	43	46	16	12	9	14
MED	100	49	31	41	44	12	9	5	11
CHI	100	69	27	34	51	8	11	8	7

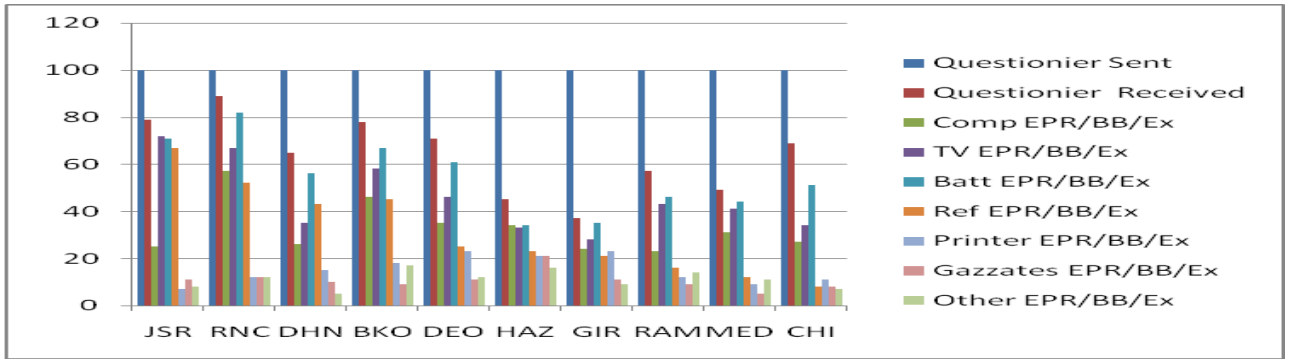


Fig. 12

V. CONCLUSION

EEE trends and development with changing technology is very fast and this fastness is leading to frequent changes of products in use. The old EEE are mainly responsible for contamination of environment as they constitute mostly toxic and hazardous constituernts. The recent development has banned use of certain materials which are deadly for environment and human kind. The old but in practice EEE products are the ones which are loosing their life and are contributing to the e waste . The lack of formal network for collection / recycling / reuse and even disposal leads to a situation where these are left to persons who have no technologyfor disposal and crude disposal takes place. The crude disposal leaves the half disposed substances in environment and in case of opening burning the fumes spreads the gases which are very harmful to environment. These all when add together result in increased degradation. The main constituents have been listed in the paper which have very harmful effects to human kind. The possible health hazards have also been dealt in the section. Health hazards ranges from irretation to severe damages to humans. The study of the slum areas of the major cities of Jharkhand shows the level of contamination to high level and sometimes very alarming level. The major cities which have rich industrial background have persons of varied demography who have access to varity of kinds of electronic appliances. In absence of formal and proper collection system these equipments are handed over to radiwalls who have their own mechanism of distruction or disposal. The study of the buy back / extended producers responsibility / exchange through which these obsolete EEE products which has turned to e waste can be handed over to the manufacturer is also lacking. The mindset of population for small gains is also responsible for unscientific disposals. The buyer gets very marginal amount on buyback or exchange so they prefer to hand over to the radiwals who inturn hand dismentals the product in his own way and sells the components as scrap for the obsolete equipments repair at higher prices. The EPR on other hand invites additonal amout to be paid by the purchaser for proper scientific disposal or collection, hence are not getting popularity. The study of awareness about the regulatory and legislative measures shows the poor response and this also adds to the compounding situation.

The situation is day by day becoming alarming and requires creation of awareness among the masses as purchaser and manufactureres have to be committed to do away with the hazardous substances and replace it by environment friendly & safe materials. The formal sector for collection and disposal has to be created with increased effort in public private partnership for cost consideration and motivating private parties in spreading awareness for sustained development of EEE industry and manage e waste effectively.

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