

Assessment of Local Community Awareness on Health Effects of Improper Electronic Waste Disposal in Rwanda: A Case of Gasabo District Kigali City

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Abstract: *Electronic waste improper disposal in Rwanda particularly in Gasabo district is major health threat due to the fact that there is no laws governing its disposal and local community is not aware of the effect of e-waste on human health and the study was done on 207 informants in Gasabo district and 36 participants from district authorities, 33 participants from sector authorities and 138 participants from local community level*

Keywords: e-waste, health effects, Rwanda

INTRODUCTION

Gasabo is one of the three districts of the most beautiful city of Kigali, it boards with Kicukiro, Rwamagana and

In technological era many electronic equipments and gadgets have been invented, this technological innovation makes life easy, comfortable and simple for people around the globe. The electronics products have evolved since the 1950s where electronics were only limited to radio and television, today the world has turned into a virtual, ranging from automotive engines to automated equipment in production settings: travel with ease, pay bills instantly, getting clothes washed, office now can do away with loads of files which data are stored in discs or sticks instead of cupboards saving office space, factories produces items by the thousands in very little time, bank deposit and withdraw in an automatic cash distributor machine, electronic trade, various kind of communications, telemedicine and entertainment. Electronic industry is experiencing the planned obsolescence strategy where the production of uneconomically short lives products such that customers will have to repurchase more often became a policy.

Electronic waste (e-waste) is one of the fastest-growing pollution problems worldwide given the presence of a variety of toxic substances which can contaminate the environment and human health (1), if disposal protocols are not meticulously managed

and the lifespan of many electronic goods has been substantially shortened due to advancements in electronics. All these factors have contributed to the current phenomenon of continuous increasing of e-waste as emerging environmental health issues. These kinds of problems occur in exchange for the simple and easy lifestyle that people get with the use of electronics. It is urgent to find a balance on how to use electronics and maintain the environment and health safe otherwise we are all at risk while using electronics in our daily lives.(2)

Electronic-waste is much more dangerous than many other municipal wastes because electronic gadgets contain thousands of components made of deadly chemicals and metals like lead, cadmium, chromium, mercury, polyvinyl chlorides (PVC), brominated flame retardants, beryllium, antimony and phthalates (3). Long-term exposure to these substances damages the nervous systems, kidney, and bones, reproductive and endocrine systems. Some of them are carcinogenic and neurotoxin. (4)

Generally, e-waste can be defined as all secondary electronic equipment including computers, entertainment devices, mobile phones, television sets, refrigerators, etc. whether sold, donated or discarded by their original owners.

According to the Australian Bureau of Statistics, Electronic waste are the electronic appliances such as computers, laptops, TVs, radios, DVD players, printers, mobile phones, MP3 players etc. including their assembly, sub-assembly, components and consumables, which have reached end-of-life through being obsolete, broken or used. Sometimes the term e-waste also includes electrical waste such as refrigerators, washing machines, dryers, air conditioners, vacuum cleaners, coffee machines, toasters, irons, etc. The US Environmental Protection Agency (EPA) defines e-waste by categorization (5). EPA policy states that obsolete electronics are not considered waste until a specialized decision is made stating their continuous usability hence the use of

non-waste as indicated in the definition above(6). In Rwanda, E-waste means any electrical or electronic equipment which the holder discards or intends or is required to discard. In Rwanda (7), the legal framework for waste management is documented in the Organic Law N° 04/2005 of 08/04/2005 determining the modalities of protection, conservation and promotion of environment in Rwanda. The Law N° 39/2001 of 13th September 2001 establishing Rwanda Utilities Regulatory Agency (RURA) giving responsibility of handling the removal of waste products from residential or business premises among others. The Law N° 16/2006 of 03/04/2006 determining the organisation, functioning and responsibilities of Rwanda Environment Management Authority (REMA) provides details of its responsibility, among many others responsibility we can list: to implement the Environmental Policy, to assess and approve EIAs for development projects, and to prepare action plans for prevention of environmental risks and hazards (8). The Law N° 43/2010 of 07/12/2010 establishing Energy, Water and Sanitation Authority (EWSA) determining its responsibilities, organization and functioning establishes and defines its responsibilities, among others to establish ways of transporting and treating of waste. However, these Laws do not specifically address E-waste and there are currently no specific legislations regulating the management and safe disposal of Electronic Wastes (9) that is imply that the lower administrative levels which are closer to communities are managing the e-waste issue without any specific legal and regulatory framework (10)

By 2013, the number of active mobile cell phones subscribers was 63.5% of the population which represent 6,689,158 subscribers, the internet penetration was at 20% by December 2013 with 2,068,178 subscriptions, 2.4 % of Household had a computer, 7.8% of Household had a TV set and 64% of household had radio set. Although Rwanda is a signatory to the Basel Convention on the Control of Trans-boundary Movements of hazardous wastes and their disposal, at this stage, nothing has been done about e-waste.

EFFECTS TO HEALTH AND ENVIRONMENT

E-waste consists of a large variety of materials, some of which contain a range of toxic substances that can contaminate the environment and threaten human health if not appropriately managed. E-waste disposal methods include landfill and incineration, both of which pose considerable contamination risks (11). Landfill leachates can potentially transport toxic substances into groundwater whilst combustion in an incinerator can emit toxic gases into the atmosphere.

Recycling of e-waste can also distribute hazardous substances into the environment particularly when the recycling industry is marginally profitable at best

and often cannot afford to take the necessary precautions to protect the environment and workers health.

While there are more than 1000 toxic substances (11) Associated with e-waste, the more commonly reported substances include: toxic metals, persistent organic pollutants (POPs) and polyvinyl chloride (PVC) (12). These are persistent, mobile, and bioaccumulative toxins that remain in the environment (13) But their forms are changed and are carcinogens, mutagens and teratogens. Human beings and other biodiversity face fatal diseases, such as cancer, reproductive disorders, neural damages, endocrine disruptions, asthmatic bronchitis, and brain retardation (14)

COMMON TOXIC SUBSTANCES ASSOCIATED WITH E-WASTE AND THEIR HEALTH IMPACTS.

Substance and location in e-waste	Health impact
Antimony (Sb) a melting agent in CRT glass, plastic computer housings and a solder alloy in cabling	Antimony has been classified as a carcinogen. It can cause stomach pain, vomiting, diarrhea and stomach ulcers through inhalation of high antimony levels over a long time period
Arsenic (As) Gallium arsenide is used in light emitting diodes	It has chronic effects that cause skin disease and lung cancer and impaired nerve signalling
Barium (Ba) Sparkplugs, fluorescent lamps and CRT gutters in vacuum tubes	Causes brain swelling, muscle weakness, damage to the heart, liver and spleen though short-term exposure
Beryllium (Be) Power supply boxes, motherboards, relays and finger clips	Exposure to beryllium can lead to beryllicosis, lung cancer and skin disease. Beryllium is a carcinogen
Brominated flame retardants (BFRs): (polybrominated biphenyls (PBBs), polybrominated diphenyl ethers (PBDEs) and tetrabromobisphenol (TBBPA) BFRs are used to reduce flammability in printed circuit boards and plastic housings,	During combustion printed circuit boards and plastic housings emit toxic vapours known to cause hormonal disorders

Substance and location in e-waste	Health impact
keyboards and cable insulation	
Cadmium (Cd) Rechargeable NiCd batteries, semiconductor chips, infrared detectors, printer inks and toners	Cadmium compounds pose a risk of irreversible impacts on human health, particularly the kidneys
Chlorofluorocarbons (CFCs) Cooling units and insulation foam	These substances impact on the ozone layer which can lead to greater incidence of skin cancer.
Hexavalent chromium/chromium VI (Cr VI) Plastic computer housing, cabling, hard discs and as a colourant in pigments	Is extremely toxic in the environment, causing DNA damage and permanent eye impairment
Lead (Pb) Solder, lead-acid batteries, cathode ray tubes, cabling, printed circuit boards and fluorescent tubes	Can damage the brain, nervous system, kidney and reproductive system and cause blood disorders. Low concentrations of lead can damage the brain and nervous system in fetuses and young children. The accumulation of lead in the environment results in both acute and chronic effects on human health
Mercury (Hg) Batteries, backlight bulbs or lamps, flat panel displays, switches and thermostats	Mercury can damage the brain, kidneys and fetuses
Nickel (Ni) Batteries, computer housing, cathode ray tube and printed circuit boards	Can cause allergic reaction, bronchitis and reduced lung function and lung cancers
Polychlorinated biphenyls (PCBs) Condensers, transformers and heat transfer fluids.	PCBs cause cancer in animals and can lead to liver damage in humans
Polyvinyl chloride (PVC) Monitors, keyboards, cabling and plastic computer housing	PVC has the potential for hazardous substances and toxic air contaminants. The incomplete combustion of PVC release huge amounts of hydrogen chloride gas

Substance and location in e-waste	Health impact
	which form hydrochloric acid after combination with moisture. Hydrochloric acid can cause respiratory problems
Selenium (Se) Older photocopy machines	High concentrations cause selenosis

Source: (15)

METHODS

This study was purposive and all participants were 207 and were distributed as follows: 36 participants from district level stratum, 33 participants from sector level stratum and 138 participants from community level to determine the target population, two methods of sampling was employed: stratified random sampling and quota sampling. Stratified random sampling was applied to determine the primary stakeholders in the electronic waste management in Gasabo district which are (i) the district councilors, (ii) the district executive committee members, (iii) the district staff, (iv) the Sectors staff, (v) contracted waste collectors companies and workers in selected Sectors and Nduba dumping site management company and workers.

RESULTS AND DISCUSSION

AWARENESS OF THE EFFECTS OF E-WASTE ON THE HUMAN HEALTH AND ENVIRONMENT

Findings showed that, the awareness of the respondents about the environmental pollution/threat by the electronic waste is serious and complex, therefore, there is need to have a special treatment for electronic wastes, and the effects of its improper disposal has potential risks to both human health and environment.

ENVIRONMENTAL POLLUTION

Results indicated that the participant who know that improper e-waste disposal has negative consequences on the environment pollution is 64.5% of district level respondents, 62% at sector level and 54.3% at the waste collection company workers.

Pathways of Electronic and Electrical discarded equipment

When participants from the district and sector level were asked if they are aware of what happen to the discarded electronic and electrical equipment, the study revealed that 60% of respondents said that they are refurbished by local repairs, 36.6% said that they are scavenged then smelted to make new materials and 3.3% said that they are sent to land fill.

EFFECTS OF THE IMPROPER E-WASTE DISPOSAL ON ENVIRONMENT

Regarding the risks associated with the improper disposal of e-waste, the study showed that the majority do not know the effects of the improper disposal of the e-waste.

At the district level 77% of respondents indicated that they are not aware of the effects of improper e-waste disposal on the environment while 29% indicated to be aware. At the sector level 89% of respondents indicated not to be aware of the effects. At the waste collection company workers level 89% of respondents indicated to be not aware of the effects of improper e-waste disposal on the environment.

AWARENESS OF THE EFFECTS OF THE IMPROPER E-WASTE DISPOSAL ON HUMAN HEALTH

The results, showed that 74% of the respondents are not aware of the effects of improper e-waste disposal on the human life while only 26% are aware. For sector level 79% are not aware of the effects of improper e-waste disposal and 21% are aware while the waste collection workers 89% are not aware of the effects of improper e-waste disposal. This showed that people in Gasabo district are not aware of effects of improper e-waste disposal on human health. And among the respondents who claimed to be aware of the effects of the improper e-waste disposal on human health 92.3% indicated that they do not know exactly the effects on human health

while 7.7% of them indicated the improper disposal of e-waste has high risk of cancer and skin problems and this is due to heavy metals (4).

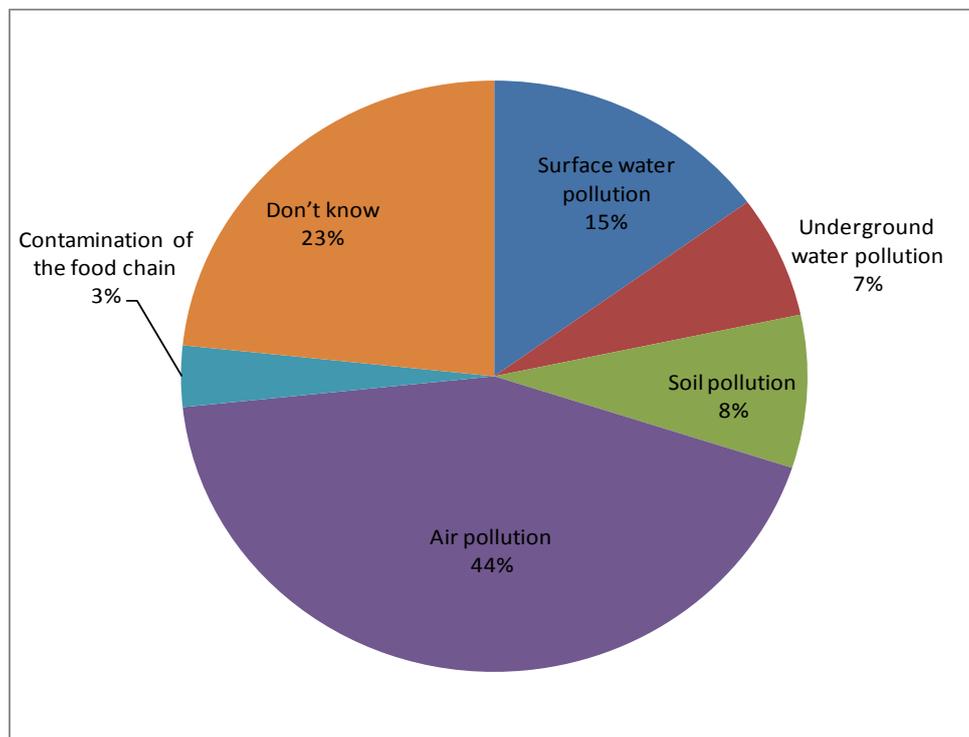
WASTE COLLECTION WORKERS AWARENESS ON IMPROPER HANDLING OF E-WASTE AND LOCAL COMMUNITY

Among the respondents belonging to the waste collection companies and dump site workers' 56.7% confirmed to be aware that improper handling or being exposed to electronic waste may have a negative impact on their health and environment when those e-wastes are liquid or powder while 43.3% said the electronic waste as hazardous than as other wastes.

AWARENESS OF E-WASTE AS ENVIRONMENTAL CONTAMINATION

Results revealed that 44% of respondents are aware that e-waste causes air pollution, 23% don't know the mechanisms through which the e-waste enters into the environment therefore, it does not contaminate the environment, 15% are aware that the e-waste pollutes the surface water, 8% are aware that it pollutes soil, 7% are aware that it pollutes the underground water while 3% are aware that it enters into the food chain. As shown in the figure below

Awareness and local community awareness on electronic wastes and environmental impact



The above pie-chart shows awareness of e-waste as environmental contamination

INCREASE OF E-WASTE

72% of the respondents from waste collection company management and workers indicated that they have noticed an increase of discarded electronic and electrical equipments in the client's waste bins and the dumpsite, 28% indicated to have not noticed any change.

SPECIAL TREATMENT FOR SOME HAZARDOUS FRACTIONS BEFORE DISPOSAL

Within the respondents from the district and sector level, 37% are aware that some hazardous materials need a special treatment before disposal while 63% are not aware.

The research showed that 100% of respondents from waste collection

Company management and workers are aware that e-waste may be entirely valuable which can be sold to repairs or in valuable in parts like metals which are sold to smelters.

The waste are taken from the entrance of every compound by waste workers to the waste truck. The workers have to transport waste a long distance. The waste truck is loaded manually and unloaded manually in Nduba sector while the Kacyiru waste trucks are manually loaded but automatically unloaded. The manual loading and unloading require some workers to operate inside the waste trucks which puts their health in danger (16). In Nduba sector waste workers are equipped with an apron only, while in Kacyiru waste workers are equipped with overalls, boots and gloves. For Kacyiru waste company, the workers operating inside the waste truck are equipped with extra pants covering the overalls and boots which covers them from high risk (8)

HEALTH AND SAFETY CONSIDERATIONS

Waste are not segregated from the waste generator, are stored in inappropriate containers as used and damaged bags previously used to pack rice, sugar or flour, that bags may leak when they contain wet or liquid substances. Other households use old and often damaged basins and buckets. The collection day the containers are displaced to the street, discharged and returned back to its owner to be reused and some of these wastes are non-recycled (17). The waste trucks are loaded or unloaded manually by workers without adequately equipped for such special tasks. Those practices are not safe and healthy to the waste work and even to the environment. Local authorities and waste collection companies leaders should put in place good and health mechanisms to load and offload these waste collection trucks such that they workers are safe.

Again awareness campaigns on the health effects of these heavy metals that are found in these e-wastes should be put in consideration (18)

The government should emphasize on household proper separation of e-waste and put in place policies and regulations that governs e-waste collection transportation and disposal.

In fighting these chronic disease and increasingly observed disease even toxic environment and environmental alterations, the effects of these heavy metals such as Arsenic (As), Mercury (Hg), Nickel (Ni), Selenium (Se) etc should be looked at.

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