An Empirical Analysis on Present Status of E-waste Management Awareness in Chitwan District, Nepal

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Abstract

The study aims to assess the current status of E-waste management awareness in Chitwan District. The electrical and electronic waste (e-waste) is the fastest growing waste rivulets in the world. The increasing "market penetration" in developing countries, "replacement market" in developed countries and "high obsolescence rate" make e-waste as one of the fastest growing waste streams. Environmental issues and trade associated with e-waste at local, national and international level have driven many countries to introduce interventions. It has become an urgent need of the hour to know the awareness level of e-waste management at Chitwan. The exploratory and descriptive survey research method have been adopted in the study. The responses have been taken from the people of Chitwan using convenient sampling method. The survey research design has been used in the study. The 5-point Likert scale has been used to measure the awareness of e-waste management in Chitwan district. The study concluded that e-waste management awareness is mainly important because a few electronic and industrial elements are difficult to dispose of or recycle. When it comes to e-waste, it is important for people to be aware of the increasing threat and secure disposal and their impacts on

socio-economic values as well as health and environment. A growing amount of e-waste is not considered to be products that have stopped working or become obsolete. Technological advances are coming at us at such a dizzying speed that a lot of electronic devices that still work fine are the ones considered obsolete. The main finding of this study is that the respondents consider e-waste management as an eco-friendly practice. Government of Nepal does not have adequate managing policies regarding e-waste. The study has been focused to understand the e-waste recycling status in Nepal and the concept of 3R'S (reduce, reuse and recycle) should be implemented as soon as possible.

Keywords; E-Waste, Market Penetration, Replacement Market, Obsolescence, E-waste Management Awareness

Introduction

Electronic waste (e-waste) is waste electronics/electrical goods that are no longer usable and reached the end of their useful life. Apart from white goods like refrigerators and air conditioners, this could include items like computers, servers, mainframes, monitors, CDs, printers, scanners, copiers, calculators, fax machines, battery cells, cellular phones, transceivers, TVs, medical devices, and electronic components. Electrical and electronic equipment consumption and production have increased as a result of rapid economic expansion, urbanization, and a growing desire for consumer products. The information technology industry has been one of the most important drivers of economic development in the previous decade, contributing considerably to the global digital revolution. New technological gadgets and appliances have entered every part of our everyday lives, bringing more comfort, health, and security to our society. The knowledge society is leaving its own destructive imprint.

E-waste is one of the fastest-growing waste streams, thanks to rising market penetration in developing nations, a "replacement market" in developed countries, and a "high obsolescence rate." While having some of the world's most advanced high-tech software and hardware development facilities, this new type of garbage is providing a severe issue in terms of disposal and recycling for both developed and developing countries. The dumping of e-waste, particularly computer garbage, into Nepal by wealthy countries, who find it easier and cost-effective to export waste, has exacerbated waste management issues. As a consequence, e-waste management is concerned with

environment and public health. Unscientific urban e-waste mining causes health risks, soil and water contamination, and air pollution, affecting a large number of people. As a result, it's critical to figure out the people concerns on e-waste management and environment. Electronic trash has become a global environmental problem. It raises worries about a variety of other pollutants, including air and water pollution, soil contamination, and human exploitation. Such garbage is difficult to dispose of because it contains chemicals that, if not handled appropriately, can be detrimental to humans and the ecosystem as a whole.

Toxic substances such as lead, mercury, and phosphor compounds, among others, can harm the reproductive, renal, and respiratory systems of humans. E-waste is a idiomatic span for electronic goods that have touched the end of their useful lives and is deemed unsafe. There's no agreement on whether the phrase should apply to the resale, reuse, and refurbishment sectors as a whole, or only to products that can't be utilized for their intended purpose. Underground water is not drinkable in most parts of the world. Long ago, people used to just drink water drawn from wells. However, everyone uses a filter to cleanse and make the water drinkable. It's only one of the numerous issues and dangers associated with e-waste. Electronic gadgets, dead cells, and batteries that you throw away with other trash contain lead, which quickly combines with subterranean water and renders it unsafe for human use. The development of technological capability during the last century has brought a new challenge in waste management. Computers, for example, include extremely harmful chlorinated and brominated compounds, poisonous gases, toxic metals, biologically active elements, acids, plastics, and plastic additives. As a result, while discarding or recycling e-wastes, effective management is required.

In Nepal, e-waste management assumes greater significance not only due to the generation of its own e-waste but also because of the dumping of e-waste from developed countries. This is coupled with Nepal's lack of appropriate infrastructure and procedures for its disposal and recycling. Effective waste management can decrease civil and criminal liability risks, operation costs and the need for transport and disposal. Perkins, et al., (2014) had revealed that the amount of e-waste generated each year was increasing at an alarming rate. Globally above fifty million tons of e-waste were produced in 2019.

The 24.90 million tons of e-waste were created in Asia Pacific area. The quantity of e-waste produced in the globe grew three times faster than the global population.

Furthermore, the bulk of e-waste created is redirected for landfilling, which is a prevalent method of e-waste disposal across the world. The existing e-waste management procedures have two fundamental flaws: a lack of effective collection and recycling infrastructure, and a lack of mechanisms to make manufacturers accountable for end-of-life disposal. Because of this, improper e-waste recycling practices may have negative effects on the environment and human health. Thus, the objective of the study is to identify the issues and difficulties associated with managing e-waste in Bharatpur, Chitwan and to suggest appropriate management strategies and policy approaches to handle and regulate e-waste in order to significantly reduce environmental and health concerns.

Conceptual Review

E-waste is a generic term embracing various forms of electric and electronic equipment that have ceased to be of any value to their owners (Widmer, et al., 2005). E-waste is waste that comprises both electronic white goods and brown goods which have reached the end of their current owner's needs (Kalana, 2010). E-waste refers to any white goods, consumer and business electronics, and information technology hardware that is at the end of its useful life (Khurrum, et al., 2011). E-waste is the term used to describe old, end-of-life electronic appliances such as computers, laptops, televisions, DVD players, cellular phones, MP3 players etc. which have been disposed of by their original users (Enviroclaim, 2012). E-waste is a term used to cover items of all types of electrical and electronic equipment and its parts that have been discarded by the owner as waste without the intention of re-use (United Nations University & Step Initiative, 2014).

Anything that works with electricity or batteries and it is no longer needed or it is no longer working is classified as e-waste (Africa E-waste, 2015). Any device that held or required an electric charge for its intended operation and which has reached the end of its useful life as mentioned by KZN Department of Economic Development, Tourism and Environmental Affairs, (2015). United Nations University and Step Initiative (2014), namely, "e-waste is a term used to cover items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without

the intention of re-use", was adopted. Old, end-of-life, or malfunctioning electrical and electronic equipment are referred to as e-waste. Computers, electronics, mobile phones, household appliances, and other items that have been discarded by users are referred to as e-waste.

The world is currently in the phase of the Information Technology (IT) revolution, following the industrial and agricultural revolutions. The IT revolution has resulted in significant increases in productivity and efficiency. It has increased people's quality of living. The electrical and electronic products have become necessary in our life. The fast expansion of electronic and electrical items has created a new environmental problem for E-waste treatment. All secondary computers, entertainment electronic devices, mobile phones, and other products such as TVs and refrigerators, whether sold, donated, or thrown by their original owners, are considered as electronic trash. Several public policy activists use the term e-waste to refer to all surplus electronics because cargoes of surplus electronics are typically mixed (good, recyclable, and non-recyclable). Obsolete computers are classified as "hazardous home waste" by the US Environmental Protection Agency (EPA). The distinction between "commodity" and "waste" electronics classifications is still up for debate. Some exporters may purposefully combine old or nonfunctioning equipment into cargoes of working equipment to make it difficult to recognize (through ignorance, or to avoid more costly treatment processes). The term "waste" electronics could be widened by protectionists. Electronic garbage (e-waste), or obsolete electrical or electronic gadgets is a major global concern, as it is currently the world's fastest increasing waste source (Ogunseitan, et al., 2009).

The recovery and recycling rates of e-waste are estimated differently depending on the region. Only about 25% of e-waste generated in the European Union (Perkins, et al., 2014) and 40% in the United States (USEPA, 2015) is properly recycled each year, with the rest becoming "untraceable." Rapid economic growth has resulted in a surge in demand for new electronics, resulting in an increase in both production and consumption of electrical and electronic equipment around the world. The electronics industry has grown to become the largest and fastest growing industrial sector on the planet (Schwarzer, et al., 2005). E-waste generation is predicted to reach 93.5 million tons globally in 2016 AD (Tiwari & Dhawan, 2014), yet e-waste management technologies are

still in their early phases, particularly in newly industrializing countries. According to estimates, 1734 percent of e-waste produced in wealthy countries is shipped to underdeveloped countries each year (including illicit exports) (Breivik, et al., 2014). This includes discarded but repairable and reusable electronic devices that find their way into secondary markets before ending up in landfills. The legal trade of e-waste has slowed since the ratification of the Basel Convention in 1989, especially from industrialized to developing countries (Lepawsky, 2015). The specific products of electronic waste are listed in Table 1.

Table 1

Electrical and Electronic Equipment's covered by WEEE Directive

Product Category	Specific Product Name
Large household appliances	Refrigerators, freezers, washing machines, clothes dryers, dish-washing machines, electric stoves, microwaves, electric heating appliances, electric fans, air conditioner appliances
Small household appliances	Vacuum cleaners, carpet sweepers, irons, toasters, fryers, coffee grinders, electric knives, coffee machines, tooth brushes, shavers, clocks, scales, hair dryers
IT & Telecommunications equipment	Mainframes, minicomputer, printer units, personal computers, notebook computers, copying equipment, electric and electronic typewriters, pocket and desk calculators, user terminals and systems, facsimiles, telephones, cordless telephones, cellular telephones, answering systems
Consumer equipment	Radio sets, television sets, video cameras, video recorders, audio amplifiers, musical instruments.
Lighting equipment	Straight fluorescent lamps, high pressure sodium lamps and metal halide lamps, low pressure sodium lamps, other lighting equipment
Electrical and electronic tools	Drills, saws, sewing machines
Toys, leisure and sports equipment	Electric trains or car racing sets, hand-held video game consoles, video games.
Medical devices	Radiotherapy equipment's, cardiology, dialysis, pulmonary ventilators, nuclear medicine, laboratory equipment's for in-vitro diagnosis, analyzers, freezers.
Monitoring and control instruments	Smoke detectors, heating regulators, thermostats, measuring, weighing or adjusting appliances for household or as laboratory equipment.

Automatic dispensers	Automatic dispensers for hot drinks, automatic dispensers for solid products.

Source: European Waste of Electrical and Electronic Equipment's (WEEE) Directive, 2012/19/EU

Table 2

Country Wise E-Waste Management Practices

Practice / Countries	Australia	India	China	Malaysia	Indonesia
Electrical and electronic equipment modelling and e-waste estimation	√	√			
E-waste legislation and implementation practices	√	√	√		
Material flow analysis of e-waste	√				
E-waste generation estimation and recovery potential	√				
E-waste management practices	√	√	√	√	√
Extended producer responsibility (EPR) legislation	√	√			
E-waste recycling scheme	√	√	√	√	
E-waste generation and mitigating measures	√	√	√	√	
E-waste management systems	√	√	√	√	
E-waste social related issues	√				
E-waste environmental and health impacts	√	√			

Source: Khetriwal and Jain, 2021.

Nepalese Scenario

Although the usage of electronics in daily life is almost as essential to our survival in our quicklyglobalizing world, consumers are still uninformed of the proper management as well as future effects of the waste generated. This is mostly owing to the fact that there is only a small body of knowledge on e-waste in the field of waste management. Furthermore, different countries view and manage e-waste in different ways. Local level is responsible body for the collection of waste materials in Nepal. Local levels collect the waste from household and dispose them. At present waste materials are collected randomly from the household without being separated. All of the waste products are disposed directly. Those waste products also comprise of electronic waste and disposing them directly into environment has raised the concern. The import of electronic product is increasing day by day in Nepal and government lacks proper guidelines and regulations for the proper disposal of those items after their lifetime is over. The citizens of Chitwan

are at risk to the contamination caused by emissions from those devices and equipment's. If this continues then Chitwan is sure to face difficult time in near future as this type of wastes could not be recycled. In constitution of Nepal, it has secured the rights of public to survive in clean environment as fundamental rights.

The provision of Environment Conservation Act and Environment Policy talk about the conservation of nature and natural resources. It has the provision for Initial Environment Examination IEE and Environment Impact assessment. These acts focus on the sustainable development and seems that Nepal is also concerned in the waste management. Waste is managed according to Solid Waste Management Act. But this alone is not enough. However, there is no separate Act or regulations for electronic waste management. The waste management depends upon the scavengers and scape hawkers. They are the one who separates the waste product into recyclable and non-recyclable at landfill sites. The recyclable waste separated by them are then delivered to scrap dealers. Some earlier studies on the state of e-waste management in Nepal have emphasized the importance of developing legislation to reduce E-waste generation.

Chitwan Scenario

Bharatpur, Ratnanagar, Madi, Kalika, and Rapti municipalities, as well as various rural municipality are the structure of Chitwan. Bharatpur Metropolitan is one of Nepal's largest municipalities, with a population of 1.5 million people. Informal interviews conducted in various government departments revealed that there are no regulations for obtaining a license to import electronic equipment; therefore, it can be imported for commercial purposes or by individuals. Individuals who wish to ingress goods for individual use must notify the government and pay the relevant customs tariffs by bringing an approval letter from the Ministry of Information and Communication to the Department of Commerce. The contacted government officials identified no plan or efforts toward environmentally sound management of e-waste from any concerned government authorities about e-waste and its management. The study conducted by CEPHED in 2011 AD, Kathmandu is the electrical and electronic equipment's' largest market, followed by Chitwan, which serves as the country's business center.

According to a market report, business has declined in comparison to previous years, yet consumers have not ceased purchasing electrical and electronic equipment's.

Chinese goods are sold in Chitwan's market, as they are in other areas. Apart from China, electrical equipment may be found in Chitwan from India, Singapore, Japan, Malaysia, and other countries. Because a significant number of electronic devices are utilized in, a large number of people come to have them repaired. However, like in other regions, many involved in repair and maintenance lack e-waste management training and are unaware of the health risks posed by e-waste. The sole known destination for abandoned e-waste in Chitwan appears to be scrap dealer (Kwadis), with the rest ending up in the general solid waste stream along rivers' banks or temporary landfills. The scrap dealers collect the remaining unused parts from repair and maintenance shops. It does not seem that there is a fixed price to buy e-waste in Chitwan, which entirely depends on the condition (whether it can be reused or it is of no use). As the metal recovery from these wastes are completed, remaining parts go to places like Birgunj and Janakpur to be exported to the nearest Indian markets.
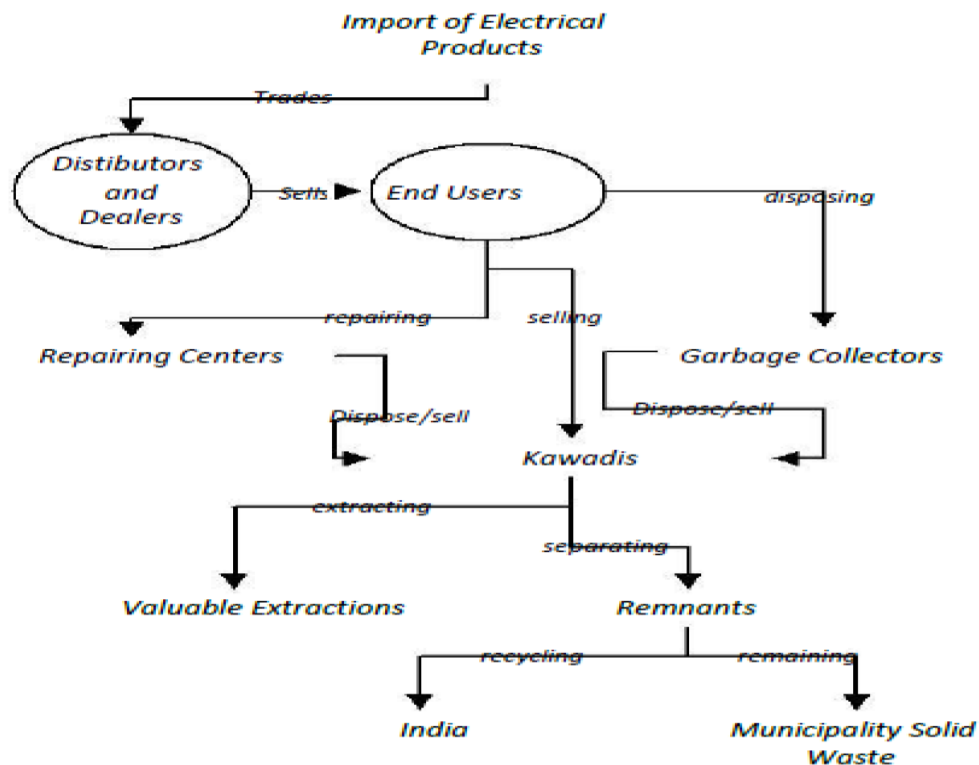

Figure 1

The Flow of Electronic Item and Waste in Nepal

Karmacharya, Basnet and Rana (2010) performed the study on status of E-waste and potential mitigating measures using IT, where it was found that the e-waste is sent to India for recycling but not proper laws, policies and reports is maintained to supervise flow of e-waste. The flow of electronic items and waste is shown in the Figure 1, where it is seen that the waste is collected at scrap dealers and after some valuable extractions are either transported to India or dumped at the municipal solid waste. Previous study by then Ministry of Environment, Science and Technology in 2007 brought some statistics forward with the steady increase in the use of electronic equipment's. It was suggested that due to hazardous nature, the e-waste should not be dumped together with Municipal Solid Waste (MSW) and the proper initiatives for management of e-waste must be commenced before it was too late. In the same study it was forecasted that the number of mobiles would reach 1.7 million by 2007, which has been increased by many folds to this date. Nepal's constitution has reserved the right to survive in a clean environment as fundamental right of any citizen. Section 30 about fundamental rights in the constitution has provisions for right to clean environment.

Environment Protection Act (1997), has been formulated and enacted effective from January 30, 1997, according to the Nepal Telecommunication Authority's statement on e-waste legislation. The act's preamble aims to make legal provisions as quickly as possible in order to maintain a clean and healthy environment by minimizing, as much as possible, the adverse effects likely to be caused by environmental degradation on humans, wildlife, plants, nature, and physical objects; and to protect the environment through proper use and management of natural resources, taking into account that sustainable development can be achieved through the inseparable inter-relationship between the economic development and the environment protection. A proponent is required to conduct an Initial Environmental Examination (IEE) and an Environmental Impact Assessment (EIA) under the statute. There are the provisions for pollution prevention and control.

The act also includes provisions for national heritage protection, environmental protection, and the establishment of a laboratory. The power to form an Environmental Protection Council has also been provided, with the goal of providing policy guidance and suggestions to the Nepalese government on environmental issues, as well as

coordination among other agencies at the national level. Although provisions are made to formulate guidelines and Rules as stated relating to the Environmental protection, it seems that there has not been any regulation, guidelines/directives in connection with the e-waste management. The Solid Waste Management Act and the Solid Waste Management Rule were enforced on their respective dates of publication in the Nepal Gazette. Hazardous substance management regulations are included in the solid waste management legislation. Unfortunately, neither of the bills specifically mentions e-waste as a waste stream. Because electronic wastes are classified as hazardous wastes under the Basel Convention, the Solid Waste Management Act only mentions them briefly.

However, because hazardous waste is a broad category that includes fertilizers, pesticides, and other chemicals that require different handling than electronic trash, Nepal needs a unique e-waste policy. Nepal's government has set a program to reduce greenhouse gas emissions through lowering fossil fuel use. Vehicles with electronic engines have been emphasized, and these vehicles use lead acid batteries. Those batteries aren't indestructible and will need to be replaced in the near future. If lead acid batteries are disposed of in the soil without being properly treated, the soil's quality may be harmed. As a result, Nepal's electronic waste management has become a source of concern and problem.

Research Methods

The study had adopted exploratory as well as descriptive study. The quantitative data required for the study has been collected by conducting the survey through a well-structured self-administered questionnaire. The study area is populated by industrial and manufacturing organizations and the potential to generate e-waste is relatively high. Questionnaires were distributed and twenty to twenty-five minutes time had been given to the respondents to fill up the questionnaire in order to reduce the sampling error. The convenience sampling method had been used in the study. The 5-point Likert scale had been used to take the response from the respondents on the given items in the study. The frequency, percentage, mean and summated mean score had been calculated to analyze and interpret the data. The target population of the study constituted Nepalese residing in Chitwan. The useable 108 samples from Chitwan district had been taken for the study.

Results

Assessment of Status of Demographic Characteristics

Table 3

Demographic Profile

Variables	Frequency	Percentage
Gender		
Female	52	48.1
Male	56	51.9
Total	108	100
Age		
Below 25 years	42	38.9
26-35 years	30	27.8
36-45 years	14	13.0
Above 45 years	22	20.4
Total	108	100
Education		
Secondary	34	31.5
Bachelor	50	46.3
Masters	22	20.4
Above Masters	2	1.9
Total	108	100

Table 3 provided the profile of respondents based on gender, age and education. Among total respondents, majority of respondents were male and remaining were female. Male were more interested in e-waste management. More than 46 percent of the respondents had bachelor degrees. It indicated that the respondents were literate and shown that they could understand the theme of e-waste management awareness in Chitwan, Nepal. Thus, the study covered the ideas of undergraduate peoples.

Analysis of Respondents Opinion on E-Waste Management in Chitwan

The survey polled 108 persons on their thoughts on 'E-Waste Management Awareness in Chitwan.' The initiative or E-Waste management techniques, according to respondents, were good and should be implemented as soon as possible. The majority of the participants were concerned about environmental degradation and stated that each household or individual should played the major part in reducing the e-waste footprint in Chitwan. During the survey, e-waste was found significant due to its direct influence on the environment. Secondly, the majority of individuals had believed that recycling e-waste

was important for environmental and resource sustainability. Furthermore, the participants also mentioned the influenced on human and environmental health. The participants offered the wide range of proposals, the majority of which focused on Nepal's frail legal system and the need for the government to solve legal issues. They had recommended that the awareness program about e-waste management should be included in the school curriculum. There should be the need of long-term strategy for reducing, reusing, and recycling e-waste.

Analysis of E-Waste Management Awareness s in Chitwan

The analysis was based on 5-point Likert Scale. In Likert scale, 1 has been assigned for strongly agree (SA), 2 for agree (A), 3 for neutral (N), 4 for disagree (DA) and 5 for strongly disagree (SDA). The mean score, summated mean score and grand mean were assessed through the use of SPSS software. The question and variables ranked supported the mean and analyzed the worth accordingly as shown in Table 4.

Table 4

E-Waste Management Awareness in Chitwan

STATEMENT		SA	A	N	DA	SDA	MEAN	RANK
EWM 1	E-Waste management is familiar among people.	15	53	18	18	4	2.47	IV
EWM 2	E-Waste management is ecofriendly.	63	25	15	2	3	1.68	I
EWM 3	Government has E-Waste management policies.	2	6	35	24	41	3.89	VI
EWM 4	Public sector has done proper contribution in E-Waste management.	2	10	22	56	18	3.72	V
EWM 5	E-Waste management seems economical.	23	57	18	8	2	2.16	III
EWM 6	E-Waste management reduce electronic waste footprint in environment.	72	8	20	6	2	1.69	II
						GM	2.60	

Table 4 had exhibited the e-waste management awareness measured through 6 items questionnaire. The analysis found that the respondents had given first ranking to e-waste management as ecofriendly because through proper management of electronic wastes, it promoted sustainable environment. Secondly, the respondents had thought that

e-waste management reduced the electronic waste footprint in environment. Simultaneously, they thought that the initial cost of e-waste management was economical. Respondents were familiar about e-waste management and public sector had not done proper contribution in e-waste management. Finally, the respondents thought that the government had not implemented e-waste management policies. The grand mean score had indicated that the people of Chitwan district were aware on e-waste however, the government policy and support needed for good e-waste management.

Discussions and Conclusions

E-waste is being generated and collected in developing countries all over the world. To lessen the adverse impacts of dangerous compounds in e-waste on the environment and human health, this e-waste recycling issue must be addressed. Because this type of debris cannot be recycled and is too toxic to be managed at landfill sites, Nepal is bound to have a difficult time in the coming days. In Nepal, industrial waste management appears to be a major challenge. The most serious issue with e-waste is that the Nepalese government lacks any laws or regulations governing the proper management of hazardous e-waste. The government has been dealing with all environmental issues under the Environmental Protection Act of 1997, which excludes e-waste treatment. This e-waste recycling issue must be solved in order to reduce the negative effects of hazardous substances in e-waste on the environment and human health. Because this type of garbage cannot be recycled and is too toxic to be treated at dump sites, individual safety would be jeopardized if adequate legislation and strategies for e-waste management were not in place. There is no distinct law for the management of e-waste in the government. It's a severe problem that needs to be handled as soon as possible in order to preserve the environment and individuals from becoming victims. There is no organized mechanism for collection, transportation and disposal of e-waste in Nepal and no mechanism exists in the capital to monitor and track its inventory, collection, transportation and disposal. Due to hazardous nature, the e-waste should not be dumped together with Municipal Solid Waste (MSW). Finally, the study had pointed out the proper management of e-waste in Chitwan effectively.

Implications

The state has no system in place to collect, transport, destroy, or dispose of e-waste. As result, a competent institutional structure to check into the e-waste trade chain is required. No scientifically developed facility for its safe disassembly and disposal exists in the state. Within the country, a segregation, dismantling, and recycling plant is required so that potential environmental problems can be avoided as soon as possible, and money creation and job possibilities can be generated. Raising public awareness about the dangers of e-waste and how to reduce its generation can be accomplished at the national level. Formulation of policy by involvement of all stakeholders: government, NGOs, waste dealers, and producers/suppliers of electronic products define hazardous materials and e-waste under Environment Protection Act and Environment Protection Regulation. Developing countries are suffering from the fact of being dumping ground of second-hand electronic devices. Hence, the concerned authorities should employ strict rules of prohibiting the import of second hand, refurbished items and electronic wastes. Requiring waste dealers to furnish information on e-waste generation, storage, transportation and disposal. Ban on outdated recycling technologies such as open burning, simple incineration, and rough extraction of metals from e-waste using acids. Promotion of environment friendly devices that seamlessly adjust to the environment, which are easily degradable and durable.

Acknowledgements

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