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Research Article

Policy and Practices of E-Waste Management in Nepal: An Emerging Challenge

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Abstract

E-waste management is an immediate matter of concern for every country of the world as it not only pollutes the environment but also very toxic and hazardous to the health of living beings. Major challenges to its management come from lack of understanding of the scope and depth of the management methods, legislation relating to e-waste and socio-economic issues of the country. These challenges can be resolved only if public-private partnership goes hand in hand with knowledge of the consequences of improper disposal practices. The reuse and recycle of e-waste is to be disseminated backed by the proper Regulatory Framework.

Keywords:*E-waste, E-waste management, E-waste management in Nepal, E-waste Regulatory Framework, E-waste in Nepal.*

1. Introduction

1.1 Background

The world of today is characterized by strong international competition and rapid technological advancement [1]. Population growth, expansion of areas and economic activities are major inheritant characteristics of urbanization resulting in the growth volume of municipal solid waste (MSW) which creates an ever-increasing major global concern. In low-income nations, managing municipal solid waste (MSW) is critical for protecting human health and the environment. Kerere *et al.* (2018) claim that in the Guiyu region, people of surrounding settlements may be exposed to significant quantities of hazardous compounds and soil contamination [2, 3].

In order to enjoy a lavish life, people are heavily dependent on electrical and electronic equipment (EEE). The global Electronic-Web (E-Web) is thus established as a result of increased demand and consumption for EEEs [3]. E-waste has beenoverrun, and its handling has emerged as one of the world's most pressing problems [4]. In the late 1980s, the dangers posed by e-waste development and management led to the issuance of strict environmental restrictions in developed countries. As a result, the cost of processing hazardous waste increased. The so-called developed nations adopted a strategy to shift the burden of decaying e-devices to the underdeveloped and developing countries with slight refurbishing as a result, illegal trading started to take place at cheaper prices in developing nations.

1.3 billion tonnes of solid garbage are produced annually in cities, which was 680 million tonnes a decade ago, according to statistics from the World Bank [5]. Earth's generation of solid waste will have been doubled by 2025, with 53 percent of the growth coming from low- and lower-middle-income nations. South Asian countries generate 70 million tonnes of solid trash each year, ranging from 0.12 to 5.1 kg per person every day-1 [5,6]. Across the globe, the cost of garbage management has constantly increased. It was valued at US$205 billion in 2010, and it is expected to be worth US$375 billion by 2025.

Kathmandu has been facing waste management issues since 1970, despite producing only 0.66 kg of MSW per individual each day [6]. 64.24 percent of

the domestic waste in Kathmandu is made up of plastics (15.96%), paper and paper products (8.66%), glass (3.75%), metals (1.72%), textiles (3.4%), rubber and leather (1.12%), and others (1.15%) [6]. (Asian Development Bank, 2013). In Kathmandu, commercial firms and non-governmental organizations, or NGOs, collect and transport 30% of MSW, whilst informal scavenging handles 10% of SWM and formal recycling is non-existent (Nippon Koei Co. Ltd. and Yachiyo Engineering Co. Ltd., 2007).Despite spending US$2.71 per capita per year on SWM, equivalent to 1.01 percent of GDP, the majority of countries spend less than 1% of GDP on SWM. The results exceed those of their South Asian counterparts [6] and those suggested for low- and middle-income cities (i.e., spending no more than 0.5 percent of GNP on SWM) [7].

In Nepal, the average efficiency of collecting MSW is 62%; however, only 37% of it is actually disposed. The efforts to organize SWM in Kathmandu were moved from the local government to the national government, to donor organizations, and then back to the municipalities, according to a 2013 study by the Asian Development Bank, or ADB. As a result, the majority of e-waste in Nepal originates from households, businesses, and the government, which either import equipment with a short lifespan, obsolete technology, or other similar items.

1.2 Objective of the study

The fundamental questions that are answered in this review are:

a. To investigate the challenges for e-waste management in Nepal
b. To suggest the Regulatory Framework that are feasible in Nepalese context

However, the overarching goal of our investigation is to determine the ramifications of resolving these issues for e-waste management.

1.3 Methodology

This paper is entirely derived using the various relative articles and information available on the topic in public domain. The consideration has been towards various emerging nations, having e-waste management challenge such as India, China, and Malaysia, and attempt has been made to identify the major issues in dealing with e-waste. Finally, some relative techniques have been presented that may be useful to limit the production of e-waste and maximize its amount that can be recycled. The majority of relevant literature of the issue that supports the review's purpose is studied, and a conclusion is reached based on that analysis to uncover the methods of solving these challenges for e-waste disposal.

1.4 Limitations of the Study

a. The paper is based on the secondary data.
b. Conclusion may not be valid for all, as this study is based on the literature review only.

2. Literature Review

This chapter entails the finding and conclusion of different credible and published article, research, study, reports conducted by various individuals and institutions from countries that have a similar demographic, socio-economic and environmental background as Nepal to know exact scenario of the e-waste management issues.

According to Zurbrügg et.al., integrated and sustainable SWM should not only be given high importance, but also must go beyond technical difficulties to incorporate multiple critical sustainabile components to ensure the success of any solid waste project by strengthening legislation and norms and emphasizing waste transportation and disposal technology.

The Solid Waste Management National Policy was passed by the Nepalese government in 1996. Every local authority, particularly municipalities, was

required by this program to establish a separate sanitation unit that included SWM. The Kathmandu city and 15 municipalities have dedicated sanitation or SWM departments, according to Nippon Koei Co. Ltd. and Yachiyo Engineering Co. Ltd. (2005). The remaining towns' public health and sanitation departments, which are in charge of sweeping and waste collection, have merged. Many individuals have questioned the fundamental principle of improving SWM structure and effectiveness by establishing a centrally recognized body to support municipalities' efforts.

According to Thapa and Devkota (1999), a new national agency, as anticipated in the SWM National Policy 1996, would create a variety of difficulties in managing local resources to handle SWM and would ultimately undermine efforts to promote resource centralization and strengthen self-governance [8]. The GTZ offered Kathmandu Valley communities two options before stopping aid in 1993: clean and collect rubbish or adopt SWMRMC and be reimbursed for sweeping and collection charges. The Environmental Policy and Action Plan, 1993, which empowered municipal wards to collect waste and dispose at fixed points or municipal landfills.

The government established the Kathmandu Valley Development Council, which comprised 39 ministries and secretaries but only three representatives from local governments. Even though decentralization was the objective, SWM was given to the Ministry of Local Development (MLD) [9]. The Kathmandu administration, which was making an effort to control waste, made consistent progress without fully adopting the previous strategy. Recognizing the urgent need to regulate SWM in Kathmandu, the commission recommended a GTZ Fact-Finding Mission to look into SWM in Nepal in 1996. The mission's findings revealed the need for a new national policy with broad, integrated, accurate, realistic, and measurable goals that could link to the then existing SWM procedure.

Even though the above study recommended developing a comprehensive national policy combining the then existing waste legislation, the timing and influence on SWM National Policy, some foreign partner seemed interested in reviving previous projects, such as SWMRMC. The central government attempted to prepare this policy, ignoring earlier policies which remained unimplemented, according to Joshi (personal communication, 21 July 2007) and Thapaliya (personal communication, 21 July 2007).

When SWMRMC was on the verge of bankruptcy it had 900 sweepers earning wages comparable to those paid to industrial workers, the government implemented a new regulation as a backdoor attempt to save the company. Municipal officials in Kathmandu claim that although NR140 million was spent to retire these kuchikars from SWMRMC, crucial tasks outlined in the policy objectives, like developing building-integrated SWM strategies, have not yet been actually completed (Joshi, Mainali, and Manandhar, personal communication, 2007)[9,10].

In 2005, the National Environmental Impact Assessment Guidelines for SWM Projects in Nepal’s Municipalities (NEIA Guidelines for SWM Projects in Nepali Municipalities) were issued. According to the guidelines, municipalities in Nepal should perform an initial environmental evaluations (IEEs) and environmental impact assessments (EIAs) before commencing any SWM projects [10]. Even though there are regulations, Kathmandu has not yet completely implemented SWM programs. The technical staff member for the GLS's building projects addressed to a query regarding the nature of the IEE and EIA conducted for the Gokarna Landfill Site and Sisdol Landfill Site by claiming that it lacked the appropriate academic training to perform

these examinations and evaluations (SLS). As a result, a Japanese expert was consulted for the GLS technical assessment [11,12].

Globally, 2050 million tonnes of e-waste are expected to be wasted each year, whereas, Asia accounts for approximately 12 million tonnes (Greenpeace International, 2005). Despite the fact that per capita e-waste creation in India and China is less than 1 kilogram per year, the total volume of e-waste generated is enormous [12]. Developed and industrialized countries are the main producers of e-waste. The United States is the world's largest e-waste generator, according to the USEPA (2009), with 3.16 million tons created in 2008.

Many metals are found in electrical and electronic goods, many of which are toxic to people and ecosystems. Metal ions make up more than 60% of e-waste, with hazardous metals accounting for only 2.7 percent. Because harmful compounds such as aluminum (Al), arsenic (As), bismuth (Bi), cadmium (Cd), chromium (Cr), mercury (Hg), nickel (Ni), lead (Pb), and antimony (As) are included in these wastes, effective waste management (collection, storage, recycling, and disposal) is required (Sb). E-waste collection in 2017 is expected to surpass 17,730 metric tonnes, according to the Department of Environment (The Himalayan Times, 2017).

International accords, like the Basel Convention, Stockholm Conference, and EU Directives (WEEE and Reduction of Hazardous Substances (RoHS)), were developed to minimize the unlawful exports of hazardous waste due to the enormous consequences of the increasing piles of e-waste.

Switzerland has been found adopting coercive initiatives towards framing appropriate regulation to promote recovering of WEEE, take back approach and the ordinance on the return schemes and disposal of EEE (ORDEA) in 1998 to ascertain that any defunct or outdated (e-waste) devices should not be mixed with solid waste considering that should be the responsibility of the manufacturers or the retailers to manage. The Swiss ICT Industry Association has adopted a policy that specifies the invoice of any new electronic item must include charge to cover the recycling case from 1 to 20 euros as applicable.

Japan was the first nation to develop both the "Revised Law for Promotion of Effective Utilization of Resources" and the "Specifies Home Appliance Recycling Law" (SHARL) for LHA was Japan. The consumer is obligated by these laws to pay collection and recycling fees after leaving the products at the collection station or retailer. Using a coupon system where customers pay a fee for the waste, the E-waste recycling system for household appliances was designed in Japan.

The Norwegian legislation provides a special procedure for dealing with e-waste, such as requiring that the distributor or the local government entity handle it for free. The treatment of electronic waste was governed under the Hazardous Trash (Management and Handling) rules up to 2010. Because there are important concerns and negative consequences of e-waste on the environment and human health [13, 14].

India campaigned for the development of a comprehensive strategy to address the hazards associated with e-waste and its growing concern. According to the Environmental Protection Act (EPA) of 1986, the Government of India started enforcing the first E-waste (Management and Handling) Rules in 2011. Everyone involved in production, distribution, sale, purchase, or processing was subject to the rules. The guidelines were laid forth in order to reduce the amount of dangerous waste that needed to be disposed of by collecting, disassembling, handling, transporting, storing, sorting, and recycling materials.

3. Characterization of waste

In emerging economies, waste collection systems are usually overcrowded, and dumpsites are unregulated and poorly managed. The problem is becoming worse [15, 16]. Due to inadequate institutions, increasing urbanization, and ongoing insufficient resources, waste management is a regular issue in many nations and towns. Trash treatment is influenced by all of these challenges as well as a lack of understanding of the many components of the waste management hierarchy [16]. Industrial waste management remains a challenge in the developed world even though nearly all industrialized nations and communities have established an appropriate waste management systems and regulations.

According to the European Waste Catalogue, defining rubbish's composition and categorizing it as completely hazardous, partially hazardous, or completely non-hazardous are indeed the primary elements in defining garbage. Absolute hazardous entries are hazardous because of the method by which they were produced, but non-hazardous absolute entries are problematic because of the process by which they were created.

4. Risk assessment of Waste management

The systematic process of evaluating the potential risks associated with a planned waste management operation or attempt is referred to as risk analysis in the field of waste management [4,17]. Successful collaborations between corporations, the general public, state regulators, and other stakeholders require environmental risk communication skills. As more risk-based decisions are made in environmental management, understanding the science behind risk assessment is becoming increasingly critical for all stakeholders involved. To encourage public participation in environmental decision-making, all interested parties must understand the core concepts of risk assessment and be able to discuss the evolution of the analysis' assumptions on an equal footing.

5. E-Waste Management in Nepal: An Emerging Challenge

Electronic waste, or e-waste, refers to discarded electrical or electronic devices or appliances that are no longer usable to their owners. E-waste is detrimental because, depending on their state and density, individual components of various electronic goods contain toxic substances. Simultaneously, the global increase of end-of-life and near-end-of-life ICT equipment is raising considerable worry. If not properly treated, the chemical substances they contain have the potential to harm both the environment and human health. By repurposing, refurbishing, or recycling this e-waste, it can be managed in an environmentally sustainable manner, causing less harm to the ecosystem. As a result, in compliance with evolving global best practices and standards, responsible e-waste management is essential.

E-waste is classified as used electronics that are required for recycling involving material recovery, re-sale, re-furbishment, re-use, or destruction. Informal e-waste processing in underdeveloped countries can have serious health repercussions and contaminate the environment. Cadmium, beryllium, lead, and brominated flame retardants, among other things, may be present in electronic waste components such as CPUs. Employees and communities in both developed and developing countries have challenges with e-waste recycling and disposal. To safeguard the environment and the well-being of individuals and animals, offering quality for the management and treatment of industrial waste must be implemented and maintained.

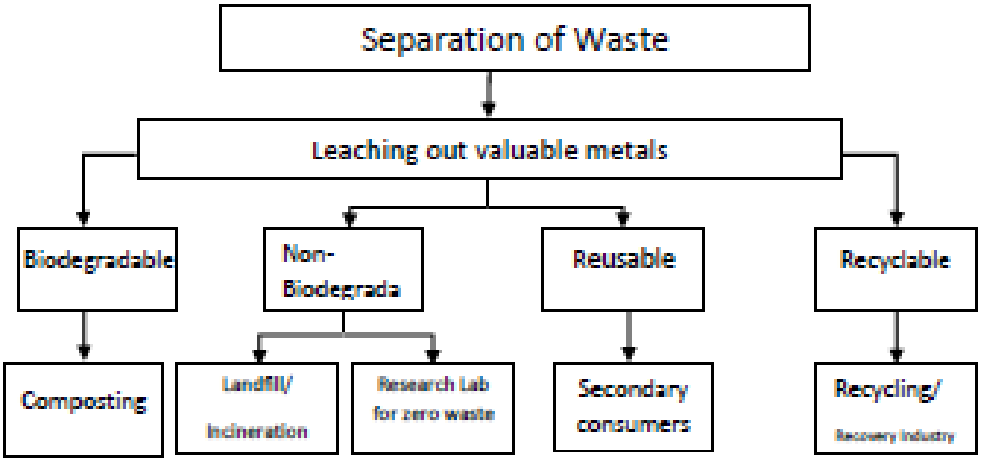

Figure 1: Developing Countries E-Waste Classification/Management System [17].

E-waste is a sort of waste that is currently wreaking havoc on the global environment. Used electronics that are intended for reuse, refurbishing, or salvage recycling via material recovery, disposal, or abandonment are referred to as e-waste. In developing nations, informal e-waste processing has the potential to harm human health and contaminate the environment. Hazardous substances such as cadmium, lead, beryllium, and brominated flame retardants may be present in electronic debris, such as CPUs. In both industrialized and developing countries, the recycling and disposal of e-waste can pose significant health dangers to workers and communities [18].

The words "management," "challenging," and "Nepal" spring to mind when thinking of e-waste. Any electronic equipment or product that has reached the end of its usable life cycle is referred to as electronic garbage, or e-waste [17]. Trash Electrical and Electronic Equipment, or e-waste, is a sort of development trash (WEEE). According to Hotta *et al.*, e-waste is one of the world's fastest-growing waste streams, and "Asia has become the engine of world garbage generation" [19]. The problem of e-waste is no longer limited to domestic concerns because electronic equipment and E-waste are regularly exchanged across national borders.

E-waste production is on the rise, especially in developing countries that lack the financial and other resources to properly dispose of it. Technology, on the other hand, is constantly improving; new technologies are faster, smaller, and easier to use than ever before. What about that old phone, computer, or camera you upgraded to a newer and better model. We live in a consumerist world where new technology, which is purchased, improved, and replaced on a regular basis. Because of the appealing economic incentives provided by increased electronic output and e-waste exports from wealthy to impoverished countries, the e-waste problem is rapidly expanding.

The total amount of e-waste produced in 2014 was anticipated to be over 41 million tons, with a 3-5 percent yearly increase rate [20]. Because of the presence of several harmful compounds in e-waste, it is considered dangerous. These waste materials contain high levels of non-recyclable concentrated lead, cadmium, and beryllium. Burning this garbage is harmful to one's health and releases toxic substances into the atmosphere. Cellphones, cellphones, radios, televisions, computers, refrigerators, air conditioners, and other electronic

devices are increasingly used, resulting in increased e-waste creation in the country. As a result, effective e-waste management seems essential for the nation.

5.1 Nepal's current situation

The right to live in a clean environment is guaranteed by the constitution of Nepal. The Environment Protection Act, 1997, was drafted and converted into law in 1997. The preamble of the legislation intends to hasten the passage of legal requirements that will ensure a clean and healthy environment. Minimizing the negative impacts that environmental deterioration is anticipated to have on humans, wildlife, plants, ecosystems, and physical artifacts. Protecting the environment through effective use and management of natural resources, while keeping in mind that sustainable development is only possible through inescapable interdependencies.

A proponent must complete an Initial Environmental Examination (IEE) and an Environmental Impact Assessment (EIA) as required by law. The Act lays out the rules for preventing and controlling pollution. The Act defines the position, responsibilities, and powers of the relevant Environment Inspector. The Environment Protection Act, which includes, no mention of e-waste remediation, has been used by the Nepal government to deal with all environmental challenges. In Nepal, there are currently no legal systems in place to deal with the growing problem of electronic waste disposal. Developing countries like Nepal are vulnerable due to lack of inventory data, e-waste management policies, and improved technologies for environmentally sound management. Local governments in Nepal are responsible for waste management, which includes planning, financing, and implementing waste management services. Only national institutions are responsible for creating waste management policies and providing technical support. At the national and local levels, waste management is now a low priority. Financial resources, human resource expertise, waste management technologies, and infrastructure are all issues that affect waste management. In mid-2018, a fast assessment of SWM procedures was carried out in several municipalities throughout seven provinces of Nepal. Daily, 0.39 kg of municipal solid waste was generated per resident.

Organic waste accounted for 43.6 percent of MSW, while paper and paper products accounted for 22.7 percent, plastic accounted for 13.8 percent, glass accounted for 6.4 percent, metals accounted for 2.7 percent, textiles accounted for 3 percent, rubber and leather accounted for 1.3 percent, and other accounted for 6.6 percent [18,21]. Waste recycling and energy recovery, according to this analysis, have greater promise. Despite its potential, trash recycling in Nepal is still in its infancy and controlled by the informal sector. Scrap merchants and recycling companies, which are part of the informal or small-scale formal private sector, play an important role in recycling. Because just a few hundred of Nepal's thousands of scrap merchants and small-scale recycling firms are registered, most recycling efforts and earnings go unnoticed.

These recycling options are similarly limited to the Terai region, allowing hill and mountain towns to fend for themselves in terms of recycling. New recycling enterprises are springing up in Nepal, which is a welcome development compared to previous arrangements that saw waste items collected and sent to Indian recycling organizations. As a result, Nepalese recycling methods should be formalized and scaled up, with the informal sector being incorporated in recycling efforts.

The present improvement in electronics has expanded the usage of technology, particularly in Telecom/ICT, and the low initial cost and unplanned obsolescence of electrical and electronic equipment has resulted in a problem with e-waste in Nepal.

Telecommunication/ICT devices, as well as their electrical and electronic components, are in high demand and have a limited lifespan. The ubiquitous usage of electrical and electronic equipment in our day-to-day operations, as well as the disposal of obsolete equipment, is posing a growing environmental threat.

6. Expected outcome

Developing nations face significant challenges in addressing with e-waste, which is either domestically produced or illegally imported as "used" equipment, to close the so-called "digital gap." The lack of policies, legal instruments, regulations, technology, and infrastructure needed for environmentally sound e-waste management is a matter of serious concern. Most of the industrialized countries have legislation requiring electronic manufacturers and importers to accept back outdated electronic equipment at their end-of-life based on the notion of extended producer responsibility. The implementation of EPR in developing countries has become critical due to the current high level of transboundary e-waste migration into developing countries and the lack of basic or state-of-the-art recycling and waste disposal facilities.

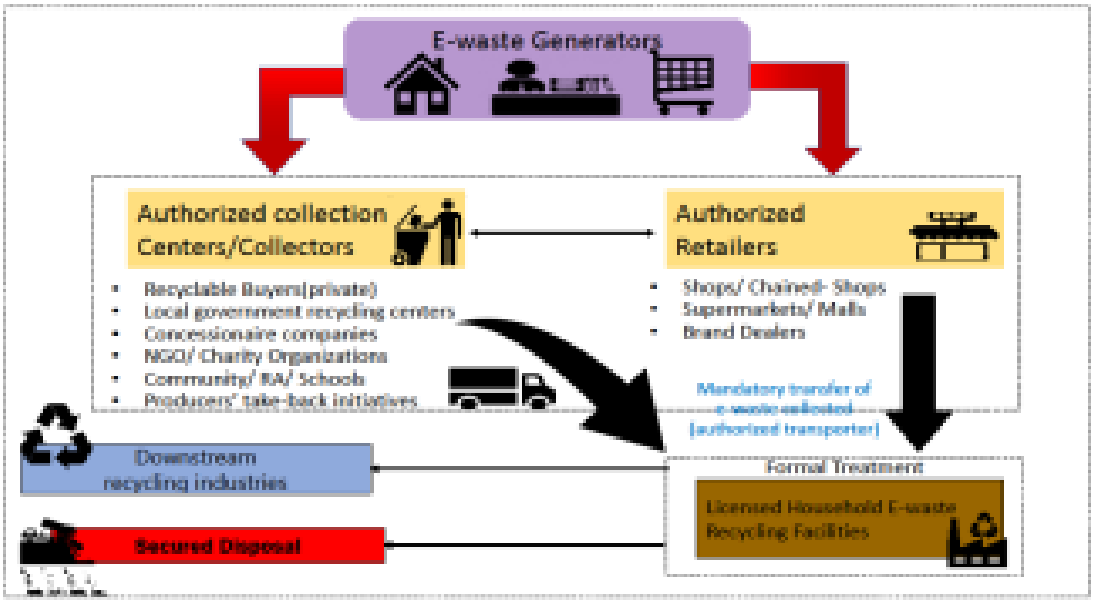

Figure 2: Schematic chart showing different recycling patterns of solid wastes in Nepal [17]

Sustainable urban mining of e-waste has expanded to be a considerable global issue in order to achieve the Sustainable Development Goals (SDG) agenda, especially Goal 3 (Water and Sanitation Health), Goal 8 (Decent Work & Economic Growth), Goal 11 (Sustainable Cities and Communities), and Goal 12 (Responsible Consumption and Production)[9] (UNEMG, 2018). In light of this, it has been determined that explanation of suitable management systems, treatment alternatives, and safe disposal of electronic waste are urgently needed in Nepal and other developing nations.

The key causes of the growing trend of E-waste are socio-economic development and technical improvement. Two of the most important environmental concerns and hurdles to appropriate management in Nepal are the rising trend of e-waste generation and the lack of regulatory provisions. Given the potential for harmful eco-toxicological repercussions, an e-waste management legislative instrument covering e-waste handling, storage, transportation, recycling, and disposal is urgently needed.

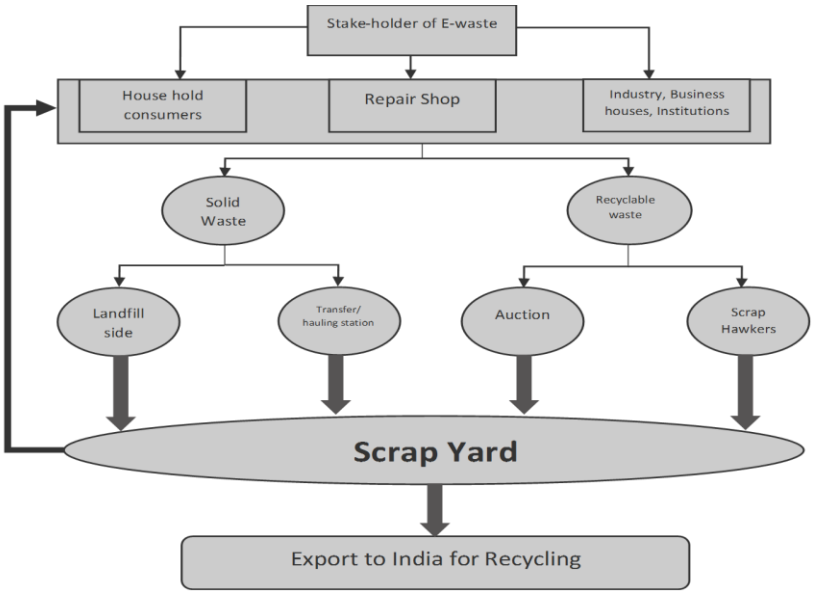

Figure 3: Model e-waste management system

Various non-governmental bodies in Nepal have initiated various e-waste management initiatives and published related documents. Other trade and industry groups throughout the world are also establishing best practices for dealing with e-waste. There is a need for a model framework for e-waste management that considers the national context as well as any current legal, regulatory, and policy framework. A unified legislative and policy framework based on the concepts of sustainable development, green ICT, and the circular economy can make e-waste management system. The current e-waste scenario evaluates existing challenges and concerns in e-waste management, taking into consideration International trends and practices, to develop an implementable e-waste policy and regulatory framework in Nepal.

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