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RESEARCH PAPER

Electronic Waste in Bangladesh: Its Present Statutes, and Negative Impacts on Environment and Human Health

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ABSTRACT
Technology has made the life of Bangladeshi people very flexible with new inventions. In most cases, here the people depend on these technological devices. These devices, along with various facilities, have also invited a series of problems mostly due to the lack of proper management. The Bangladeshi citizens often leave electronic devices that went bad or became unusable, in landfills, rivers, canals, and open spaces. As these devices possess a variety of toxic substances, dumping huge amounts of electronic waste can pollute the environment and threaten human health. Around 2.7 million metric tons of e-waste are generated each year in Bangladesh. Only 20-30% of this waste is recycled while the rest amount is released in landfills, rivers, canals, and open spaces posing a serious threat to the health and environment. Bangladesh has experienced rapid advancement in the technological sectors over the years. Therefore, it is a must to take steps necessary for avoiding the future jeopardized situation because of e-waste. The present e-waste management in Bangladesh experiences a number of drawbacks such as challenges in incentivization, unhygienic conditions of informal recycling, insufficient law and policy, less awareness, and lack of enthusiasm on part of the corporate to address the critical issues. In spite of the alarming levels of e-pollution in the country, the concerned authorities are yet to take any effective step or formulate any legislation to prevent the existing e-pollution. Moreover, the prevailing environmental laws are not adequate to address the issue and its application is still largely absent.

KEYWORDS: Approach, Bangladesh, Electronic waste, Policy, Statutes.

INTRODUCTION

‘Electronic waste (E-waste)' is a term that applies to all secondary electronic products such as computers, phone sets or mobile phones, electronic entertainment devices, television sets, refrigerators, whether sold, donated, or discarded by their original owners. E-waste is the short and informal name of the electronic products that go bad or reach the end of ‘useful life’ (Alam et al, 2015). Some of the common electronic products are televisions, VCRs, computers, copiers, stereos, and fax machines. A large number of these products can be reused through refurbished or recycled (Babu et al, 2007). Regrettably, electronic discards have become one of the emerging concerns for Bangladeshi society. Televisions and computer monitors, audio and stereo equipment, Computers and computer peripherals (e.g. monitors and keyboards), VCRs and DVD players, Video cameras, CFL bulbs, cellular phones, telephones, and other wireless devices, Video game consoles, Fax and copy machines, Medical, and dental equipment are often liable for causing the E-waste in

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Bangladesh (Chatterjee and Kumar, 2009). Along with rapid economic growth, Bangladesh has an emerging market of electric, electronic gadgets, and home appliances. These demands have increased the production amount of locally produced electronics products also increasing the demand for re-using these products (Yousuf and Reza, 2011). Equipment is mostly reconstructed and recycled in both semi-formal and informal sectors. These electronic wastes are harmful to human health and the environment (Masud et al, 2019). At present, Bangladesh lacks awareness and has ample information gap on e-waste hazards. E-waste which means the waste coming from electronic and electrical equipment is growing rapidly, as estimation shows 72 billion tons are generated annually worldwide (Alam and Bahauddin, 2015). For sure, the digital revolution has created a massive enhancement in the quantity of e-waste but the use of harmful substances has also changed the quality of it. The massive growth of the electronics and hardware sectors has multiplied the demand for electronics products (Yang et al, 2013). Consumers are forced to dispose of their old electronic products as rapid changes of features in the electronics devices and availability of the improved products are happening overnight. This has increased E-waste at an alarming rate. Bangladesh is also facing the same serious crisis as other countries in the world due to the increasing generation of e-waste (Sudipta et al, 2017). The challenge Bangladesh faces mostly is to create awareness of the environmental, social, and economic aspects of e-waste among the public, consumers, producers, institutions, policymakers, and legislators. It has been observed over the years that a large volume of E-waste is being exported from western countries to Asian countries for disposal. Due to the rising cost of manpower and availability of input materials, it seems that the recycling business in western countries is not capable of running the plant in full capacity (Shamim et al, 2015). Therefore, western countries are bound to look for alternative destinations for disposal. They look for a place that has a low labor cost and is weak at environmental laws enforcement. E-waste is also harmful in nature because it has presence of toxic substances like Pb, Cr6, Hg, Cd, and flame retardants (Ahmed, 2011). In a developing country like Bangladesh, E-waste disposal mixed with solid municipal waste is creating great environmental pollution (Rana et al, 2016). There is no formal recycling technology available and non-formal operators extract precious metals for simply making money. The non-formal units extract metals by dipping a printed circuit board in the acidic/alkaline solutions and heating/burning of PCB (Salam et al, 2008). These processes are not only harmful to the workers but also the environment which is a matter of great concern for E-waste management in a developing country like Bangladesh. Due to the lack of proper waste management policy and guidelines, the practice of recycling in Bangladesh has become very complicated, sometimes injurious, and hazardous (Pawar et al, 2015). In Bangladesh, the reuse of e-equipment is a regular phenomenon (Lawrence et al, 2010). Rather, the recycling and dismantling of e-equipment have turned into an emerging business. As Bangladesh has no E-waste dismantling facility in the formal sector, all the recycling is being carried out by the informal sector. In the recycle chain of Dhaka city, the capital city of Bangladesh, there is 120,000 urban poor from the informal sector (Kannan et al, 2007). Around 475 tons (15 percent of the total generated waste in Dhaka city) are recycled per day while the rest are dumped into landfills, rivers, ponds, drains, lakes, canals, and open spaces. This study aims to address the causes of E-waste, the existing problem caused by it, analyses the impacts of E-waste on the environment and human beings. Furthermore, this study will analyze the relevant E-waste policy and its gaps. Significantly, the present study will provide few recommendations that can bring an end to the e-waste generation through policy and law.

MATERIALS AND METHODS

During the study, both primary and secondary data have been used. All the relevant data and information of the existing paper were collected and used from primary and secondary sources. The secondary data sources include books, articles, different national and international law reports, Acts, etc. The information from different books, journals, booklets, proceedings, newsletters, souvenirs, and consultancy reports that are available in the libraries of Daffodil International University, Bangladesh was compiled chronologically to complete it successfully. The necessary supports, and figures were taken from the *Daily Star*, Springer, and the Bangladesh Today. The selected data (collected from the selected stations between 2019 and 2020) reveals that around 2.7 million metric tons of electronic waste is generated each year in Bangladesh and only 20-30% of this waste is recycled while the rest amount is released in landfills, rivers, drain lakes, canals, and open spaces posing a serious threat to health and the environment. The present E-waste management in Bangladesh experiences a number of drawbacks such as challenges in incentivization, unhygienic conditions of informal recycling, insufficient law and policy, less awareness, and lack of enthusiasm on part of the corporate to address the critical issues. In spite of the alarming levels of e-pollution in the country, the concerned authorities are yet to take any effective step or formulate any legislation to prevent the existing e-pollution. This situation is expected to worsen further in the upcoming days due to the increasing number of e-products resulted from the rapid growth of technology and industrialization. The existing study provides some considerable recommendations to the concerned authority in order to stop E-waste generation in Bangladesh through policy and law.

RESULTS AND DISCUSSIONS

The use of technology in Bangladesh has increased over the years. At present, the sustainable and safe use of technology has become a big concern for the country. The waste from electronic equipment has emerged to be a curse as people throw the useless and unusable products in open places and water bodies without thinking about its impact on the environment and human health. Around 2.7 million metric tons of E-waste are generated in Bangladesh every year (Islam, 2016). Every year Bangladesh legally imports different electronic goods include electronics, clothes irons, light switches, paint (Latex), pesticides, television sets, antiques, thermometers, washing machines, mirror, calculators, desktop liquid crystal display (LCD) monitors, laptop, neon lights, lamp/light bulbs, sewer pipes, etc. from different countries of the world. On the contrary, the wastes from television sets stand second-highest producing 0.182 million metric tons of e-waste (Chatterjee and Kumar, 2009). It leaves no doubt that Bangladesh has become one of the most e-waste generating countries in the world. But, the country is yet to make any inventory to address the extent of this emerging problem so far. The goods below generate E-wastes in Bangladesh:

i. In the year 2006, Bangladesh had a sum of 600,000 personal computers, 1,252,000 television sets, and 2,200,000 refrigerators (Riyad, 2014).

ii. Two years later, the total number of TV set users increased to 10.3 million in 2008. Around 59, 85,000 TV sets become scrape and generate 88,357.14 metric tons of E-waste per year (Mourshed et al, 2017).

iii. Bangladesh had a sum of 58.36 million mobile phone users at the end of December 2020 (ICT Division Report, 2021).

iv. In the last twenty years, the country received 10,504 metric tons of toxic e-waste by cell phone sets (Zamena, 2002).

Fig. 1. E-waste in Bangladesh (Source: The Daily Star)

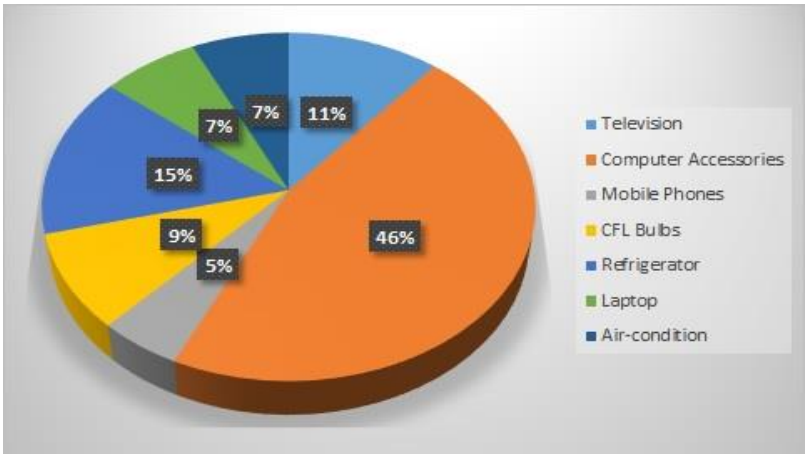

Fig. 2. Graphical representation of E-waste in Bangladesh

v. The information and telecommunication sector has also generated 35,000 metric tons of E-waste in the last 10 years (Shams et al, 2017).

vi. Mobile phone users have sharply increased in Bangladesh over the years. Mobile phones have become one of the fast-growing market sectors in the country. Bangladesh has a huge number of active mobile phone users. Probably the country has more than three core mobile phone sets. As the average longevity of a mobile set is about one year, the country is getting over one core mobile phone set as E-waste per year (Awasthi and Li, 2017).

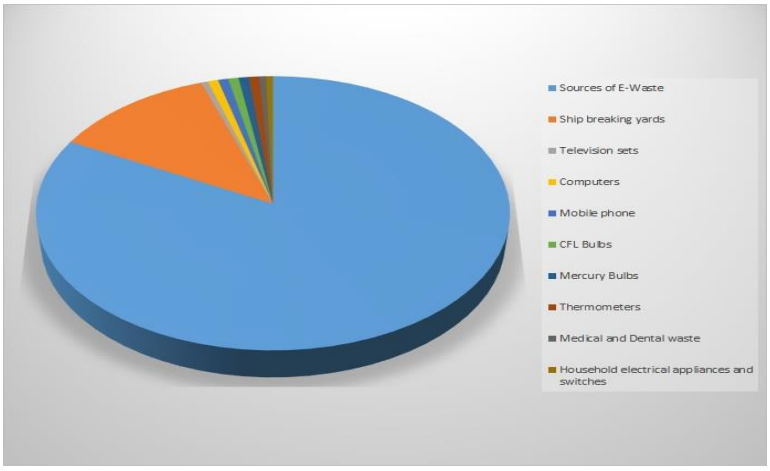

Fig. 3. Generation of E-waste in Bangladesh

In developing countries like Bangladesh, e-waste issues related to trade and trans-boundary movement have environmental, social, and economic consequences. Illegal waste trade, as we all know, continues to this day. Surprisingly, waste trade trends and patterns have shifted (Iqbal et al, 2010). In recent years, the majority of commonly used electrical and electronic equipment/goods i.e. television, computer, mobile, CFL bulb, medical and dental equipment have been exported from developed countries to developing countries such as Bangladesh. Bangladesh's local consumption of electrical and electronic equipment is increasing day by day, owing to the country's large population and rapid economic growth. While this growth is desirable from a development standpoint, especially in terms of living standards and access to information and communication technologies, it also raises concerns about the country's lack of sound end-of-life solutions. In Bangladesh, e-waste has become the fastest-growing waste stream and a lucrative market. According to the UNEP report, developed countries dump e-waste through illicit trade routes in "developing" Asian countries including Bangladesh. To control their e-waste, developed countries have strict rules and regulations. Developing countries, on the other hand, lack certain appropriate rules and policies for the management of manufactured e-waste. Illegal e-waste trade exists primarily to avoid external costs associated with e-waste management in developed countries, as well as to achieve economic advantage for developing-country importers (Hossain and Sultan, 2011). Bangladesh is a net importer of electronic products from the developing world. From the United States, brain-damaging mercury and poisonous electronic and plastic wastes; from Canada, cancer-causing asbestos; defective steel and tin plates from the European Union, Australia and the United States; toxic waste oil from the United Arab Emirates (UAE), Iran and Kuwait; toxic zinc ash, residues and skimming; lead waste and scrap; used batteries; and waste and scrap of metals such as cadmium, chromium, cobalt, antimony, hafnium and thallium from Germany, Denmark, the Netherlands, the United Kingdom, Belgium and Norway are all dumped on Bangladesh (Hossain and Sultan, 2011).

Merging human rights with environmental problems creates a mutual standpoint for the people who are affected by it. This process creates a right-based platform for environmental safety. However, it puts the affected people at the core of this matter. Intellectuals from all over the world came to this conclusion after various researches. Most of the people who come to this mutual standpoint are either affected by environmental crisis or pollution. This enunciation of human rights makes some openings to achieve the rights for the affected people (Babu, 2020). It plays an important role both in overseas and local areas to get the appropriate justice through an authorized process. The most affected part of the community to this environmental crisis has something to gain from this judicial process (Babu, 2020). It may soothe their scars at least by gaining some political support. Human rights and environmental ruins have a reciprocal relationship and it's like the two ends of a rope. Sometimes, exploitation of human rights can create an environmental disaster. On the other hand, at times, environmental collapse can manipulate human rights too. The world is getting wrapped by the wire of technology. One of the most dangerous causes of environmental pollution is E-waste (Babu, 2020). It's a slow poisoning but certainly kills. There are numbers of electronic wastes and thousands of particles that are merging into our earth every second and making the environment hostile. These electronic wastes come in the form of metals or chemicals. Mercury, lead, cadmium, chromium, magnetic properties, and antimony (flame retardants) are examples of heavy metals or chemicals, which include polybrominated biphenyls, polyvinyl chloride, polychlorinated biphenyls, and polybrominated diphenyl ethers. One of the deadliest elements of digital wastes is the mercury-made items, namely batteries, electronic circuit boards, and CRTs (Gibson and Tierney, 2006). Besides, there are certain plastic wastes that carry brominated flame retardants and it is one of the major

concerns for environmental pollution. Sometimes, mishandling of these serious components during the waste management process may lead to catastrophe.

If one of these highly sensitive substances somehow outflows or merges into the atmosphere then it may cause serious damage to the surroundings. Reports say, mismanagement during waste dumping, continuously affecting our soil, food, and nearby water reservoir and lives in it. The experimental observation took place at the shipyard of Chittagong in Bangladesh. It exposed that the soil of that area was contaminated by the excessive appearance of various chemicals such as cobalt, arsenic, selenium, cadmium, antimony trioxide, and chromium (Sthiannopkao and Wong, 2012). There is another major concern regarding this waste management system. Most often, these electronic wastes are burnt which makes the air toxic and paves the way for a new environmental crisis.

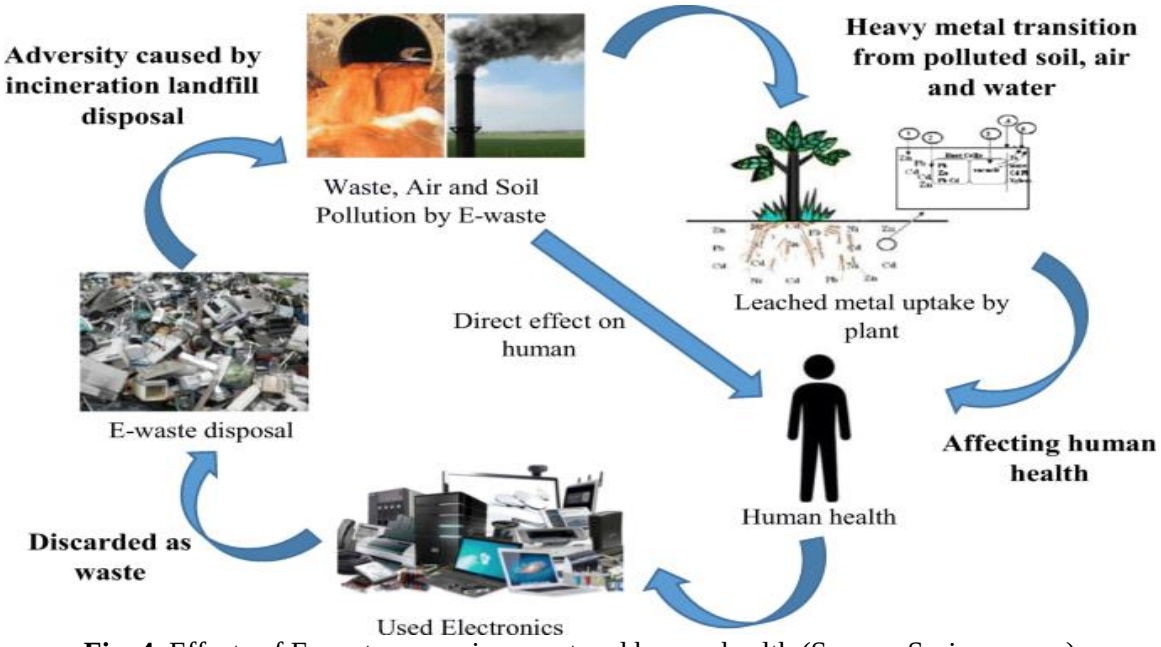

Fig. 4. Effects of E-waste on environment and human health (Source: Springer.com)

Fig. 5. Effects of E-waste on human health (Source: *The Bangladesh Today*)

Not only these electrical wastes pose a threat to environmental ruins but also create substantial risk for the human body. Workers at the electrical waste disposal plants suffer from various diseases in Bangladesh like other developing countries. Research shows that people who work in electrical waste plants are more likely to suffer from nausea, headache, and respiratory complications. It is not wise to say that the people who only work inside the waste dumping plants suffer from these complications rather the whole neighborhood is highly affected by this environmental hazard. However, these contaminate the soil, food, and rivers and indirectly make the environment hostile for living. Most often, people who deal with electrical waste are found consuming waste particles inside their bodies, mostly through dust inhalation and dietary intake. These electronic wastes can lead to serious damage to health such as upsetting the nervous system, causing brains to function imperfectly, damaging kidneys and liver, and also could make newborn babies suffer serious birth defects (Kojima et. al, 2009). The main reason behind E-waste pollution is the lack of an appropriate disposal system. Most people don't know how to handle these sensitive products and this can lead to hazardous scenarios. One of the major concerns about this E-waste is its illegal or unsafe dumping into the land which can significantly damage the fertility rate of or land resulting in less production of crops. The problem is identified vividly but either the authorities are not taking necessary measures to make sure our environment is as safe as it is possible or the law that exists to ensure the proper disposal of this waste is not good enough to change the scenario. Geographically, Bangladesh has a huge advantage as it has many rivers and frequent rainfall. However, if the deadly chemicals from the waste can make their way to the underground water reservoir once, the blessing could turn into a curse in a moment.

National Environmental Policy was adopted by the Bangladesh government in 1992 for the regulation of all activities that pollute and destroy the environment. Later, the government formulated the Environment conservation Act, 1995, with a view to regulating, conserving, and enhancing the quality of the environment and controlling, preventing, and reducing pollution. The Medical Waste Management Rules, 2008 only address the waste management issues for the medical sector including E-waste (Dana, 2011). In Bangladesh, the latest initiative is Electrical and Electronic Waste (Management and Handling) Rules, 2011 which has the following features: These rules apply to every producer(s), dealer(s), collection center(s), refurbished(s), dismantler(s), recycler(s), auctioneer(s) consumer(s) or bulk consumer(s) involved in the manufacture, sale, and purchase and processing of electrical and electronic equipment or components. It defines responsibilities of the producer, responsibilities of dealers and responsibilities of refurbishes, responsibilities of collection centers, and responsibilities of consumer or bulk consumer, Responsibilities of dismantler, responsibilities of recycler/preprocessor.

Department of Environment (DoE) is the first body established in Bangladesh in 1977 under the Environment Pollution Control (EPC) Ordinance, 1977 for the protection of the environment followed by the Ministry of Environment and Forest. Later, the National Environment policy came into effect in 1992 which includes the regulation of all activities that pollute and destroy the environment. The Environmental Protection Act (ECA), 1995 subsequently allows DoE to undertake any action that is appropriate for maintaining and enhancing environmental quality and for controlling, avoiding, and reducing pollution (Bangladesh Environmental Protection Act, 1995). The Act also authorized DoE to provide clearance on environmental issues for any new project. In compliance with the subsequent rules under ECA, the Environment Conservation Rules, 1997 differentiates industries and projects into various groups considering their pollution load and possible impact on the environment. Though some provisions and obligatory rules urge for building a waste

management system within industry sectors, none of the act and rules covers e-waste. However, the Bangladesh government is planning to formulate a solid waste management policy that may cover E-waste. Meanwhile, the Medical Waste Management Rules, 2008, covers only waste management issues for the medical sector, including E-waste.

For Bangladesh, the development of policy related to e-waste including waste reduction initiatives such as Extended Producer Responsibility (EPR) can be very fruitful. This legislation provides Bangladesh with the policy framework to deal formally with e-waste problems as well as to quickly control the lessons learned in e-waste legislation and management from developing countries. However, the implementation of E-waste policy can also be disadvantageous if it is implemented by developing countries without applying it to local socio-economic circumstances and challenges.

National Environment Policy was adopted in 1992 to protect the environment of Bangladesh. However, no particular law or ordinance is available at present for E-waste management and recycling in the country. Bangladesh has several acts and rules such as the Environment Conservation Act, 1995, The Environmental Court Act, 2000, and The Environmental Conservation Rules, 1997. The Environmental Protection Act, 1995 subsequently allows DoE to undertake any action as it seems fit for maintaining and enhancing environmental quality and for controlling, avoiding, and reducing pollution. The government has already drafted National 3R (Reduce Reuse and Recycle) strategy where E-waste issues have been addressed. The rules i.e. the Hazardous Waste Management Rules and Solid Waste Management Rules are under preparation. As both of the rules have not been finalized yet, there is still a chance to include the E-waste management issues in them. Bangladesh has signed the Basel Convention prohibiting transboundary movement to hazardous waste. In Bangladesh, government approval is required for any kind of waste import. However, it is a matter of regret that the Supreme Court of Bangladesh founds the lack of cooperation from the concerned ministries for ensuring conformity to the environmental laws.

CONCLUSION

Bangladesh is yet to take any effective step to put an end to generating e-waste or proper disposal of this sludge. Following actions could be taken as part of the way forward:

i. Identifying and creating a reservoir of E-waste in large cities of Bangladesh

ii. Formulation of applicable E-waste disposal regulations and guidelines with consulting the concerning stakeholders.

iii. Establishment of efficient collection manuals for selected E-waste.

iv. Introduce registration as well as efficiency improvement programs for E-waste recyclers.

v. Introduction of Environmental Management System in the E-waste sector.

vi. Establishing E-waste tracking a mechanism so that the inventory can be kept updated.

vii. Raising Awareness through the development of communicative materials i.e. posters, leaflets, brochures, TV spots, etc.)

viii. Supervision of E-waste trafficking and shipment in order to serve the purpose.

At present, solid waste management has become one of the biggest challenges for Bangladesh. The emergence of E-waste has also fueled the problem urging to assess. A detailed assessment of the present and future scenario of the E-waste and its management including quantification, characteristics, existing disposal practices, environmental impacts, etc. is a must for now. Institutional infrastructures, including E-waste import, collection, transportation, treatment, storage, recovery, and disposal, need to be established, at national and/or regional levels for the

environmentally sound management of E-wastes. The establishment of E-waste collection, exchange, and recycling centers should be encouraged in partnership with private entrepreneurs and manufacturers. E-waste policy development may require a paradigm shift in perception from a problematic waste issue to an opportunistic green growth solution for Bangladesh. Consequently, the E-waste policy development may require a more customized approach where instead of addressing e-waste in isolation it should be addressed as part of the national development agenda that integrates GEA and SEA as part of national policy planning.

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CONFLICT OF INTEREST

The authors declare that there is not any conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/ or falsification, double publication and/or submission, and redundancy has been completely observed by the authors.

LIFE SCIENCE REPORTING

No life science threat was practiced in this research.

REFERENCES

Alam, M. and Bahauddin, K.M. (2015). Electronic Waste in Bangladesh: Evaluating the Situation, Legislation and Policy and Way Forward With Strategy and Approach. Environ. Dev. Sustain., 9(1); 81-101.

Ahmed, F.R.S. (2011). E-waste management scenario in Bangladesh. In: WEEE/E-waste management workshop on take-back system, pp. 13–15.

Awasthi, A.K. and Li, J. (2017). Management of electrical and electronic waste: a comparative evaluation of China and India. Renew Sust. Energ. Rev., 76(1); 434–447.

Babu, B.R., Parande, A.K., and Basha. C.A. (2007). Electrical and electronic waste: a global environmental problem. Waste Manag. Res., 25(4); 307-31108.

Babu, K.E.K. (2020). The interconnection between environment and human rights: An overview on legal context. Eco. Env. & Con; 26(2); 914-917.

Babu, K.E.K. (2020). Water Pollution in Bangladesh, Its Causes and Impact: An Analysis Based on Existing Regulatory and Institutional Framework. Poll. Res., 39(4), 1-5.

Chatterjee, S. and Kumar, K. (2009). Effective electronic waste management and recycling process involving formal and non-formal sectors. Int. J. Phys. Sci., 4(13); 893-905.

Dana, T. (2011). Unhygienic Living Conditions and Health Problems: A Study in Selected Slums of Dhaka City. Int. J. Sustain. Dev., 2(11); 27-33.

Gibson, K. and Tierney, J.K. (2006). Electronic waste management and disposal issues and alternatives. Environ. Claims J., 18(4); 321–332.

Hossain, S. and Sultan, S. (2011). Illegal import and trade off of e-waste in Bangladesh. J. Env. Soc. Development., 2(1); 11-21.

Iqbal, K. S., Golam, N. M. and Hossain, A. (2010). Identifying and Analyzing Underlying Problems of Shipbuilding Industries in Bangladesh. Mech. Eng. J. 41(2). DOI: https://doi.org/10.3329/jme.v41i2.7509

Islam, M.N. (2016). E-waste management of Bangladesh. Int. J. Innov. Hum. Ecol. Nat. Stud., 4(2); 1–12.

Kannan, S., Misra, D.P., Dvonch, J.T. and Krishnakumar, A. (2007). Exposures to airborne particulate matter and adverse perinatal outcomes: a biologically plausible mechanistic framework for exploring potential. Environ. Health Pers., 114(11); 1636-1642.

Kojima, M., Yoshida, A. and Sasaki, S. 2009. Difficulties in applying extended producer responsibility policies in developing countries: case studies in e-waste recycling in China and Thailand. J. Mater. Cycles Waste Manag., 11(3); 263–269.

Lawrence, M.G., and Lelieveld, J. (2010). Atmospheric pollutant outflow from southern Asia: a review. Atm. Che. Phy., 10(22); 11017–11096.

Masud, M.H., Akram, W., Ahmed, A. (2019). Towards the effective E-waste management in Bangladesh: a review. Env. Sci. Pollut. Res., 26(1), 1250–1276.

Mourshed, M., Masud, M.H., Rashid, F, Joardder, M.U.H. (2017). Towards the effective plastic waste management in Bangladesh: a review. Environ Sci. Pollut. Res., 24(35); 27021–27046.

Pawar, H., Garg, S. and Kumar, V. (2015). Quantifying the contribution of long-range transport to particulate matter (PM) mass loadings at a suburban site in the north-western Indo-Gangetic Plain (NW-IGP). Atm. Che. Phy., 15(16); 9501–9520.

Riyad, A.S.M., Hassan, M.K., Iqbal, J.M., Rahim, A.M., and Uddin, W. (2014). E-waste recycling practices in Bangladesh. Int. J. Renew Energy Environ Eng., 2(3); 193–200.

ICT Division, Bangladesh (2021, January 23). Digital Bangladesh-2021 report, Dhaka. Retrieved March 12, 2021, from: https://investindigitalbd.gov.bd/page/digital-bangladesh-vision-2021

Rana, M.M., Sulaiman, N.B., Sivertsen, M.F. and Nasreen, S. (2016). Trends in atmospheric particulate matter in Dhaka, Bangladesh, and the vicinity. Environ. Sci. Pollut. Res., 23(1); 17393–17403.

Salam, T.H., Siddique, M.N.A. and Alam, A.M.S. (2008). Characteristics of atmospheric trace gases, particulate matter, and heavy metal pollution in Dhaka, Bangladesh. Air Qua. Atm. Health., 1(2); 101–109.

Sthiannopkao, S. and Wong, M.H. (2012). Handling e-waste in developed and developing countries: Initiatives, practices, and consequences. Sci. Total Environ., 463(1); 1147-1153.

Sudipta, C, Javed, S.A, Biswa, P. (2017) Reusing and recycling practice of E-waste in Dhaka City. In International Conference on Engineering Research, Innovation and Education (ICERIE), 1–7. International Conference on Engineering Research, Innovation and Education, Shahjalal University of Science and Technology, Bangladesh.

Shams, S., Sahu, J.N., Rahman, S. M. and Ahsan, A. (2017). Sustainable waste management policy in Bangladesh for reduction of greenhouse gases. Sustain Cities Soc., 33(1); 18–26.

Shamim, A, Mursheda, A.K. and Rafiq, I. (2015). E-waste trading impact on public health and ecosystem services in developing countries. Int. J. Waste Resour., 5(188). DOI: https://doi.org/10.4172/2252-5211.1000188

Yousuf, T. and Reza, A. (2011). E-Waste management in Bangladesh: Present Trend and Future Implication. Proceedings of 2011 World Congress of International Solid Waste Association (ISWA), October 17-20, EXCO Daegu, Korea. DOI: 10.13140/2.1.3261.7927

Yang, X., Sun, L., Xiang, J., Hu, S. and Su, S. (2013). Pyrolysis and dehalogenation of plastics from waste electrical and electronic equipment (WEEE): a review. J. Waste Manag., 33(2); 462–473.

Zamena, U.K. (2002). Solid waste management in Dhaka City: challenges and pitfalls. J. Local Government., 29(1); 89–106.