ANNALS OF THE "CONSTANTIN BRÂNCUȘI" UNIVERSITY OF TÂRGU JIU
LETTER AND SOCIAL SCIENCE SERIES

ISSN-P: 1844-6051 ~ ISSN-E: 2344-3677

2/2025 ***https://alss.utgjiu.ro***

E-WASTE, HEAVY METALS, AND THE EMERGING RISKS TO HUMAN AND ECOLOGICAL SECURITY IN NIGERIA

Musediq Olufemi LAWAL[1]
Monsurat ISIAKA[2]
Tomisin Adedunmola AKANGBE[2]
Abdullahi Kayode IBRAHIM[2]
Abdulbaqi Salihu ZAKARIYA[3]
Tajudeen Yusuff ADEYINKA[4]

1) **Department of Sociology and Criminology, Osun State University, Nigeria**
2) **Department of Criminology and Security Studies, University of Ilorin, Nigeria**
3) **Department of Sociology, University of Ilorin, Nigeria**
4) **Department of Criminology and Security Studies, National Open University, Abuja, Nigeria**

Abstract: The rapid expansion of Nigeria's information and communication technology sector has fueled a parallel rise in electronic waste (e-waste), creating complex security challenges at the intersection of health, environment, and livelihoods. This article interrogates how informal recycling practices, particularly in Lagos hubs such as Alaba International Market and Computer Village, expose communities to heavy metals including lead, mercury, and cadmium. Drawing on environmental and human security frameworks, it situates Nigeria's experience within global e-waste flows while foregrounding the local realities of workers and residents who grapple with pollution, occupational hazards, and socio-economic marginalization. Empirical examples from Lagos highlight how the absence of formal recycling infrastructure, regulatory enforcement gaps, and limited awareness amplify risks for both human and ecological systems. The article further explores how e-waste-induced contamination threatens food security through soil and water degradation, and how it undermines urban resilience by intensifying health burdens. It concludes by advancing a call for integrated responses that combine regulatory reform, investment in sustainable recycling facilities, public health interventions, and inclusive economic models that generate green jobs while safeguarding human dignity. Ultimately, Nigeria's case illustrates how e-waste is not merely an environmental concern but a pressing human security challenge with global and intergenerational implications.

Keywords: E-waste; Heavy metals; Human security; Ecological security; Environmental pollution

Contact details of the author(s): musediq.lawal@uniosun.edu.ng

ISSN-P: 1844-6051 ~ ISSN-E: 2344-3677

2/2025 ***https://alss.utgjiu.ro***

INTRODUCTION

The Nigerian e-waste issue is characteristic of the technological and environmental risks that arise when technological innovation meets environmental uncertainty. Nigeria, which has a population of over 200 million and an ever-growing consumer base, is one of the largest importers of electronic products in Africa, both brand new and refurbished (Adanu et al., 2020, p. 1-4; Nnorom & Odeyingbo, 2020, p. 323). Lagos, the business capital of Nigeria, has also been identified as an important hub in this international network of electronic products. Alaba International Market and Ikeja Computer Village markets are flooded with the importation of used laptops, cell phones, and televisions that are nearing the end of their life cycle (Shabrina et al., 2022, p. 197). Although such products supply the need for accessible technological advancement for the lower and middle-class sectors in Nigeria, this hides an emerging environmental crisis in the country in the disposal of non-functional electronic products that soon turn to waste.

E-waste differs from other types of waste in that it contains large amounts of heavy metals. Items such as lead-glass materials in devices, cadmium in rechargeable batteries, mercury in switches, and chromium in plastics are inherently imbedded in devices (Buerck et al., 2021, p. 8362; Lawal et al., 2021, p. 255). If such materials are not disposed of properly, heavy metals leach into soil, water, and air, making them easily accessible to human and environmental exposure. In the Nigerian scenario, this problem is exacerbated by the fact that the country has informal electronic waste processing that uses primitive methods such as burning and acid leaching (Nandy et al., 2021).

Implications of environmental pollution are also reflected in human security. According to the United Nations Development Program, human security pertains to freedom from fear and want and can be measured in terms of health, food, and environmental security (Chowdhury and Chowdhury, 2024, p. 3329). In Nigeria, for example, the hazardous treatment of e-waste poses threats in relation to the above factors that contribute to human security. In Lagos, for example, increased blood lead levels among children around e-waste sites were reported (Ogunseitan, 2023, p. 15).

In addition, the problem of poor institutional capacity makes it difficult to govern the movement of electronic waste. Even though Nigeria is a member of the Basel Convention that governs the transfer of toxic waste between nations, porosity is observed in the country in terms of implementing this aspect (Shahabuddin et al., 2023, p. 4513). Smuggling of e-waste still occurs in Nigerian ports under the guise of "donations" and "fairly used electronics" (Shahabuddin et al., 2023, p. 4520). In this case, the introduction puts the issue of e-waste within the human and environmental security discourse.

MAIN TEXT

Methodology

In this research work, the approach utilized is that of qualitative multi-scale analysis, which is grounded within frameworks of environmental security and human security. Here, observations and findings from secondary sources are synthesized in an interpretive analysis that seeks to decipher the nexus of risks that can be created for human health and environmental well-being through the disposal of e-wastes in Nigeria.

Data were obtained from secondary sources that are diverse, including journal articles, reports from government and NGOs, and international documents such as the Basel Convention. Cases were

ISSN-P: 1844-6051 ~ ISSN-E: 2344-3677

2/2025 ***https://alss.utgjiu.ro***

purposively selected in Lagos, especially Alaba International Market and Computer Village, identified as the largest informal e-waste sectors in Nigeria due to the highest aggregation of recyclers and the observed pollution of heavy metals.

Content analysis techniques were used in this thesis to identify and capture some of the themes emerging around the topic of exposure to heavy metal pollution, environmental degradation, and governance-related issues. In this work, attention focused on sources of exposure (soil, ambient air, and water pollution), health concerns for the wider community, and the measures taken to regulate and manage electronic waste. By incorporating elements of environmental health (for example, soil/water toxicity levels quantified in past studies on the ground), the thesis combined human-related stories around potential occupational health hazards and socio-economic factors in this environmental health context. Insight and analysis were added at this point around human security and environmental insecurity themes via thematic analysis between micro and macro conditions and narratives around environmental protection and security discourses. Ethical standards were observed in this work, in that only publicly accessible sources were used in this thesis.

E-Waste and Heavy Metal Routes of Entry into Human Systems

Health risk for human populations in Nigeria emanates from the poor practices of dismantling and extracting reusable materials from electronic waste. Unlike formal systems for waste disposal that use equipment and special infrastructure, the Nigerian economy for electronic waste is controlled by informal sectors that harvest precious materials like metal using basic equipment, and in some scenarios, without personal protective equipment (Thakur & Kumar, 2022, p. 6957). Within markets like Alaba International Market and Computer Village in Lagos, repairers, recyclers, and learners manually disassemble computers, cell phones, and televisions, exposed to dust and smoke that contains toxic materials such as lead, cadmium, and mercury (Champion et al., 2022, p. 879; Obeng-Gyasi, 2022, p. 33).

Circuit board lead solder poses the highest risk since it finds its way into the blood and damages the nervous and cognitive systems of children (Champion et al., 2022, p. 888; Obeng-Gyasi, 2022, p. 33). Burning plastic casings for extracting copper wires is another practice. In some areas of Lagos and Port Harcourt, recyclers burn mountains of e-waste in open areas, and this fills the air with puffs of black smoke containing heavy metals and polycyclic aromatic chemicals (Kazancoglu et al., 2022, p. 1145). Inhaling the smoke makes workers and people in nearby areas develop respiratory problems, skin conditions, and cancers. Relatives of recyclers are indirectly exposed to toxic materials as dust clings to clothes and enters homes, and this affects women and children who are not in direct contact with the recyclable waste areas (Shabrina et al., 2022, p. 199).

Aside from the occupational exposures, food and water pollution are also significant routes of exposure. In Lagos, for instance, the level of lead and cadmium in the groundwaters around the sites of demolition has been identified to be higher, making it undrinkable (Ogunseitan, 2023, p. 25). Heavy metals can also be taken in through consuming vegetables that contain such contaminants in the soil (Lawal et al., 2021, p. 259). Generally, trans-generational effects are especially pertinent in that heavy metals can pass the placental barrier and can be present in breastmilk, thus continuing the cycle of exposure (Buerck et al., 2021, p. 8370).

ISSN-P: 1844-6051 ~ ISSN-E: 2344-3677

2/2025 ***https://alss.utgjiu.ro***

Above are some of the routes showing the possible conversion of e-wastes from an economic asset to an ever-changing human security concern. Health conditions resulting from exposure to heavy materials decrease the efficiency of the workforce in households, increase health care spending, and disrupt the social fabric of urban societies. Unfortunately, due to the slow progression of health-related problems, such incidents go unreported, leading to continued poor practice. In this case, the Nigerian exposure to heavy materials in e-wastes is elusive in relation to health considerations.

Ecological Security Risks from E-Waste Heavy Metals

The ecological aspect of e-wastes in Nigeria clearly indicates that environmental degradation and security threats are potentially and intimately intertwined. Poor and improper methods of informal e-waste recycling led to the leaching of toxic heavy metals such as lead, copper, and zinc into the soil, water bodies, and atmosphere, which in turn contributes to environmental instability and human health problems. In Lagos and Ibadan, for instance, soil analysis around informal e-waste disposal points indicates that lead, copper, and zinc are highly contaminated in Nigerian soil beyond WHO standards (Adenuga et al., 2022, p. 1; Alabi et al., 2021, p. 1209). Consequently, the contaminated soil has lower agricultural yield potential, thus threatening food security at the periphery of urban areas.

Water resources are especially vulnerable. Heavy elements in decommissioned electronic waste can leach into ground and surface water systems. Analysis carried out in Port Harcourt and Aba suggests that rivers and streams near clusters of recyclers contain higher concentrations of cadmium and chromium, making them toxic for human consumption or irrigation (Ogunseitan, 2023. p. 20). Aquatic life environments are also threatened and can be harmed as toxic materials can bioaccumulate in fish species that are then ingested by human populations.

Further contributing to the problem is poor air quality. In Alaba Market, for example, the open incineration of e-waste plastics is accompanied by the emission of heavy metals, in addition to the toxic chemicals of dioxin and furan. In this case, particulate emissions in the form of dark smoke are evident in Alaba Market (Kazancoglu et al., 2022, p. 1157). Eventually, this pollution can lead to less hospitable environments in cities, further aggravating migration and conflict over resources.

Ecological security threats also overlap and connect with challenges of climate change. Heavy metal pollution makes nature less secure because it reduces soil quality and diversity. In the countryside, this increases reliance on imported food, and this projected deficiency of ecosystem renewal represents what is known as "slow violence" since it is degradation that is happening out of sight, yet its effects are strongest on the poor (Davies, 2022, p. 409). For Nigeria, this means that ecological risks of e-wastes are more of triggers for wider insecurity in relation to displacement, poverty, and conflict.

In conclusion, the issue of heavy metal pollution emanating from e-waste jeopardizes the ecological bases of security and, if left unattended, threatens the current and future capacity of Nigerians to thrive in this rapidly urbanizing country.

Health Significance of Exposure to Heavy Metals

Exposure to heavy metals in e-waste in Nigeria poses a creeping or escalating concern for the health of the populations in those nations. Unlike many diseases that are contagious and easy to monitor

ISSN-P: 1844-6051 ~ ISSN-E: 2344-3677

2/2025 ***https://alss.utgjiu.ro***

due to their acute nature in relation to infections, the health problem of exposure to heavy metal poisons may be manifest in the distant or chronic symptoms of such exposure (Buerk et al., 2021; Lawal et al., 2021, p. 265).

Neurological disorders are amongst the worst effects. Mercury, commonly used in solder and cathode ray tubes, enters the nervous system and hinders memory, concentration, and behavior. In Lagos, the IQ and cognitive abilities of kids in areas around e-waste recycling sites are lowered due to increased blood lead levels (Champion et al., 2022, p. 880; Obeng-Gyasi, 2022, p. 33). Development delays in childhood lead to lower schooling performances, further fostering poverty and hindering Nigeria in terms of human capital development. Mercury toxicity in light containing and battery products endangers the nervous systems and kidneys of the fetus when mothers are exposed (Ogunseitan, 2023, p. 15).

Another health implication associated with people is respiratory diseases. Insulated wires and plastics that are burned produce toxic gases that lead to coughs, asthmatic attacks, and bronchitis. In areas like Alaba International Market that are densely populated, citizens have complained of difficulty in respiration, irritation in their eyes, and rashes on their skin due to contact (Shabrina et al., 2022, p. 221). In the long run, this leads to increased attendance at health facilities and rising health care bills, which burden health facilities in urban areas that are overstretched.

In addition to these acute physical diseases, there are chronic non-communicable diseases that are implicated. Chronic exposure to cadmium damages the kidneys and bones, and chromium compounds are known to be carcinogenic (Adenuga et al., 2022, p. 7; Alabi et al., 2021, p. 1227). This means that Nigeria is looking towards the future of cancers and organ failures that are owed not just to genetics but to environmental factors that can be prevented.

Secondly, mental health issues must also be considered. Communities that are constantly exposed to pollution, noxious emissions, and the visual manifestations of environmental degradation suffer from mental stress, such as health-related anxieties for their children and despair about their unhealthy living conditions (Davies, 2022, p. 427). All in all, what the health of the Nigerian people is exposed to in terms of exposure to heavy metals goes beyond just health or just individual problems of illness and suffering. It encompasses broader existential and developmental hazards taken in terms of social health or social well-being.

Socio-Economic Security Dimensions

In Nigeria, the socio-economic effects of heavy metal pollution due to e-waste are quite extensive and go beyond health effects. Within the domestic sphere, the health implications of exposure to heavy metals imply increased spending on health care, poverty, and lost income due to decreased productivity within the household economy. Within Lagos and Port Harcourt, many households around e-waste dumpsites spend money on accessing health care in terms of dealing with lung or brain-related disorders in children (Shabrina et al., 2022, p. 219).

In effect, this implies that health care costs are synonymous with other need essentials such as food and education. Even at the wider level, it is seen that the unplanned e-waste economy, despite some earning their livelihoods out of it, puts many in difficult working conditions. Young men and sometimes children are paid meager sums of money for extracting and incinerating wires in such

ISSN-P: 1844-6051 ~ ISSN-E: 2344-3677

2/2025 ***https://alss.utgjiu.ro***

markets, thereby threatening their health despite the absence of any protective gear (Thakur & Kumar, 2022, p. 6966). Though it poses little problem in earning some money at present, it hinders any individual from leading a healthy life and contributing usefully in the years to come due to possible illness or disablement at a premature age.

Impacts are also felt in the education and labor markets of Nigeria. Children that are developmentally impaired due to lead exposure can be expected to fare poorly in school, leading to lower potential for social mobility and further contributing to the pool of low-skilled workers (Champion et al., 2022, p. 882; Obeng-Gyasi, 2022, p. 33). Further, poor health within the employable age group leads to lowered efficiency within this group, meaning higher absenteeism and lower productiveness within the formal or informal economy. Within the community, property values decrease in areas that are perceived to be polluted or unsafe, which further marginalizes the community and limits their socio-economic potential (Buerk et al., 2021; Lawal et al., 2021, p. 260).

Micro-traders and craftsmen in nearby locations of electronic waste generation are further impacted in terms of lower consumer support, owing to decreased environmental conditions. From the national perspective, the effects of the heavy metal pollution in the economy include higher health care spending, lower agricultural output due to poor quality, and lost potential earnings from suboptimized recycling practices due to poor control. Instead of taking advantage of the profitable international trade in recyclables, Nigeria suffers the pollution externality and foregoes its benefits. In conclusion, the socio-economic security implications of heavy metal exposure due to e-waste have created a paradox between survival and sustainability, entraining people in structural insecurity.

Policy and Institutional Responses: Challenges and Opportunities

Coming into Nigeria are large numbers of used electronics at the Lagos and Port Harcourt ports, much of this material nearing the end of its useful life, and in effect, imported toxic waste (Thakur & Kumar, 2022, 6959). Plus, due to porous borders and corruption, non-functional used electronics are entering the country in the guise of donations or refurbished products (Thakur & Kumar, 2022, p. 6960). In relation to this problem in Nigeria, the country is still committed to international regimes such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Amos et al., 2024, p. 69; Wang & Qiao, 2024; Yang, 2020, p. 713). Still, the implementation at the country level is still deficient (Amos et al., 2024, p. 84; Wang & Qiao, 2024; Yang, 2020, p. 738).

In Nigeria, some frameworks are in place, yet their poor regulation makes them less effective. There are some environmental standards and regulations for the treatment of e-wastes, as laid down by the National Environmental Standards and Regulations Enforcement Agency (NESREA), yet illegal or informal treatment of e-wastes is predominant in the industry due to poor regulation and the availability of cheap alternatives (Maes and Preston-Whyte, 2022, p. 72; Nnorom & Odeyingbo, 2020, p. 323). In this case, most Nigerians' e-wastes are treated in the informal sector, making them more susceptible to poor treatment and unhealthy working conditions due to poor formalization of the industry.

Examples from the empirical world demonstrate the above shortcomings. In Lagos, for instance, pilot programs initiated in collaboration with international bodies have attempted to create locations for the collection of electronic waste and promote the process of recycling. However, this is only

limited and only benefits a small section of the population when the majority practice illegal means of dealing with electronic waste (Ogunseitan, 2023, p. 25). Also, due to a lack of awareness, consumer electronic waste is disposed of alongside other waste.

However, some areas for improvement exist. Nigerian entrepreneurs' vibrancy can be tapped for the formalization of waste recyclers, in that training, personal protective gear, and access to environmentally friendly recyclage facilities can be provided. Synergistic relationships can be achieved between the government, the private sector, and foreign donors for investment in recycling plants that are environmentally friendly. For instance, collaborations between businesses and the government can be achieved for Extended Producer Responsibility initiatives that ensure products' life-cycle disposal (Kazancoglu et al., 2022, p. 1149).

Upgrading institutions like NESREA, improving surveillance at the border, and educating the public on the risks of e-waste can be very vital in achieving sustainable e-waste management. By implementing this approach effectively, it can be possible to convert the risk of e-waste in the country from a security threat to an economic potential for green employment.

Results and Discussion

From the findings of this study, it is evident that there exists a large nexus between the treatment of e-wastes, the issue of heavy metal pollution, and human as well as environmental insecurity in Nigeria. Based on evidence culled from both field and secondary materials, it can be generally observed that the practice of e-wastes in Nigeria is dominated by the informal sector and that Lagos is the hub of this practice and environmental pollution. Information indicates that the informal recyclers at Alaba International Market and Computer Village in Lagos use dismantling, open burning, and acid leaching in extracting precious heavy metals.

Data on environmental conditions that have been obtained from past research shows that the soil and water in such areas are contaminated to dangerous levels of lead, cadmium, and mercury, sometimes above the permissible standards of the World Health Organization (WHO) (Adenuga et al., 2022, p. 10; Alabi et al., 2021, p. 1217; Ogunseitan, 2023, p. 22). Specifically, the level of lead is dangerous to the neurological and cognitive functions of children in such areas, consistent with findings that areas around the e-waste dumping sites have higher blood lead levels (Champion et al., 2022, p. 885; Obeng-Gyasi, 2022, p. 33). Mercury and cadmium are also contaminating the ground and vegetables around the dumping sites.

In human security terms, exposure to heavy metals affects several areas of well-being: health, economy, and environmental sustainability. Health effects include lung diseases, impaired cognitive functions, and higher health care expenses. Economic effects include decreased work efficiency and job insecurity of recyclers, whereas environmental damage translates to lower agricultural productivity.

Institutional analysis shows that there are loopholes in the environmental governance structure in Nigeria. Even when the country has formal laws like the regulation of e-wastes in Nigeria authorized by NESREA and that it is signatory to the Basel convention, it has little to no formal environmental enforcement mechanism. In addition, it is the irregular recyclers that are the backbone of this industry and are not considered in formal frameworks in environments that are toxic.

This serves to re-validate the paradox of e-waste in that it provides livelihood activities for many people while at the same time causing insecurity within the communities and environments that it touches, and it further confirms that the issue of e-waste in Nigeria is more of a security problem than just an environmental concern.

Based on this finding, the need for integrated policy reforms that incorporate informal recyclers as stakeholders in green job creation and investment in secure recycling infrastructure is highlighted. By integrating e-waste management in human and ecological security frameworks, the risks and challenges associated with addressing e-wastes in Nigeria are converted into opportunities for sustainable development in the cities.

CONCLUSION

Based on this analysis, it can be concluded that the problem of e-waste in Nigeria has become a multi-layered threat that goes beyond environmental pollution and encompasses health and survival and ecological sustainability.

Based on the analysis of environmental pollution arising from e-wastes and the health hazards emanating from it, it can be concluded that e-wastes present a potential health threat to the people of Nigeria. From the analysis, there are several factors that continue to lead to hazardous conditions in e-waste recycling in Nigeria. Even though Nigeria follows international agreements such as the Basel Convention, the absence of a comprehensive approach towards managing e-waste in the country has ensured that dangerous toxic wastes are still present within the informal economy. It is ironic that it is in e-waste recycling that many people get employment opportunities despite this process indirectly affecting the security that it guarantees.

Policy implications derived from this work include the need for a multi-layered and inclusive approach to managing e-wastes. First, there should be an improvement in the capacity of offices like NESREA to monitor imports and ensure compliance and environmentally sound disposal. Second, involving most recyclers in the formal sector through cooperatives and supply of protective gear can help in addressing health factors while incorporating socioeconomics. Third, joint investment needs to be made in the creation of eco-industrial parks for e-waste which use environmentally friendly dismantling and metal extracting technologies. Strategies for improving public health must focus on educating citizens, biomonitoring, and health care services for those exposed to toxic heavy metals. Informed verification and implementation of Extended Producer Responsibility (EPR) programs must be pursued at the formulation of health care and environmental protection policies.

Ultimately, the issue of e-waste in Nigeria needs to be addressed through a paradigm shift from remediation to preventative and comprehensive environmental governance. By integrating e-waste management into the wider agenda of human and environmental security, Nigeria can turn its problem of waste into an exemplary initiative for green innovation and environmental justice.

REFERENCES

Adanu, S.K., Gbedemah, S.F., & Attah, M.K. (2020). Challenges of adopting sustainable technologies in e-waste management at Agbogbloshie, Ghana. *Heliyon*, *6*(8), (e04548)1-6

Adenuga, A.A., Amos, O.D., Olajide, O.D., Eludoyin, A.O., & Idowu, O.O. (2022). Environmental impact and health risk assessment of potentially toxic metals emanating from different anthropogenic activities related to E-wastes. *Heliyon*, *8*(8). (e10296)1-13.

Alabi, O.A., Adeoluwa, Y.M., Huo, X., Xu, X., & Bakare, A.A. (2021). Environmental contamination and public health effects of electronic waste: an overview. *Journal of Environmental Health Science and Engineering*, *19*(1), 1209-1227.

Amos, O., Abiodun, O.A., Olalekan, O., Opeodu, O.T., & Ademola, A. (2024). Investigation of Efforts and Problems in Implementing the Basel Convention on the Control of Transboundary Movements of wastes and their Disposal in Nigeria. *Asian Journal of Geographical Research*, *7*(1), 69-84.

Buerck, A.M., Usowicz, M., Cunningham, J.A., Khaliq, M., Barrett, L.J.P., Rakotoarisoa, L., Rakotondrazaka, R., Alfredo, K., Sommariva, S. & Mihelcic, J.R. (2021). Health and economic consequences of lead exposure associated with products and services provided by the informal economy. *Environmental Science & Technology*, *55*(12), 8362-8370.

Champion, W.M., Khaliq, M., & Mihelcic, J.R. (2022). Advancing knowledge to reduce lead exposure of children in data-poor low-and middle-income countries. *Environmental Science & Technology Letters*, *9*(11), 879-888.

Chowdhury, E. K., & Chowdhury, R. (2024). Role of financial inclusion in human development: Evidence from Bangladesh, India and Pakistan. *Journal of the Knowledge Economy*, *15*(1), 3329-3354.

Davies, T. (2022). Slow violence and toxic geographies: 'Out of sight' to whom?. *Environment and Planning C: Politics and space*, *40*(2), 409-427.

Kazancoglu, Y., Ozkan-Ozen, Y. D., Mangla, S. K., & Ram, M. (2022). Risk assessment for sustainability in e-waste recycling in circular economy. *Clean Technologies and Environmental Policy*, *24*(4), 1145-1157.

Lawal, K. K., Ekeleme, I. K., Onuigbo, C. M., Ikpeazu, V. O., & Obiekezie, S. O. (2021). A review on the public health implications of heavy metals. *World Journal of Advanced Research and Reviews*, *10*(3), 255-265.

Maes, T. & Preston-Whyte, F. (2022). E-waste it wisely: lessons from Africa. *SN Applied Sciences*, *4*(3), 72.

Nandy, S., Goswami, S., Marques, A., Gaspar, D., Grey, P., Cunha, I., Nunes, D., Pimentel, A., Igreja, R., Barquinha, P. & Pereira, L. (2021). Cellulose: a contribution for the zero-e-waste challenge. *Advanced Materials Technologies*, *6*(7), 2000994.

Nnorom, I.C., & Odeyingbo, O.A. (2020). Electronic waste management practices in Nigeria. In *Handbook of electronic waste management* (pp. 323-354). Butterworth-Heinemann.

Obeng-Gyasi, E. (2022). Sources of lead exposure in West Africa. *Sciences*, *4*(3), 33.

Ogunseitan, O.A. (2023). The Environmental justice agenda for e-waste management. *Environment: Science and Policy for Sustainable Development*, *65*(2), 15-25.

Shabrina, Z., Arcaute, E., & Batty, M. (2022). Airbnb and its potential impact on the London housing market. *Urban Studies*, *59*(1), 197-221.

Shahabuddin, M., Uddin, M. N., Chowdhury, J. I., Ahmed, S. F., Uddin, M. N., Mofijur, M., & Uddin, M. A. (2023). A review of the recent development, challenges, and opportunities of electronic waste (e-waste). *International Journal of Environmental Science and Technology*, *20*(4), 4513-4520.

Thakur, P., & Kumar, S. (2022). Evaluation of e-waste status, management strategies, and legislations. *International Journal of Environmental Science and Technology*, *19*(7), 6957-6966.

Wang, J., & Qiao, Z. (2024). A comprehensive review of landfill leachate treatment technologies. *Frontiers in Environmental Science*, *12*, 1439128.

Yang, S. (2020). Trade for the environment: Transboundary hazardous waste movements after the Basel Convention. *Review of Policy Research*, *37*(5), 713-738.