Impact of Urban Mining Towards Sustainability of Lagos Mega City

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Urban mining is a concept that involves the extraction of valuable materials from waste generated in cities. Lagos Mega City is facing a significant challenge in managing its waste, with a significant portion being disposed of in landfill sites, leading to environmental degradation and health hazards. This research aims to assess the impact of urban mining towards sustainable development in Lagos Mega City. This research adopted a quantitative research design method with a random sampling technique used in administering a survey questionnaire to residents of Lagos Mega City to assess their familiarity and knowledge of urban mining and its impact on sustainable development. The data collected from the survey were analyzed using statistical tools. The study identified respondents' familiarity, level of knowledge and the challenges of urban mining practices in Lagos Megacity. The result showed that 60no (49.6%) are familiar with the urban mining concept while 27no (22.3%) are not familiar and 34no (28.1%) are neutral, also the level of knowledge 37no (30.6%) are not knowledgeable, 49no (40.5%) are knowledgeable while 35no (28.9%) are neutral, lack of awareness constituted 75.2% of the challenges/drawback. The study recommended that efforts should be made by all stakeholders to raise awareness of urban mining especially among the young age to maximize the benefits of urban mining especially waste management strategy to achieve sustainable development in Lagos Mega City.

Keywords: Lagos Mega City, Sustainable Development, Urban Mining, Waste Management

Introduction

In recent years, the concept of urban mining has gained significant attention as a promising solution to address the mounting challenges of resource scarcity, environmental degradation, and waste

management in rapidly expanding urban areas. As one of Africa's most populous and rapidly developing cities, Lagos, the megacity of Nigeria, stands at the forefront of these challenges (UN-Habitat, 2016).The 2030 Agenda with its Sustainability Development Goals (SDGs) addresses the importance of the building and construction sector towards sustainable development (Goubran, 2019). Rapid urbanization in Lagos has led to increased consumption and waste generation, putting a strain on natural resources and exacerbating environmental pollution (Olawoyin et al., 2019; . Traditional waste management systems often struggle to cope with the volume of waste generated, leading to improper disposal practices and negative environmental consequences (Akinbile, 2018. Additionally, the extraction of virgin resources to meet the city's growing demands contributes to environmental degradation and further depletes finite resources. However, urban mining presents a potential solution to these challenges by harnessing the value of discarded materials and waste streams within the city. It involves recovering valuable resources through practices such as recycling, reclamation, and repurposing, thereby reducing reliance on virgin resources, minimizing environmental impacts, and promoting circular economy principles (Saeed et al., 2021). By implementing effective urban mining strategies, Lagos can enhance its sustainability, improve resource efficiency, and mitigate the adverse effects of waste generation and resource extraction.

Karak et al., (2019) posits that urban mining can contribute to the economic development of cities by creating job opportunities, fostering local industries, and stimulating innovation and entrepreneurship. It can also enhance community engagement and social inclusion by involving local residents in waste management and resource recovery activities. It is therefore important to know the current level of familiarity and knowledge of the subject while assessing the current practice of urban mining with a view of identifying the impacts before urban mining will be embraced.

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The study aimed at assessing the impact of urban mining on the sustainability of the Lagos Megacity with a view to highlight the potentials of urban mining towards city sustainability. This is motivated by the pressing need to address resource scarcity, environmental degradation, and waste management challenges in rapidly growing urban areas. Lagos, as one of Africa's most populous cities and the economic hub of Nigeria, faces unique sustainability challenges due to its rapid urbanization and increasing demands for resources. This study was guided by the following objectives i. assessing the respondent's familiarity of urban mining, ii. Examine the current state of urban mining practices in Lagos, and, iii. Identify the impact and challenges they present.

Waste management and Sustainable Development

In Lagos Mega city, efforts have been made in waste management to enhance sustainable development at various levels such includes; promoting recycling and waste-to-energy technologies (Ola, Mauthe,

& Khatib, 2017). These approaches can reduce the volume of waste going to landfills, conserve resources, and generate renewable energy by creating recycling points program citizens are encouraged to recycle and incentives were provided, while waste-to-energy projects like the Olusosun landfill gas recovery project harness methane emissions from landfills for electricity generation (Adebola, 2018; Agunwamba, 2020). Other initiatives such as the Cleaner Lagos Initiative aim to educate citizens about waste segregation, proper disposal, and the importance of recycling. Raising public awareness and promoting waste management education are vital for achieving sustainable practices. Education campaigns can help change behavior and attitudes towards waste, leading to improved waste management practices. Engaging the private sector in waste management through public-private partnerships (PPPs) can enhance efficiency, innovation, and investment in the sector.

Urban Mining

Urban mining practices encompass a range of strategies aimed at extracting valuable resources from urban waste streams and discarded products. These practices play a crucial role in resource recovery and contribute to the broader concept of sustainable development by fostering a more circular economy, reducing environmental impact, and promoting efficient resource management.

Urban mining involves the identification, collection, and processing of materials from various sources such as electronic waste (e-waste), construction and demolition waste, and municipal solid waste (MSW). Through processes like recycling, reclamation, and repurposing, valuable materials like metals, plastics, and rare earth elements can be recovered, reducing the reliance on virgin resources and minimizing the need for resource extraction (Mancini et al., 2018).

Urban mining cannot be mistaken for recycling or waste treatment techniques alone, although they are integral parts of the whole. It requires the use of an industrial process which is capable of recovering elements of an artifact that for some reason has turned into urban waste.

Urban mining and Sustainable development

The linkages between urban mining and sustainable development are multifaceted. Firstly, urban mining supports the principles of a circular economy, where materials are kept in use for as long as possible and their value is maximized through multiple lifecycles. This approach helps reduce waste generation, conserve resources, and minimize environmental pollution and greenhouse gas emissions (Saeed et al., 2021). Secondly, urban mining contributes to the sustainable management of resources by reducing the pressure on primary resource extraction. As urban areas continue to grow and consume more resources, the traditional linear model of extraction, consumption, and disposal becomes increasingly unsustainable. Urban mining provides an alternative approach by recovering resources from waste streams, thereby extending their lifespan and minimizing the need for new resource extraction (Karak et al., 2019; Corrêa & Gaya de Figueiredo, 2021).

Moreover, urban mining practices have socio-economic benefits, including job creation, local economic development, and the promotion of innovation and entrepreneurship. The establishment of recycling facilities, material recovery plants, and resource reclamation centers can create employment opportunities and stimulate economic growth in urban areas (Saeed et al., 2021). The successful integration of urban mining into sustainable development requires the implementation of supportive policies, regulations, and incentives. Governments and municipalities play a crucial role in creating an enabling environment that promotes resource recovery and incentivizes investment in urban mining infrastructure and technologies. Collaboration between public and private sectors, along with the active involvement of stakeholders, is vital for effective urban mining practices and sustainable resource management (Saeed et al., 2021).

Case studies of successful urban mining initiatives in other cities.

Various countries have engaged different approaches in urban mining with varying results; in Belgium, there has been successful urban mining initiatives in Antwerp, which focuses on metal recycling, Kuehr and Stegmann (2013) highlighted the opportunities, limits, and infrastructure necessary for effective metal recycling in an urban. Also in Melbourne, Australia a study by Rebeiz and Ball (2019) examined the urban mining practices related to building material recovery which gave positive outcome contributing to a circular economy and resource efficiency. Whereas, in Sweden, Ekberg and Björklund (2016) on Integrated Waste Management discusses the city's successful strategies for waste reduction, recycling, and resource recovery, including that urban mining initiatives contributing to a more sustainable and circular urban environment. Study in China focuses on the urban mining aspect of recycling metals from waste-to-energy bottom ash in Beijing. It explores the challenges and opportunities associated with extracting valuable resources from ash residues, highlighting the potential for resource recovery through innovative technologies (Zhou, Wang & Chen, 2017).

Existing policies and regulations related to waste management and resource recovery in Lagos

Nigerian government has initiated broader policy frameworks and strategies that promote sustainable development, which can indirectly support the urban mining. Some of the current laws and rules that support the institutional and policy framework for the circular economy in the metropolis of Lagos are listed below.

National Policy on Solid Waste Management (2011) in Nigeria which provides a framework for sustainable waste management practices, including waste reduction, recycling and resource recovery. This policy encourages the implementation of integrated solid waste management systems, waste segregation and the establishment of recycling facilities. While this policy applies nationwide, it sets the foundation for local authorities in Lagos, such as the Lagos Waste Management Authority

(LAWMA), to implement circular economy practices in waste management (Federal Government Nigeria, 2011).

National Renewable Energy and Energy Efficiency Policy (2015) in Nigeria this alsopromotes the development and the use of renewable energy sources and energy –efficient technologies. This policy encourages the adoption of clean and sustainable energy solutions, which aligns with the urban mining's goals of recovering resource from waste and environmental conservation. Transitioning to renewable energy sources can contribute to more sustainable and circular energy system in Lagos (FGN, 2015).

Potential sources of urban mining resources in the megacity.

With the rapid urbanization and population explosion of Lagos megacity, the volume of Electronic Waste (E-Waste) discarded electronic devices, appliances and waste generated as a result of construction and demolition waste cannot be overemphasized. E-waste is significant urban mining sources due to its high content of valuable metals and other recoverable materials, it contains metals such as gold, silver, copper, and rare earth elements that can be recycled and reused (Baldé, et al., 2015). The building and construction industry has been identified as the largest consumer of environmental treasures therefore Construction and demolition waste, generated from building and infrastructure projects, constitutes another significant urban mining source. It includes materials such as concrete, wood, metals, and plastics, which can be recycled and repurposed in new construction projects or other applications (Tam, et al., 2007). Also, discarded products encompass a wide range of items that are no longer in use but may contain valuable materials. This category includes products like furniture, textiles, packaging materials, and household goods, which can be recycled or upcycled to recover valuable resources and reduce waste (Kirchherr, et al., 2017).

Impact of urban mining

Resource Conservation and Recovery:

Urban mining plays a crucial role in conserving natural resources by reducing the dependence on primary raw materials. Recycling and recovering valuable resources from urban waste streams, such as electronic waste and construction debris, reduces the need for extracting and processing virgin materials (Reck, & Graedel, 2012).

Environmental Impact Reduction:

Urban mining contributes to mitigating environmental impacts associated with traditional mining activities. By recycling and reusing materials, it helps reduce energy consumption, greenhouse gas emissions, water usage, and the release of pollutants and hazardous substances (Su, et al., 2013).

Economic Opportunities:

Urban mining presents economic opportunities through the recovery and recycling of valuable materials. It can lead to the development of new industries, job creation, and the generation of revenue streams from the sale of recycled materials and recovered resources (Tanskanen, Kaartinen, & Eronen, (2017).

Waste Reduction and Landfill Diversion:

Urban mining initiatives contribute to waste reduction and diversion from landfills. By extracting valuable materials from waste streams, it minimizes the amount of waste requiring disposal, thus reducing pressure on landfill capacity and associated environmental issues (Yuan, W., Shen, L., Liu, & Xu, 2019).

Methodology

This study adopted the quantitative research design methods using a random sampling technique among the population of Lagos mega city, the questionnaire were administered using an electronic form (google form) to resident within the Lagos Mega City with a special consideration for student population to test their level of awareness of the concept of urban mining.121 responses were returned, none of the respondents were forced. The data collected were analysed using Statistical Package for social sciences (SPSS).

Results

This study was guided by three clearly stated objectives and the results are as follows; firstly, considering the demographic characteristics of the respondents 24% (29 no) were females while 76% (92no) were males with ages ranging significantly from 21– 60years,with 21-30years been 72no (59.5%),31-40years 22no(18.2%),41-50years 16no (13.2%) while ages between 51-60 are 5no (4.1%). Occupation

Table 1: Showing the demographic characteristics of the respondents

Gender		Frequency	Percent	Cumulative Percent
	Female	29	24.0	24.0
	Male	92	76.0	100.0
	Total	121	100.0	

Age		Frequency	Percent	Percent
	20 and below	4	3.3	3.3
	21 – 30	72	59.5	62.8
	31 – 40	22	18.2	81.0
	41 – 50	16	13.2	94.2
	51 –60	5	4.1	98.3
	61 and above	2	1.7	100.0
	Total	121	100.0	

Occupation	Frequency	Percent	Cumulative Percent
Employed (Private Sector)	20	16.5	16.5
Employed (Public Sector)	5	4.1	20.7
Self-employed	18	14.9	35.5
Student	77	63.6	99.2
Unemployed	1	.8	100.0
Total	121	100.0	

Secondly, assessing the respondent knowledge and familiarity with the concept of urban mining the results showed that out of the 29 females only 11no are familiar with urban mining and 11no were not familiar while 7no were neutral in their response. For the males, 49no were familiar, 16no are not familiar while 27no are neutral in their response. This implies that 60no (49.6%) are familiar with urban mining concept while 27no (22.3%) are not familiar and 34no (28.1%) are neutral. Also, comparing the

gender characteristics with the knowledge of urban mining, result showed that 12 of the females are not knowledgeable while 11no are knowledgeable only 6no had neutral response. However, for males 25 no are not knowledgeable, 38no are knowledgeable but 29 no of the males had neutral response. Therefore, 37no (30.6%) are not knowledgeable, 49no (40.5%) are knowledgeable while 35no (28.9%) are neutral.

Table 2: Showing the knowledge and familiarity with Urban Mining concept

Gender		Familiar	Neutral	Unfamiliar	Total
	Female	11	7	11	29
	Male	49	27	16	92
Total		60	34	27	121

Gender		Neutral	Not knowledgable	Very knowledgeable	Total
	Female	6	12	11	29
	Male	29	25	38	92
Total		35	37	49	121

Age		Neutral	Not knowledgable	Very knowledgeable	Total
	20 and below	1	1	2	4
	21 - 30	25	22	25	72
	31 - 40	6	7	9	22
	41 - 50	3	7	6	16
	51 -60	0	0	5	5
	61- above	0	0	2	2
Total		35	37	49	121

Also, seeking to understand the current state of urban mining initiative and practices as shown in table 3, the 52.9% are not if there are urban mining initiatives, 33.9% and 7.4% allude that there are initiatives while 5.8% said there are no urban mining initiatives.

Table 3: Showing the knowledge of Urban Mining initiatives.

Urban mining initiatives		Frequency	Percent
	No, there are no initiatives	7	5.8
	Not sure	64	52.9
	Yes, there are a few initiatives	41	33.9
	Yes, there are several initiatives	9	7.4
	Total	121	100.0

Finally, assessing the challenges of urban mining in Lagos mega city, a number of possible challenges were identified and the result showed that resistance from the stakeholders is the least of all the challenges with 0.8%, followed by implementation cost with 1.7%,insufficient government policies ranked third with 9.1% while limited infrastructure and limited technology accounts for 11.6%, again the result showed that lack of awareness and education about urban mining constitute the major challenge amounting to 37.2%, however, 38% of the respondents showed that all the challenges above contributes to the challenges of urban mining. Therefore, lack of awareness will amount to 75.2% as shown in table 4.

Table 4: Showing challenges of Urban Mining in Lagos

Challenges or drawbacks		Frequency	Percent	Cumulative Percent
Valid	All of the above	46	38.0	38.0
	High implementation costs	2	1.7	39.7
	Insufficient government policies and regulations	11	9.1	48.8
	Lack of awareness and education about urban mining	45	37.2	86.0
	Limited infrastructure and technology for urban mining	14	11.6	97.5
	None of the above	2	1.7	99.2
	Resistance from stakeholders	1	.8	100.0
	Total	121	100.0	

Conclusions

This study was concluded based on the finding from the result firstly, the majority of the respondents are not familiar with the urban mining concept, showing that there is a knowledge gap between urban mining practices and resident familiarity among the study area. Secondly, the level of awareness of urban mining initiatives among the respondent showed that a greater percentage of the respondents are not aware nor sure if there are urban mining initiatives within the Lagos megacity. Lastly, the study concluded that among the challenges of urban mining lack of awareness and education is a key limiting factor or constitute a drawback to effectiveness of urban mining rather than finance, policy or reluctance from stakeholders.

Therefore, the study recommends that, i. efforts should be made by all stakeholders to raise awareness of urban mining especially among the young age to maximize the benefits of urban mining towards developing strategies to improve resource management, reduce environmental impacts, and promote socio-economic development in the Lagos mega city.

References:

Adebola, O. (2018). Waste management in Lagos, Nigeria: A case study of Olusosun landfill. Heliyon, 4(7), e00695.

Akinbile, C. O. (2018). Waste Management in Lagos Metropolis: Challenges, Strategies and Prospects. *International Journal of Environmental Science and Technology Research, 2(3), 48-54.*

Alagbe, O.A, Onamade,A.O and Asaju,O.A.(2023) In C. Aigbavboa, W. Thwala, & A. Douglas (Eds.), *Investigating Construction and Demolition Waste Management Practices Among Building Industry Professionals in Lagos, Nigeria* (pp. 456–467).

Baldé, C. P., Wang, F., Kuehr, R., Huisman, J. (2015). The Global E-waste Monitor - 2014. United Nations University, IAS - SCYCLE, Bonn, Germany. Retrievedfrom: https://collections.unu.edu/eserv/UNU:2271/GEM_2014.pdf

Corrêa HL, Gaya de Figueiredo MA. (2021). Urban Mining in Developing Countries: An Ally to Circular Economy. *Aspects Min Miner Sci. 7(2).* AMMS. 000656. 2021. DOI: 10.31031/AMMS.2021.07.000656

Ekberg, C., & Björklund, A. (2016). Integrated waste management for sustainable development: The case of Stockholm, Sweden. Journal of Cleaner Production, 115, 217-229. doi: 10.1016/j.jclepro.2015.10.010

Goubran, S. (2019). On the Role of Construction in Achieving the SDGs *J. Sustain. Res.* 1

Karak, T., Bhattacharyya, P., Das, D., & Saha, P. (2019). Urban Mining: An Untapped Resource for Circular Economy. *Sustainable Materials and Technologies, 22, e00109*.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling, 127, 221-232. doi: 10.1016/j.resconrec.2017.09.005

Kuehr, R., & Stegmann, P. (2013). Metal recycling: Opportunities, limits, infrastructure. United Nations University. Retrieved from https://collections.unu.edu/eserv/UNU:1073/Metal_Recycling.pdf

Lagos Waste Management Authority (LAWMA). (2021). Blue Box Programme. Retrieved from http://lawma.gov.ng/bluebox-programme/

Lagos Waste Management Authority (LAWMA). (2021). Lagos Waste Management Authority - About Us. Retrieved from http://lawma.gov.ng/about-us/

Lardinois, J. (2021). Waste-to-energy project in Lagos, Nigeria. Retrieved from https://waste-management-world.com/a/waste-to-energy-project-in-lagos-nigeria

Mancini, L., Sala, S., &Koh, L. (2018). Urban Mining of E-Waste is Becoming More Cost-Effective Than Virgin Mining. *Environmental Science & Technology, 52(9), 4835-4841.*

Ola, A., Mauthe, A., & Khatib, H. (2017). Towards sustainable waste management in Lagos: An evaluation of scavengers' perception of waste separation at source. Waste Management & Research, 35(12), 1217-1227.

Olawoyin, R., Idris, A. M., Amole, O. D., & Davies, O. A. (2019). Analysis of Solid Waste Management and Strategies for Lagos Metropolis. *Journal of Environmental Science and Public Health, 3(1), 14-26.*

Olowoporoku, A. (2021). Lagos residents to embrace waste sorting, recycling with blue box initiative. Retrieved from https://nairametrics.com/2021/02/25/lagos-residents-to-embrace-waste-sorting-recycling-with-blue-box-initiative/

Onamade, A., Alagbe, O., Dare-Abel, O., & Daramola, S. (2022). An Empirical Study Of Solid Waste Collection And Management. *Global Scientic Journal*, *10*(11), 1602–1613.

Rebeiz, K., & Ball, R. (2019). Urban mining of building materials in Melbourne, Australia. Journal of Cleaner Production, 233, 1230-1240. doi: 10.1016/j.jclepro.2019.06.203

Reck, B. K., & Graedel, T. E. (2012). Challenges in metal recycling. Science, 337(6095), 690-695. doi: 10.1126/science.1217501

Saeed, A., Yang, H., &Keoleian, G. A. (2021). Comparative Analysis of Circular Economy Transition Strategies in Global Mega-Cities: A Case Study of Lagos. *Journal of Cleaner Production, 281, 125109.*

Sanusi, S., Adetola, L., &Ayedun, H. (2020). Solid waste management in Lagos State, Nigeria: Challenges and prospects. *Sustainable Cities and Society, 53, 101981*.

Su, B., Heshmati, A., Geng, Y., & Yu, X. (2013). A review of the circular economy in China: moving from rhetoric to implementation. Journal of Cleaner Production, 42, 215-227. doi: 10.1016/j.jclepro.2012.11.020

Tam, V. W. Y., Tam, C. M., & Zeng, S. X. (2007). Towards total construction waste recycling: A case study in Hong Kong. Waste Management, 27(12), 1632-1648. doi: 10.1016/j.wasman.2006.07.014

Tanskanen, P., Kaartinen, T., & Eronen, P. (2017). Assessing the economic potential of urban mining in Finland. Resources Policy, 53, 18-29. doi: 10.1016/j.resourpol.2017.05.002

UN-Habitat. (2016). Urbanization and Development: Emerging Futures. World Cities Report 2016. United Nations Human Settlements Programme (UN-Habitat).

Yuan, W., Shen, L., Liu, Y., & Xu, H. (2019). Assessment of the urban mining potential in China: A case study of discarded electrical and electronic devices. Resources, Conservation and Recycling, 148, 57-65. doi: 10.1016/j.resconrec.2019.04.008

Zhou, C., Wang, H., & Chen, Y. (2017). Recycling metals from waste-to-energy bottom ash: A case study in Beijing, China. Journal of Cleaner Production, 142, 2298-2307. doi: 10.1016/j.jclepro.2016.11.049