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Quantitative Assessment and Environmental Implications of Hazardous Crude Oil Waste in the Niger Delta Region of Nigeria

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Abstract: Generation of hazardous crude oil waste from its production and exploration have had a detrimental effect on the host populations' environments of Niger Delta of Nigeria. In this study, analysis of crude oil exploration waste generation in Nigeria Niger Delta was carried out. Waste component samples generated from an Oil servicing company from a time period, 2012 to 2019 was analyzed. The waste categories were non-hazardous recyclable waste (NHRW), non-hazardous non-recyclable waste (NHNRW), hazardous recyclable waste (HRW), others waste (OW), and hazardous burnable waste (HBW). The study revealed that 654, 955 tons of non-hazardous recyclable waste (NHRW), 3,081,778 of non-hazardous non-recyclable waste (NHNRW), 94,946 tons of hazardous recyclable waste (HRW), 1,935,089 tons of others waste (OW), and 5,868,122 tons of hazardous burnable waste (HBW) were generated under the period considered. Besides, the continuous increase in volume of crude oil waste is an evidence of poor waste management with oil companies operating in the region.

Keywords: *Niger Delta, Crude oil exploration, Production Waste, Hazardous Waste, Nigeria..*
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1. INTRODUCTION

Nigeria holds extensive reserves of crude oil, establishing it as a major player in the global oil market. Crude oil exploration in Nigeria began over five decades ago, leading to extensive growth in onshore and offshore operations conducted by companies like Shell, Chevron, and Seplat (Ogunnubi et al., 2021). According to (Adewuyi & Awotunde, 2021), a cumulative tendency of exploration and production of crude oil in Nigeria reveal that more than 13 crude oil firms presently run more than 7000km of pipelines and flow lines, as well as numerous flow stations. Also, existing statistical data statistics shown that petroleum production makes up more than 90% of the nation's income. Despite this economic boon, the environmental and health impacts of oil production are severe, especially in the Niger Delta, where hazardous waste disposal and pollution have led to widespread ecological damage (Udo et al., 2020). The impact of oil extraction activities in the Niger Delta has been profound, resulting in persistent air, soil, and water pollution. Hazardous waste from oil production - such as drilling fluids, cuttings, and toxic emissions—has been linked to ecosystem degradation, reduced agricultural productivity, and health complications among residents (Ekong et al., 2020). Pollution in this region also threatens marine biodiversity and has led to bioaccumulation of toxins in fish and other aquatic organisms, posing significant health risks to local communities who rely on these resources for sustenance (Oghenevwede & Aghogho, 2021). More so, generated waste from offshore crude oil production activities create atmospheric emissions effects such as drilling fluids, drilling cuttings, asbestos, pigging wastes, deck drainage and well treatment fluids, batteries (both wet and dry cell), metallic and plastic drums, and oil spills that can be caused by unintentional releases, intentional or willful vandalism, maintenance errors, and human error (Watson, 2020).

This environmental degradation has also drawn attention internationally, with global environmental groups calling for enhanced regulatory oversight and sustainable practices in oil production. Research indicates that poor management of generated wastes, including oil spills and industrial chemicals, has exacerbated these issues, leading to soil degradation and groundwater contamination (Orji et al., 2020). Water quality is a particularly pressing issue, as oil spills and industrial waste have severely impacted local water sources,

rendering them unsafe for both domestic and agricultural use. According to Anyadiegwu and Ohia (2021), water pollution is the primary driver of aquatic life depletion and poses a health risk to residents in the Niger Delta region. This aligns with global concerns around water contamination, with the United Nations Environmental Programme (UNEP) noting that water safety remains a critical issue worldwide, particularly in regions affected by industrial activities (UNEP, 2021). Notwithstanding the last 20 years, the area has been subject to all governmental regulations, rules, and authorities which is exposed to bigger environmental disasters and uncertainty. This is mainly the culvert of management of generated waste and unsustainable oil and gas operation in the area. Environmental pollution caused by the waste from crude oil is extensively dispersed throughout the oil-rich regions. The consequences of inadequate management of generated crude oil waste can be unembellished, vacillating from surface and groundwater contamination to soil deterioration. Lower land values and the loss of some land use capacities are common outcomes of these issues (Tomakov *et al.,* 2019; Sojinu and Ejeromedoghene, 2019; Ukhurebor et al, 2021).

Furthermore, environmental hazard from pollution resulting from generated waste due to the operations related to crude oil in the region has numerous negative effects in the host communities which hassled damage to aquatic life and sources of income, devastation of vegetation and low agricultural crop yields, joblessness, contamination of natural water supplies for household use, etc. (Nnaemeka, 2020). However, the international optimal methods require an obligatory conducting Environmental Impact Assessments (EIAs) is a prerequisite for managing created wastes in all onshore and offshore oil and gas production operations, starting with seismic surveys and continuing through field development, drilling, production, and decommissioning (Albeldawi, 2023).

To address these challenges, modern oil waste management practices emphasize the importance of segregating waste streams based on their physical and chemical properties to facilitate recycling and safe disposal. This enhances easy identification of the various waste streams either recyclable or non-recyclable, toxic or non-hazardous, and so permits the appropriate disposal techniques for each component (Veil, 2019). Sustainable practices include waste identification, collection, segregation, storage, and treatment before disposal, all of which are guided by international environmental and safety standards (Nwokedi et al., 2021). Furthermore, conducting mandatory Environmental Impact Assessments (EIAs) has been recognized as essential for managing waste effectively and mitigating the environmental footprint of oil production activities. However, recent studies highlight that inconsistent enforcement of these regulations continues to pose challenges in ensuring compliance (Okonkwo et al., 2022).

The socio-economic effects of oil-related environmental damage are equally significant, as pollution has diminished agricultural productivity and increased unemployment in affected areas (Orji & Onoh, 2021). This degradation has also contributed to declining land values and made large areas unsuitable for habitation and farming, furthering economic hardships for local communities. Implementing and enforcing stricter environmental policies and adopting cleaner production practices are essential for addressing the adverse effects of oil production and promoting sustainable development in oil-producing regions (Ekong et al., 2020). For a sustainable crude oil waste management, procedures such as waste identification, waste collection, waste segregation, waste transfer, waste storage, and waste treatment and disposal, can be follow as reported cited as exemplary practices by Total Nigeria Limited (Nwokedi *et al.,* 2015). The summaries of crude oil waste production and exploration management process is shown in Figure 1.

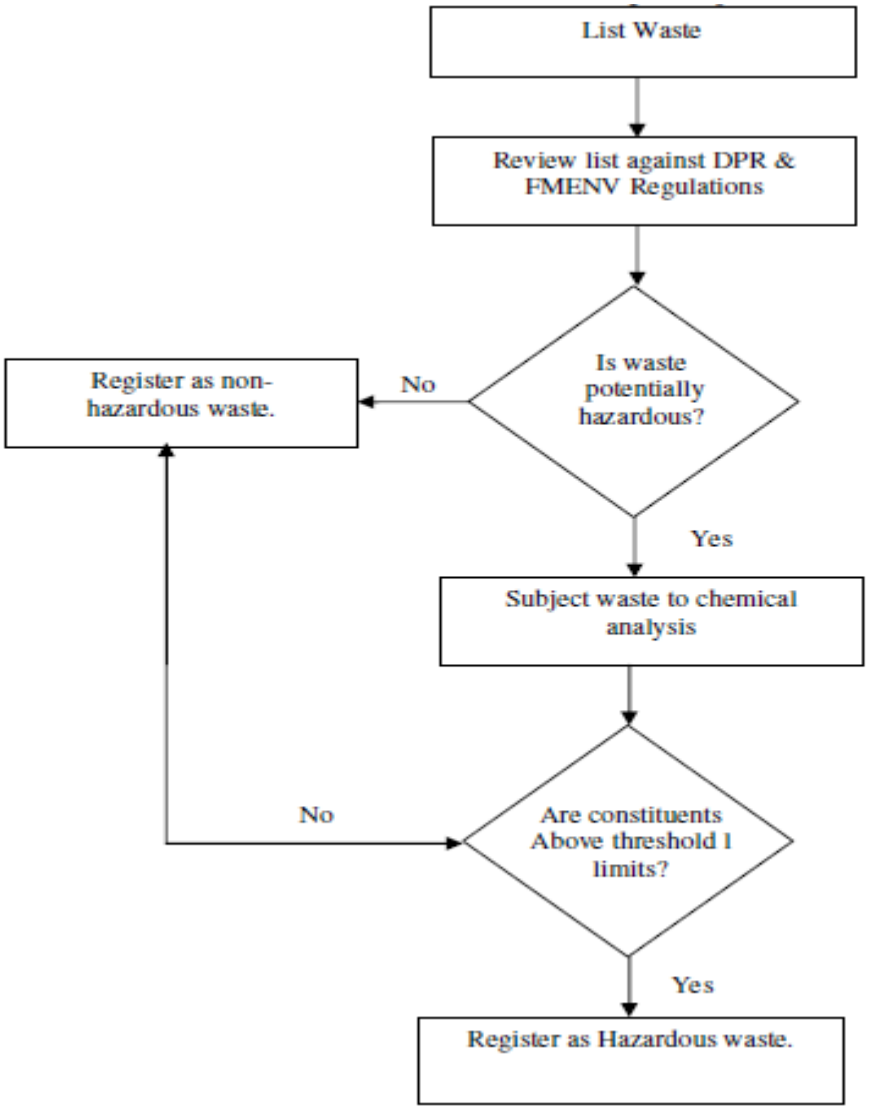

Figure 1: The process of managing waste manifests at Total Nigeria Limited (Nwokedi *et al.,* 2015)

According to recent reports, third-party contractors often operate without proper facilities, such as closed combustion chambers or high-temperature furnaces, that are necessary for safe and effective incineration of hazardous materials (Ogbonna & Njoku, 2020). Instead, these companies are known to burn toxic E & P waste outdoors, frequently in or near populated areas within the Niger Delta region, exposing local communities to harmful pollutants (Ite et al., 2021).

Such outdoor incineration practices release hazardous emissions, including volatile organic compounds, heavy metals, and polycyclic aromatic hydrocarbons, which pose serious health risks to nearby residents and contaminate the local environment (Ekong et al., 2020). This unethical handling of hazardous waste highlights a gap in regulatory enforcement and monitoring, which has led to calls for stricter oversight of waste management contractors involved in the oil industry (Okonkwo et al., 2022). These concerns underscore the need for improved environmental policies and waste disposal standards to protect communities and mitigate the ecological impact of oil production in Nigeria.

According to Ofuani, A. I. (2011), the classification of crude oil trash produced by its six (6) main offshore platforms of a Major Oil and gas company are: Ofon, Obagi, Obite, Amenam, Unity, and Odudu is shown in Table1.

Table 1: Classification of Crude Oil Waste produced by Six (6) main Offshore Platforms

S/N	Waste Category	Descriptions
1.	Non-Hazardous Nonrecyclable (NHNR)	Food and all biodegradable waste
2.	Hazardous Burnable (HB)	Obsolete chemical, oily sludge or tank bottom, Mud/drill cutting, Pigging waste, Contaminated soil, Absorbents, Combustible trash, Fuel filters, oil filters, air filters, and medical waste filters.
3.	Non-Hazardous Recyclable (NHR)	recyclable metal scraps, drums made of plastic and metal, Plastics, and Recyclable paper
4.	Hazardous Recyclable (HR)	Toner, cartridges, Batteries (wet and dry cell), Fluorescent tube, Spent lube oil Ink-jet, and electric bulbs
5.	Other waste categories	Wood cuttings, Sewage Asbestos, and Construction debris

2. MATERIALS AND METHODS

In this study, crude oil waste components generated in Niger Delta area of Nigeria by an Oil Servicing company were collected for analysis. The waste component samples include eight (8) offshore and onshore platforms of gathered statistics on the E&P trash produced by the platforms between 2012 and 2019. The waste categories were as follows.

Sample A: Non-hazardous recyclable waste (NHRW)
Sample B: Non-hazardous non-recyclable waste (NHNRW)
Sample C: Hazardous recyclable waste (HRW)
Sample D: Others waste (OW)
Sample E: Hazardous burnable waste (HBW)

3. RESULTS AND DISCUSSION

The outcomes of the waste categories are shown in Table 2. The results obtained showed that the sum of crude oil waste generated in Niger Delta area of Nigeria by an Oil Servicing company for the 8 years (i.e., 2012-2019) under consideration represents 654, 955 tons of non-hazardous recyclable waste (NHRW), 3,081,778 of non-hazardous non-recyclable waste (NHNRW), 94,946 tons of hazardous recyclable waste (HRW), 1,935,089 tons of others waste (OW), and 5,868,122 tons of hazardous burnable waste (HBW). From all indications, HBW generation is the highest for the years under review. The burning of such hazardous waste without proper treatment, will cause environmental pollution in the area, thus leading to health hazard of the inhabitant in the region

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Table 2: Results of crude oil waste generated in Niger Delta area of Nigeria by an Oil Servicing company

S/N	Year	Sample A NHRW	Sample B NHNRW	Sample C HRW	Sample D OW	Sample E HBW
1.	2012	59,645	90,259	8,024	315,200	865,540
2.	2013	65,790	780,555	8,950	300,213	800,315
3.	2014	79,100	655,459	10,115	295,006	795,350
4.	2015	85,200	540,324	11,350	260,459	700,205
5.	2016	87,450	342,805	13,312	212,905	650,559
6.	2017	89,350	256,895	13,850	195,450	500,542
7.	2018	92,005	215,056	14,200	185,400	755,056
8.	2019	96,415	200,425	15,145	170,456	800,555
Sum		654, 955	3,081,778	94,946	1,935,089	5,868,122
Average		145, 566	684,840	21,099	430,020	1,304,027
Maximum		96,415	780,555	15,145	315,200	865,540
Minimum		59,645	90,259	8,024	170,456	500,542

Consequently, this represents an average of 145, 566 tons for non-hazardous recyclable waste (NHRW), 684,840 tons for non-hazardous non-recyclable waste (NHNRW), 21,099 tons for hazardous recyclable waste (HRW), 430,020 tons for others waste (OW), and 1,304,027 tons of hazardous burnable waste (HBW). Therefore, HRW generation was minimum throughout the period of 8 years considered. Although, HRW is hazardous to man and his environment, thus before disposing in a dumpsite which is the usual practice in the region, proper treatment is required. As depicted in Figure 2, throughout the 8 years, HBW generation was the highest, followed by NHNRW. However, unlike in the case of HBW, there was a gradual dropped in the generation of NHNRW and OW throughout the year.

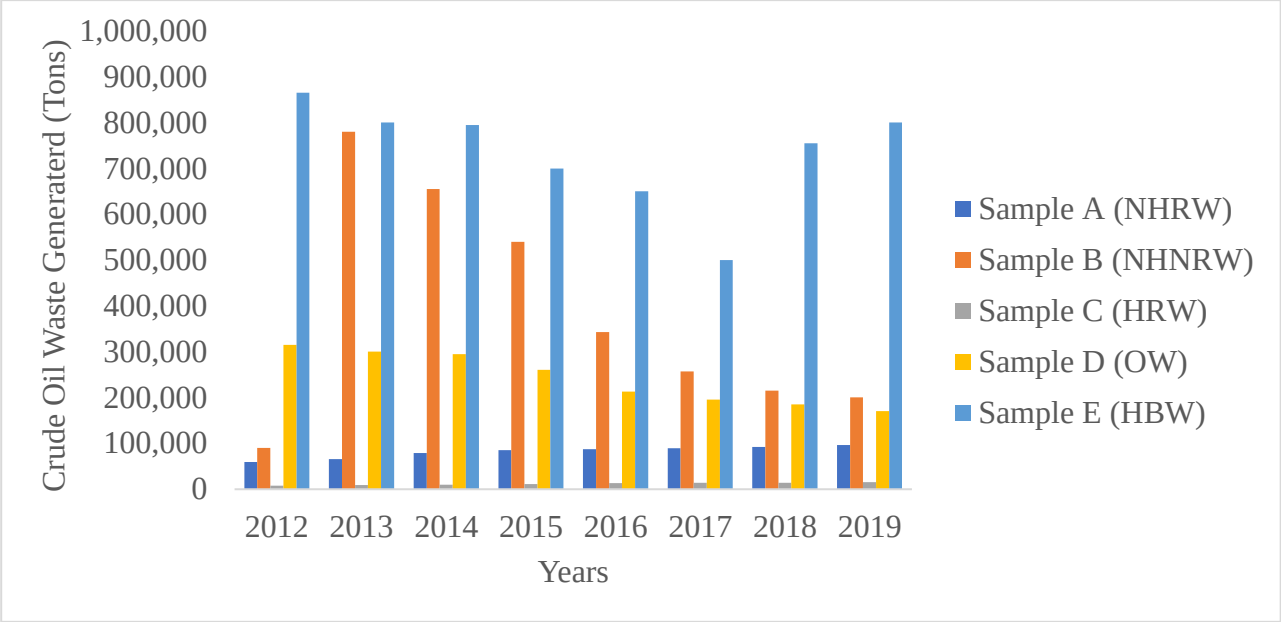

Figure 2: Analysis of crude oil waste generated in Niger Delta area of Nigeria by the Oil Servicing company

From the analysis shown in Figure 2, the amounts of waste generated within the time period shows that harmful burnable wastes is maximum. That also the hazardous recyclable waste generated is minimum in the year 2012.

4. CONCLUSION

This study has shown that non-hazardous recyclable waste (NHRW), non-hazardous non-recyclable waste (NHNRW), hazardous recyclable waste (HRW), others waste (OW), hazardous burnable waste (HBW) are the major categories of waste generated by oil businesses that operate in Nigeria's Niger Delta. The outcome of the results also showed that crude oil waste generation increases throughout the 8 years data analyzed. This is an indication of poor waste management in the region. Thus, there is a pressing necessity to implement innovative waste management procedures in the Niger Delta's crude oil operations, both operationally and through regulatory enforcement. It is important to remember that prevention of pollution is more profitable than cleanup. The regulatory agencies must force the multinational oil firms to sign an agreement of full regulatory compliance waste treatment to accomplish sustainable crude oil waste management strategies. Additionally, oil corporations are required to keep up a strong environmental protection section.

REFERENCES

Adewuyi, T. O., & Awotunde, M. (2021). Environmental impacts of crude oil production in the Niger Delta. *International Journal of Environmental Science and Technology*, 18(4), 1-13.

Albeldawi, M. (2023). Environmental impacts and mitigation measures of offshore oil and gas activities. In *Developments in Petroleum Science* (Vol. 78, pp. 313-352). Elsevier.

Anyadiegwu, C., & Ohia, N. (2021). Water contamination in oil-rich regions of the Niger Delta. *African Journal of Environmental Science*, 6(2), 45-53.

Ekong, C., Udo, U., & Bassey, A. (2020). The ecological and human health implications of oil pollution in the Niger Delta, Nigeria. *Environmental Health Perspectives*, 128(3), 310-319.

Ekong, C., Udo, U., & Bassey, A. (2020). The ecological and human health implications of oil pollution in the Niger Delta, Nigeria. *Environmental Health Perspectives*, 128(3), 310-319.

Ite, A. E., Ibok, U. J., & Akpan, U. E. (2021). Environmental degradation and human health risk assessment of oil waste management practices in Nigeria. *Environmental Monitoring and Assessment*, 193(7), 1-15.

Nnaemeka, A. N. (2020). Environmental pollution and associated health hazards to host communities (Case study: Niger delta region of Nigeria). *Central Asian Journal of Environmental Science and Technology Innovation*, *1*(1), 30-42.

Nwokedi, F. A., Amah, E., & Bassey, E. (2021). Sustainable waste management practices in Nigerian oil fields: A case study of Total Nigeria Limited. *Journal of Petroleum and Environmental Biotechnology*, 12(2), 145-153.

Nwokedi, T.C., Okoroji, L.I., Nze, I.C., and Ndukwu, I.P. (2015). Oil Exploration and Production Waste Management Practices: Comparative Analysis for Reduction in Hazardous E & P Waste Generation in Offshore Oil Platforms in Nigeria. Journal of Environment and Earth Science, 5(4): 101-107

Ogbonna, O. J., & Njoku, P. C. (2020). An assessment of third-party incineration practices in the Niger Delta: Implications for public health and the environment. *African Journal of Environmental Science and Technology*, 14(3), 99-106.

Oghenevwede, E., & Aghogho, U. (2021). Marine biodiversity impacts of oil pollution in Nigeria's Niger Delta. *Environmental Science and Pollution Research*, 28(3), 1150-1162.

Ogunnubi, O., Okoli, J., & Alabi, T. (2021). The socio-economic impact of oil exploration on the Nigerian economy. *Journal of African Economies*, 30(2), 115-136.

Okonkwo, O. O., Adeola, A., & Egbuna, C. (2022). Environmental governance and oil industry practices in Nigeria's Niger Delta. *Journal of Environmental Policy & Planning*, 24(1), 45-60.

Okonkwo, O. O., Adeola, A., & Egbuna, C. (2022). Environmental governance and oil industry practices in Nigeria's Niger Delta. *Journal of Environmental Policy & Planning*, 24(1), 45-60.

Orji, A., & Onoh, J. (2021). Socio-economic impacts of oil spills in Nigeria's oil-rich regions. *African Journal of Economic and Sustainable Development*, 12(1), 25-38.

Sojinu, S. O., & Ejeromedoghene, O. (2019). Environmental challenges associated with processing of heavy crude oils. *Processing of Heavy Crude Oils*, *241*.

Tomakov, M. V., Tomakova, I. A., Brezhnev, A. V., Pykhtin, A. I., & Timoshenko, A. A. (2019). Disagreements between legal acts regulating environmental requirements for the use and protection of land in the construction of trunk pipelines. *International Multidisciplinary Scientific GeoConference: SGEM*, *19*(5.1), 189-196.

Udo, U., Orji, J., & Akpan, U. (2020). Challenges in oil spill management and environmental protection in the Niger Delta, Nigeria. *Marine Pollution Bulletin*, 156, 111239.

Ukhurebor, K. E., Athar, H., Adetunji, C. O., Aigbe, U. O., Onyancha, R. B., & Abifarin, O. (2021). Environmental implications of petroleum spillages in the Niger Delta region of Nigeria: a review. *Journal of Environmental Management*, *293*, 112872.

UNEP. (2021). *Water quality and pollution management in developing countries*. United Nations Environmental Programme.

Veil, J. (2019). Innovations in crude oil waste management: Toward a sustainable approach. *Journal of Environmental Engineering Science*, 30(8), 753-761.

Watson, S. M. (2020). Greenhouse gas emissions from offshore oil and gas activities—Relevance of the Paris Agreement, Law of the Sea, and Regional Seas Programmes. *Ocean & coastal management*, *185*, 104942.