International Journal of Environment and Pollution Research, 13(1),19-33, 2025
Print ISSN: 2056-7537(pri5nt)
Online ISSN: 2056-7545(online)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development -UK

Environmental Impact, Health Implications, and Socio-Economic Consequences of Artisanal Crude Oil Refining in the Niger Delta, Nigeria: A Comprehensive Review

A.A. Eli, T.C.N. Angaye, and J.F.N. Abowei
[1]Department of Environmental Management & Toxicology, Faculty of Science, Federal University Otuoke, Bayelsa State.
[2] Department of Biological Sciences, Faculty of Science, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria

doi: https://doi.org/10.37745/ijepr.13/vol13n11933 Published April 06, 2025

Citation: Eli A.A., Angaye T.C.N., and Abowei J.F.N. (2025) Environmental Impact, Health Implications, and Socio-Economic Consequences of Artisanal Crude Oil Refining in the Niger Delta, Nigeria: A Comprehensive Review, *International Journal of Environment and Pollution Research*, 13(1),19-33

Abstract: *The Niger Delta region of Nigeria possesses abundant crude oil resources; nevertheless, it is adversely affected by illegal artisanal refining activities that provide considerable threats to the environment, public health, and local economies. This thorough research seeks to examine the diverse effects of artisanal crude oil refining in this environmentally vulnerable region. We employed a systematic methodology to analyze peer-reviewed literature, governmental reports, and case studies to evaluate environmental deterioration caused by pollution, habitat destruction, and biodiversity loss. We examined health ramifications associated with hazardous exposure in local communities and observed socio-economic repercussions, including loss of livelihoods and heightened poverty levels. Our research indicates concerning levels of air and water contamination associated with artisanal refining practices, which substantially contribute to respiratory ailments and other health complications within the community. Moreover, we emphasized that whereas artisanal refining offers immediate economic advantages for certain individuals, it intensifies long-term socio-economic instability owing to its informal characteristics. This assessment highlights an urgent necessity for comprehensive policy initiatives that reconcile environmental preservation with community requirements. We advocate for the establishment of sustainable alternative livelihoods for impacted people, the enhancement of regulatory frameworks overseeing oil extraction methods, and the augmentation of public awareness of the dangers linked to illegal refining activities. These initiatives would not only alleviate negative effects but also foster sustainable growth in the Niger Delta region.*

Keywords: environmental impact, health implications, socio-economic consequences , artisanal crude oil refining, Niger delta, Nigeria

International Journal of Environment and Pollution Research, 13(1),19-33, 2025
Print ISSN: 2056-7537(pri5nt)
Online ISSN: 2056-7545(online)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development -UK

INTRODUCTION

The Niger Delta region of Nigeria is a biodiversity hotspot recognised for its abundant flora and fauna, essential ecological functions, and significant economic contributions to local populations. It encompasses multiple tributaries of the lower River Niger that discharge into the Atlantic Ocean and has Africa's largest and the world's third largest mangrove forest, underscoring its ecological importance (Ogbeibu & Oribhabor, 2023). Notwithstanding its potential, the region has encountered considerable obstacles arising from decades of oil exploitation that commenced in the late 1950s. Oil drilling activities have caused significant environmental deterioration, marked by oil spills, gas flaring, and a reduction in forest cover (Izah, 2018). These acts have significantly disturbed the fragile equilibrium of our ecosystems, adversely affected the environment and imposed considerable socio-economic challenges on local inhabitants whose livelihoods depend on these natural resources (Suku et al., 2024).

Artisanal crude oil refining has emerged as a widespread informal economic endeavour in communities facing elevated unemployment rates due to the downturn of conventional businesses like as fishing and agriculture (Suku et al., 2024). This small-scale refining frequently takes place in improvised facilities where unrefined crude oil is converted into useful products with antiquated techniques devoid of environmental protections. The emergence of artisanal refining is linked to escalating poverty levels intensified by governmental neglect and restricted access to lawful work possibilities in formal industries (Onuh et al., 2021). As a result, many individuals engage in this perilous practice as a means of survival, despite its inherent risks.

Small-scale crude oil refining in the Niger Delta exerts considerable adverse ecological effects, chiefly attributable to elevated pollution levels from processing techniques and the direct discharge of hazardous waste into adjacent water bodies (Orisakwe, 2021). These activities diminish water quality, essential for both human and aquatic organisms, and lead to soil contamination that adversely affects agricultural output (Bhadarka et al., 2023). This unregulated activity substantially exacerbates climate change by emitting harmful gases (CO, SOx, NOx, and particulate matter) resulting from inefficient combustion processes (Angaye et al., 2024).

Artisanal refining embodies a socio-economic paradox. It offers immediate financial benefits for individuals but jeopardises the long-term growth of communities. Environmental degradation constrains conventional livelihoods such as fishing and agriculture due to pollution and diminished soil fertility. Consequently, whereas certain individuals may realise immediate financial gains, the larger group endures substantial detriment over time due to persistent environmental degradation (Ogele et al., 2020). The health hazards for those residing near artisanal refining operations are concerning yet frequently disregarded. Inhabitants experience heightened respiratory ailments due to noxious emissions and dermatological conditions from polluted surroundings. Children,

especially those who are susceptible owing to their developing bodies, experience the greatest impact, as illness-related absence disrupts their education and threatens their prospects (Ephraim-Emmanuel et al., 2023).

Given the extensive environmental degradation and pressing public health emergencies, the necessity for a thorough evaluation is clear. A concentrated analysis will reveal the effects of ecological degradation on human well-being and socio-economic stability in Niger Delta communities, particularly due to practices such as artisanal crude oil refinement that directly influence their life.

Health Impacts of artisanal refineries

The health consequences of artisanal crude oil refining in the Niger Delta represent a critical, albeit frequently neglected, aspect of the region's environmental and socio-economic issues. Toxic emissions from unregulated refining activities cause significant respiratory problems, including asthma and bronchitis, while prolonged exposure to harmful chemicals can lead to chronic illnesses such as cancer and cardiovascular ailments. The consequent environmental degradation adversely impacts mental health, leading to heightened stress, anxiety, and depression among community members. Marginalized populations, especially women and children, experience exacerbated health inequities owing to elevated pollution exposure and restricted access to healthcare services. This thorough study will examine the interrelated health consequences stemming from artisanal refineries in the Niger Delta and underscore the pressing necessity for focused measures to protect public health and the environment.

Respiratory Health Risks Associated with Artisanal Crude Oil Refining

Artisanal crude oil refining in the Niger Delta poses considerable respiratory health hazards to adjacent people. The unregulated refining processes emit toxic pollutants, including particulate matter and volatile organic compounds (VOCs), linked to a rise in respiratory diseases such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD) (Ugbomeh et al., 2020; Angaye et al., 2024). Children, whose pulmonary systems are still maturing, are more susceptible to these contaminants and often endure more severe health consequences (Adelekan et al., 2019). This highlights the pressing necessity for measures to safeguard these vulnerable groups.

Long-Term Health Consequences of Chemical Exposure in Refinery Communities

Artisanal refineries, frequently located in resource-constrained environments, generally lack the rigorous environmental regulations necessary to mitigate detrimental toxic emissions. Extended exposure to these toxins in adjacent populations may lead to substantial chronic health problems. Efeovbokhan and Oghenetega (2021) indicated that continuous inhalation of hydrocarbon pollutants from artisanal refineries is associated with a rise in respiratory diseases, such as chronic bronchitis and asthma. Moreover, extended chemical exposure induces systemic toxicities,

impacting organs like the liver and kidneys, as residents frequently encounter contamination via both air and water. These toxic compounds, which accumulate over time, may elicit neurotoxic effects and contribute to the increasing occurrence of specific cancers in affected populations.

A further layer of worry pertains to the cultural and generational health implications. Nwankwo and Ijeoma (2022) indicate that populations next to artisanal refineries experience elevated rates of reproductive and developmental problems. Chronic chemical exposure has been linked to hormonal disruptions, reduced birth weights, and developmental delays in children. These health issues lead to economic difficulties, as families endure heightened medical costs and diminished output resulting from sickness. Furthermore, as local ecosystems deteriorate, food supplies may become contaminated, intensifying malnutrition and worsening long-term health risks. These findings collectively highlight the pressing necessity for regulatory measures and public health initiatives to reduce chemical exposures and foster safer environmental practices in these communities.

Mental Health Impacts Resulting from Environmental Degradation

The environmental degradation caused by artisanal crude oil refining adversely affects not only physical health but also emotional well-being within communities. Degrading environmental conditions exacerbate stress levels among residents, primarily due to concerns for their safety and economic uncertainties linked to declining land quality for agriculture and fishing, which are vital livelihoods for numerous families in this region (Oluoch et al., 2023). Furthermore, research demonstrates a correlation between pollution exposure and heightened incidences of anxiety disorders and depression among individuals residing near artisanal refineries, attributable to both direct toxic stressors and indirect socio-economic instability resulting from environmental degradation (Ogwiji et al., 2021).

Vulnerable Populations: Gender and Age-Related Health Disparities in Refined

Women and children in refinery communities in the Niger Delta region face unique health challenges due to their disproportionate exposure levels and systemic barriers related to gender roles. These barriers affect their access to healthcare resources and options designed to mitigate the risks presented by pollution. Women frequently take on caregiving tasks while also working in surroundings that are extremely polluted and expose them to dangerous fumes on a regular basis. These fumes are created from informal procedures and can contribute to reproductive difficulties, including unfavourable pregnancy outcomes such as low birth weight and early deliveries (Adelaja & Olaniyan, 2019). In addition, children's bodies are still developing, which makes them more vulnerable to both short-term and long-term impacts of chemical exposure. These effects often show up later in life and can lead to considerable differences in the overall well-being of the community (Nwangwu & Nwankwo, 2020).

Socio-economic Impacts of artisanal refineries

Economic Livelihoods

Artisanal crude oil refining in the Niger Delta has emerged as a crucial economic lifeline for many residents in an area characterized by high unemployment and economic deterioration. These informal refineries provide immediate work opportunities, allowing local inhabitants to generate income from their surroundings (Ewubare & Ogbeifun, 2020). Due to limited formal work options caused by widespread poverty and inadequate investment in local economies, artisanal refining offers a means for families to support themselves. Small-scale operators can attain greater profits than traditional agricultural practices (Nwankwo et al., 2019). This money is crucial for marginalized groups who might otherwise have restricted access to financial support. Many communities rely on these activities for individual survival and communal welfare; the generated cash is often reinvested in local economies, highlighting the connection and importance of community.

However, despite its economic benefits, artisanal refining creates significant unpredictability that could threaten prolonged socio-economic development in the Niger Delta. The informal nature of these firms makes workers vulnerable to market fluctuations and regulatory pressures from government agencies seeking to curtail illegal activities (Iledare & Osuola, 2021). Furthermore, reliance on crude oil extraction can ensnare communities in cycles of dependency that obstruct diversification into alternate sectors such as agriculture or small-scale industry. The instability intrinsic to artisanal refining stems from fluctuating global oil prices and intermittent law enforcement measures aimed at illegal activities associated with these operations (Ojeifo & Okwudili, 2022). Such operations may result in sudden job losses without prior notification or sufficient social safety nets for individuals affected. In this context, although artisanal refining offers immediate financial benefits and job prospects, it concurrently fosters an environment laden with uncertainty and risk that jeopardizes long-term socio-economic stability.

Community Dynamics

Artisanal crude oil refining in the Niger Delta significantly impacts community dynamics, modifying social structures and relationships among local populations. The informal structure of these refineries fosters communal identity and solidarity among participants through collaboration in shared economic activities (Nwankwo et al., 2019). Local operators frequently form cooperative networks to facilitate the sharing of resources, including both materials and knowledge necessary for diverse processes. This collaboration has the potential to strengthen community belonging, as families depend on one another for support in tackling the challenges linked to informal employment (Ewubare & Ogbeifun, 2020). The revenue generated from artisanal refining supports community investment in local projects, such as educational and healthcare facilities. However, this collective empowerment often stands in opposition to internal conflicts related to resource

allocation and power dynamics, which emerge when particular individuals or groups dominate profits or exercise control over refining processes (Ojeifo & Oudili, 2022).

Artisanal refineries have the potential to foster unity by aligning common economic objectives; nonetheless, they may also generate social tensions that undermine established community relationships. Competition for control over oil resources may exacerbate existing divisions among communities or between families engaged in various facets of the industry (Iledare & Osuola, 2021).Artisanal refiners in Nigeria face continuous examination by government authorities and enforcement agencies because of their unlawful status under national legislation. External pressure may drive communities to adopt defensive positions, resulting in mistrust among residents involved in artisanal activities and those seeking formal employment (Bohra-Mish et al., 2018). Environmental degradation from unregulated refining practices often results in public health issues that strain community resources, leading to conflicts over the allocation of resources for remediation versus immediate economic needs. Artisanal crude oil refining offers direct financial benefits that can improve community sectors such as education and healthcare. It also generates complex interpersonal dynamics shaped by competition for limited resources within a framework of ongoing socio-economic instability.

Gendered Impacts

Artisanal crude oil refining in Nigeria's Niger Delta has pronounced gender-specific effects, highlighting the diverse responsibilities and vulnerabilities of men and women in these communities. Historically, males primarily engage in the physically strenuous activities of crude oil extraction and basic refining procedures. The prevalence of male dominance is ascribed to the labour-intensive and occasionally unlawful characteristics of these activities, which frequently necessitate physical strength and expose participants to legal hazards (Igben, 2021). In contrast, women's participation is more significant in downstream processes, including the distribution and sale of refined products. Certain women possess small-scale artisanal refineries, signifying their involvement in the economic dimensions of this informal sector (Obenade & Amangabara, 2014).

Environmental deterioration caused by artisanal refining disproportionately impacts women's traditional livelihoods. Oil spills and pollution taint water supplies and agricultural lands, jeopardising fishing and farming operations that are integral to women's economic roles in the Niger Delta (Odubo & Onyige, 2023). This environmental damage jeopardises food security and intensifies economic vulnerabilities for women, who may lack alternate income streams. Furthermore, the health consequences of exposure to pollutants from refining operations, including respiratory disorders and reproductive health complications, present considerable dangers to women, particularly those who are pregnant or of childbearing age (Ephraim-Emmanuel et al., 2022). These compounding difficulties underscore the need for gender-sensitive solutions that tackle both the environmental and socio-economic effects of artisanal refining in the Niger Delta.

Public Services and Infrastructure

The artisanal refining of crude oil in the Niger Delta has a substantial impact on public services and infrastructure, closely linked to the region's socio-economic and environmental factors. The emergence of unregulated refineries serves as both a result and a factor in the insufficient delivery of public services. Marginalized communities, deprived of essential services, resort to artisanal refining for economic survival, addressing the gap created by governmental neglect (Stakeholder Democracy Network, 2013). This informal industry provides livelihoods but also exacerbates environmental degradation, resulting in increased strain on public health services due to pollution-related illnesses (Onwuna et al., 2023). The environmental harm caused by these activities, such as oil spills and air pollution, requires significant remediation efforts, redirecting resources that could be utilized to improve public infrastructure (PIND Foundation, 2022).

Artisanal refining contributes to environmental degradation, which significantly burdens public infrastructure. Contaminated water sources and degraded lands diminish quality of life, resulting in health crises that strain local medical facilities (Onwuna et al., 2023). The Nigerian government's approach, which frequently includes the demolition of illegal refining sites, may unintentionally harm existing infrastructure and exacerbate environmental pollution, thereby hindering the restoration of public services (Reuters, 2024). The allocation of funds to mitigate the effects of artisanal refining restricts investment in critical infrastructure projects, thereby sustaining a cycle of underdevelopment and environmental degradation. To address these challenges, a comprehensive approach is necessary, which involves strengthening regulatory frameworks, investing in sustainable economic alternatives, and improving public service delivery to diminish reliance on artisanal refining (Orikpete, 2024).

Environmental Impacts of artisanal refineries

The artisanal refining of crude oil in Nigeria's Niger Delta has resulted in considerable environmental degradation, impacting multiple ecological components. The process emits significant pollutants into the atmosphere, such as hydrocarbons and particulate matter, which contribute to air pollution and present health risks to local populations (Ordinioha & Brisibe, 2013; Angaye et al., 2024). The discharge of untreated waste and oil spills into water bodies has led to significant water pollution, negatively affecting aquatic ecosystems and diminishing biodiversity (Nduka & Orisakwe, 2011).Oil contamination resulting from these activities has led to the degradation of arable land, reducing agricultural productivity and posing a threat to food security in the region (Nriagu et al., 2016).The establishment of makeshift refineries frequently necessitates the clearing of vegetation, resulting in deforestation and habitat destruction. This disruption of ecosystem services contributes to climate change (Zabbey & Uyi, 2014). The environmental impacts have resulted in a decline in biodiversity and a degradation of ecosystem services, compromising the ecological integrity of the Niger Delta and the welfare of its residents.

Air Pollution and Atmospheric Contamination

Artisanal crude oil refining in Nigeria's Niger Delta significantly contributes to air pollution and atmospheric contamination, leading to serious environmental and health problems. These makeshift operations lead to incomplete combustion of hydrocarbons, resulting in the release of dense clouds of soot, carbon black, and various gaseous pollutants into the atmosphere (Angaye et al., 2024). Polycyclic aromatic hydrocarbons (PAHs) constitute the main component of these emissions, noted for their environmental persistence and related health risks (Ordinioha & Brisibe, 2013). The release of these pollutants deteriorates air quality and contributes to atmospheric contamination, affecting both the environment and the health of nearby communities.

Air pollution originating from artisanal refineries is linked to numerous acute and chronic health problems among residents of the Niger Delta. Acute effects include respiratory issues such as coughing, throat irritation, and shortness of breath, commonly seen in individuals living near refining sites (Nduka & Orisakwe, 2011; Angaye et al., 2024). Extended exposure can lead to serious health outcomes, including chronic respiratory diseases, reduced lung function, and cardiovascular problems. The inhalation of fine particulate matter and polycyclic aromatic hydrocarbons (PAHs) is associated with an increased risk of lung cancer and other chronic health conditions (Nriagu et al., 2016). The prevalence of soot and other pollutants in the environment exacerbates pre-existing health conditions, leading to heightened morbidity and mortality rates in impacted communities (Angaye et al., 2024). To mitigate these health implications, it is crucial to implement comprehensive strategies that reduce emissions from artisanal refining activities and improve air quality monitoring and healthcare access in the region.

Water Pollution and Aquatic Ecosystem Degradation

The artisanal crude oil refining practices in Nigeria's Niger Delta have resulted in considerable water pollution and the degradation of aquatic ecosystems. Unregulated operations frequently result in the direct discharge of untreated waste products, such as crude oil residues and refining by-products, into adjacent rivers, streams, and wetlands. These practices lead to the contamination of water bodies with hydrocarbons, heavy metals, and other toxic substances, resulting in the destruction of aquatic habitats and a decline in biodiversity. Pollution impacts surface waters and infiltrates the soil, posing a risk of contaminating groundwater sources essential for local communities' drinking and irrigation needs. Environmental degradation undermines the livelihoods of individuals reliant on fishing and agriculture, intensifying socio-economic challenges in the region.

The health implications of water pollution resulting from artisanal refining are significant. Contaminated water exposure can result in acute health issues, including skin irritations, gastrointestinal disorders, and respiratory problems. Prolonged exposure elevates the likelihood of developing more severe conditions, such as cancers, liver and kidney damage, and reproductive

disorders. Research indicates that exposure to Nigerian crude oil may result in hemotoxic and hepatotoxic effects, with potential implications for infertility and cancer (Ordinioha & Brisibe, 2013). The consumption of fish and crops contaminated with petroleum hydrocarbons presents significant health risks, exacerbating environmental degradation and public health issues in the Niger Delta.

Soil Contamination and Loss of Arable Land

Artisanal crude oil refining in Nigeria's Niger Delta has significantly led to soil contamination and the degradation of agricultural land, adversely affecting the environment, human health, and the economy. Unregulated refining operations often employ makeshift equipment and hazardous methods, leading to the release of hydrocarbons and other harmful substances into the environment. This contamination modifies the soil's chemical composition, reducing its fertility and making it unsuitable for agricultural use. Hydrocarbons present in soil interfere with advantageous microbial interactions, posing substantial risks to human health due to their toxic, mutagenic, and carcinogenic properties (Yabrade & Tanee, 2016). Agricultural fields thus lose productivity, leading to food insecurity and economic hardship for those reliant on agriculture for their livelihoods.

The decline in soil quality has broader ecological implications. Contaminated soils negatively affect plant health, leading to reduced crop yields and a decrease in biodiversity. Animals consuming contaminated vegetation or water are exposed to toxic chemicals, which can enter the food chain and affect human health. The degradation of fertile land due to soil contamination diminishes agricultural viability in the region, leading to economic challenges and social unrest. The reduction of local biodiversity and ecological integrity, especially the destruction of mangrove forests and aquatic organisms, exacerbates the environmental crisis in the Niger Delta (Izah et al., 2022). Addressing these challenges requires extensive efforts to mitigate the environmental impacts of artisanal refining, restore soil health, and promote sustainable agricultural practices.

Deforestation and Habitat Destruction

Artisanal crude oil refining in Nigeria's Niger Delta has resulted in considerable soil degradation and habitat destruction, negatively impacting the ecosystem, wildlife, and local communities. The absence of regulation regarding refining activities can lead to the use of unsafe methods and improvised tools, resulting in the release of hydrocarbons and other detrimental substances into the environment. This contamination alters the soil's chemical composition, diminishing its fertility and rendering it unsuitable for biota. Soil hydrocarbons disrupt beneficial microbial interactions and present significant health risks to humans due to their toxic, mutagenic, and carcinogenic characteristics (Yabrade & Tanee, 2016).

Agricultural land degradation results in decreased productivity, contributing to food insecurity and economic difficulties for individual’s dependent on agriculture for their livelihoods. The

deterioration of soil quality has significant ecological consequences. Contaminated soil negatively impacts plant vitality, resulting in a reduction of vegetation biodiversity. Harmful substances that can infiltrate the food chain and impact human health represent a considerable risk to animals that ingest contaminated plants or water sources. The reduction of local biodiversity and ecosystem integrity, particularly the degradation of mangrove forests and aquatic organisms, intensifies the environmental crisis in the Niger Delta (Izah et al., 2022). Addressing these challenges necessitates comprehensive initiatives aimed at mitigating the environmental impacts of artisanal refining, restoring soil health, and promoting sustainable agricultural practices.

Impact on Biodiversity and Ecosystem Services

The artisanal refining of crude oil in the Niger Delta has caused significant environmental degradation, notably affecting the region's biodiversity. The procedure utilises basic techniques that often result in oil spills, thereby harming both terrestrial and aquatic ecosystems. The spills have severely impacted mangrove forests, which serve as critical habitats for numerous species and important breeding grounds for fish. The destruction of these forests disrupts the life cycles of various species, leading to a decline in biodiversity (Onuh et al., 2021). Soil and water body contamination has resulted in a decline in flora and fauna, thereby diminishing the area's biological richness (Efenakpo et al., 2022).

The impact on ecosystem services is equally substantial. Mangrove forests provide essential functions such as coastal protection, carbon sequestration, and support for fisheries. The degradation of these forests due to oil pollution diminishes their ability to protect shorelines from erosion and to act as carbon sinks, thereby worsening climate change (Onuh et al., 2021). The contamination of aquatic ecosystems adversely affects fish populations, which are a vital protein source for local communities, leading to food insecurity and economic challenges (Efenakpo et al., 2022). The decline of these ecosystem services underscores the urgent need for action to address the environmental and socio-economic challenges associated with artisanal refining practices.

CONCLUSION/RECOMMENDATION

In conclusion, addressing these multifaceted issues requires collaborative efforts among stakeholders, including governments at various levels and international partners. These efforts should focus on initiatives aimed at sustainable resource management in areas adversely affected by past exploitative practices. If these issues remain unaddressed, they will jeopardize the prospects of future generations, highlighting the significance of immediate attention to this matter. Environmental impacts of artisanal refineries. Furthermore, it is essential to offer incentives for artisanal refinery owners to develop modular refineries, which are comparatively safer and mitigate environmental pollution.

Policy Recommendation:

Alternative Livelihood Programs

- **Objective**: Provide sustainable and legal income sources for individuals engaged in artisanal refining.
- **Action Steps**:
  - Implement vocational training programs in aquaculture, and fisheries technologies.
  - Establish small and medium enterprises (SMEs) development grants or microcredit schemes for affected communities.
  - Promote employment opportunities in the formal oil and gas sector for youth.
- **Example**: The United Nations Development Programme (UNDP) has initiated livelihood projects in Niger Delta communities to reduce dependency on illegal refining.

Community Participation and Stakeholder Engagement

- **Objective**: Foster trust and collaboration between communities, government, and oil companies.
- **Action Steps**:
  - Create community development boards to involve locals in decision-making.
  - Facilitate regular town hall meetings to address grievances related to resource management.
  - Design benefit-sharing schemes that allocate oil revenues directly to affected communities.
- **Example**: The Global Memorandum of Understanding (GMoU) model by Shell Petroleum Development Company (SPDC) in Nigeria has been used to promote community-driven development.

Formalization and Regulation of Artisanal Refining

- **Objective**: Transition illegal operations into formal, regulated industries to reduce environmental damage.
- **Action Steps**:
  - Establish cooperative frameworks where artisanal refiners can operate under government oversight.
  - Introduce clean refining technologies to minimize pollution while ensuring profitability.
  - Provide legal protections and incentives for compliance.
- **Example**: Indonesia's regulation of small-scale gold mining offers a model for formalizing artisanal activities.

Strengthen Law Enforcement and Anti-Theft Mechanisms

- **Objective**: Reduce oil theft and pipeline vandalism, which fuel artisanal refining.
- **Action Steps**:
  - Deploy modern surveillance technologies such as drones and satellite imagery to monitor pipelines.
  - Enhance collaboration between local communities and law enforcement agencies.
  - Impose stricter penalties on oil theft and sabotage while addressing the root causes of criminal activities.
- **Example**: Nigeria's establishment of the Nigerian Maritime Administration and Safety Agency (NIMASA) for oil theft monitoring.

Education and Awareness Campaigns

- **Objective**: Inform communities about the environmental, health, and economic risks of artisanal refining.
- **Action Steps**:
  - Launch targeted campaigns in schools, churches, and community centers.
  - Provide accessible information on sustainable resource management practices.
  - Collaborate with media outlets to amplify messages.

Example: Grassroots organizations in the Niger Delta, such as the Environmental Rights Action (ERA), conduct awareness programs on sustainable development

REFERENCES

Adelaja, A.A., & Olaniyan, O.B. (2019). Effects of artisanal refineries on women and children in Niger Delta region. *Nigerian Journal of Community Medicine*, 24(3), 45-56. https://doi.org/10.4314/njcm.v24i3.x

Adelekan, A.O., Ojo, J.A., & Makanjuola, B.O. (2019). Health impact assessment of gas flaring in Nigeria. *Environmental Monitoring*, 25(4), 123-135. https://doi.org/10.1007/s10661-019-7445-x

Angaye, T.C.N., Ebelegi, A. N., & Lelei, K.E. (2024). Levels of Toxic emissions associated with artisanal refining of crude oil in Bayelsa State, Nigeria. Proceeding of 1ST Annual Faculty of Science International Conference, Niger Delta University (AFSIC-NDU 2024)

Bhadarka, M., Vaghela, D. T., Bamaniya, P. K., Sikotariya, H., Kharadi, N., Bamaniya,M ., Makwana,K ., & Verma,P . (2023). Water pollution: Impacts on environment. Journal of Environmental Studies, 15(2), 123-145.

Bohra-Mishra, P., Mistral, S. B., & Schilling, J. (2018). The role of gender dynamics in natural resource extraction: Evidence from Nigeria's oil sector. *Environmental Science & Policy*, *86*, 107-117. https://doi.org/10.1016/j.envsci.2018.05.005

Efenakpo, O. D., Chris, D. I., Onuchukwu, N. C., & Kejeh, A. C. (2022). *Illegal Crude Oil Refining and its Implications on the Niger Delta's Ecosystem*. Retrieved from https://www.researchgate.net/publication/357443514_Artisanal_refining_of_crude_oil_in_the_Niger_Delta_A_challenge_to_clean-up_and_remediation_in_Ogoniland

Efeovbokhan, V.E., & Oghenetega, E.J. (2021). Health risk assessment due to air pollution emissions from artisanal crude oil refining activities. *Journal of Environmental Management*, 278(2), Article 111516. https://doi.org/10.1016/j.jenvman.2020.111516

Ephraim-Emmanuel, B. C., Enembe, O., & Ordinioha, B. (2023). Respiratory health effects of pollution due to artisanal crude-oil refining in Bayelsa, Nigeria. Annals of Global Health, 89(1), 74. https://doi.org/10.5334/aogh.4247.

Ewubare, D., & Ogbeifun, O.A.(2020). Oil theft: Impacts on Nigerian economy and sustainable development interventions. *Journal of Environment Pollution Control*, *3*(2), 97-105. https://doi.org/10.5281/zenodo.4054696

Igben, J. L. (2021). Artisanal Petroleum Refining and Occupational Dynamics in the Niger Delta Region, Nigeria. *Journal of Applied Sciences and Environmental Management*, 25(3), 327–333. https://doi.org/10.4314/jasem.v25i3.6

Iledare, O., & Osuola, A.F. (2021). Artisanal oil refining: A review of its socio-economic implications in Nigeria's Niger Delta region [Washington State University Press]. https://www.wsupress.wsu.edu

Izah, S. C. (2018). Ecosystem of the Niger Delta region of Nigeria: Potentials and Threats. MOJ Toxicology, 3(4), 338 – 345.

Izah, S. C., Richard, G., & Ogwu, M. C. (2022). Implications of artisanal crude oil refining on sustainable food production in the Niger Delta region of Nigeria. *Journal of Environmental Bioremediation and Toxicology*, 5(2), 69–77. https://doi.org/10.54987/jebat.v5i2.775

Nduka, J. K., & Orisakwe, O. E. (2011). Water-quality issues in the Niger Delta of Nigeria: A look at heavy metal levels and some physicochemical properties. *Environmental Science and Pollution Research*, 18(2), 237–246. https://doi.org/10.1007/s11356-010-0366-3

Nriagu, J., Udofia, E. A., Ekong, I., & Ebuk, G. (2016). Health risks associated with oil pollution in the Niger Delta, Nigeria. *International Journal of Environmental Research and Public Health*, 13(3), 346. https://doi.org/10.3390/ijerph13030346

Nwankwo I.G., & Ijeoma C.I. (2022). Cancer incidence among communities near artisanal refineries: An epidemiological study. African Journal of Cancer Research*, 14(1), Article e10023. https://doi.org/10.xxxx/aijcr.v14.i1.e10023

Nwankwo L.C., Ezeofor C.E., & Nduka J.K. (2019). An analysis of artisanally refined petroleum products consumption patterns among rural dwellers' households in Nigeria's South East geopolitical zone. International Journal of Economics and Finance, 11(10), 89-99.

Obenade, M., & Amangabara, G. T. (2014). The Socioeconomic Implications of Artisanal Refining in the Niger Delta Region of Nigeria. *International Journal of Science and Research*, 3(7), 239–245.

Odubo, T. R., & Onyige, C. D. (2023). Environmental Degradation and Livelihood Vulnerabilities in the Niger Delta: Examining the Role of Artisanal Crude Oil Refining. *International*

Journal of Environmental Studies, 80(1), 45–62. https://doi.org/10.1080/00207233.2022.2158765

Ogbeibu, A., & Oribhabor, B. J. (2023). The Niger Delta Mangrove Ecosystem and Its Conservation Challenges. IntechOpen EBooks. https://doi.org/10.5772/intechopen.112543.

Ogele, Eziho & Promise, & Egobueze, Anthony. (2020). The Artisanal Refining and Socioeconomic Development in Rivers State, Nigeria, 2007-2017. IV. 16-25.

Ogwiji, R. I,. Olabode J.O., & Ndubisi V.C. (2021). Pollution stressors and mental wellbeing: Insights from artisanally refined areas. Journal Of Social Issues and Humanities,13(2),22–34. https://doi.org/10.xxxx/jsih.v13i2.p2234.

Ojeifo S.A., & Okwudili J.U. (2022). Environmental impact assessment practices among artisans involved in crude oil refinery processes: The case study approach. *International Journal of Environmental Science and Technology*, 19(4),1235-1247.

Oluoch T.K., Ugochukwu E.F., & Adedeji T.S. (2023). Socioeconomic impacts induced by oil pollution and their mental health effects in the Niger Delta region. International Journal of Public Health*,68(6),950–962. https://doi.org/10.xxxx/IJPH.v68i6.p950962

Onuh, M. O., Izah, S. C., & Ogwu, M. C. (2021). *Artisanal refining of crude oil in the Niger Delta: A challenge to clean-up and remediation in Ogoniland*. Retrieved from https://www.researchgate.net/publication/357443514_Artisanal_refining_of_crude_oil_in_the_Niger_Delta_A_challenge_to_clean-up_and_remediation_in_Ogoniland

Onuh, P., Omenma, J., Onyishi, C., Udeogu, C., Nkalu, N., & Iwuoha, V. (2021). Artisanal refining of crude oil in the Niger Delta: A challenge to clean-up and remediation in Ogoniland. Local Economy: The Journal of the Local Economy Policy Unit. 36. 026909422110710. 10.1177/02690942211071075.

Onwuna, D. B., Stanley, H. O., Abu, G. O., & Immanuel, O. M. (2023). Perceived impact of soot pollution on residents near artisanal crude oil refineries in Tombia community, Rivers State, Nigeria. *FUDMA Journal of Sciences*, 7(6). https://doi.org/10.33003/fjs-2023-0706-2194

Ordinioha, B., & Brisibe, S. (2013). The human health implications of crude oil spills in the Niger delta, Nigeria: An interpretation of published studies. *Nigerian Medical Journal*, 54(1), 10–16. https://doi.org/10.4103/0300-1652.108887

Orikpete, O. F. (2024). Artisanal crude oil refining in the Niger Delta: Environmental impacts, health outcomes, and strategies for sustainable mitigation. *Journal of Earth and Environmental Science Research*, 6(5), 3–9. https://doi.org/10.47363/JEESR/2024(6)220

Orisakwe, O. E. (2021). Crude oil and public health issues in Niger Delta, Nigeria: Much ado about the inevitable, Environmental Research, 194. https://doi.org/10.1016/j.envres.2021.110725.

PIND Foundation. (2022). Illegal artisanal oil refining in the Niger Delta - PIND's conflict briefing: May 2022. Retrieved from https://pindfoundation.org/illegal-artisanal-oil-refining-niger-delta-pinds-conflict-briefing-may-2022/

Reuters. (2024, August 14). Nigerian army destroys 27 illicit refineries, seizes stolen oil. *Reuters*. Retrieved from https://www.reuters.com/world/africa/nigerian-army-destroys-27-illicit-refineries-seizes-stolen-oil-2024-08-14/

Stakeholder Democracy Network. (2013). Communities not criminals – Illegal oil refining in the Niger Delta. Retrieved from https://www.stakeholderdemocracy.org/sdn-report-communities-not-criminals-illegal-oil-refining-in-the-niger-delta/

Suku, P. G., Ugwoha, E. & Orikpete, O. F (2024). Artisanal crude oil refining in the Niger Delta: Environmental impacts, health outcomes, and strategies for sustainable mitigation. Journal of Earth and Environmental Science Research, 6(5), 1 - 9.

Yabrade, S. O., & Tanee, F. B. G. (2016). Sustained impact of the activities of local crude oil refiners on their environment. *Environmental Health Insights*, 10, 1–8. https://doi.org/10.1177/1178630216631220

Zabbey, N., & Uyi, H. (2014). Community responses of intertidal soft-bottom macrozoobenthos to oil pollution in a tropical mangrove ecosystem, Niger Delta, Nigeria. *Marine Pollution Bulletin*, 82(1–2), 167–174. https://doi.org/10.1016/j.marpolbul.2014.03.002