

## **Integration of Modular and Artisanal Refinings (Kpofire) into the Downstream Oil Sector in the Niger Delta, Nigeria**

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### ***Abstract***

*The Niger Delta region of Nigeria is plagued by the proliferation of artisanal refining activities, commonly referred to as "Kpofire." These illegal refining practices have emerged as a response to socio-economic challenges, including high unemployment rates and poverty. While they provide a source of livelihood for many local inhabitants, these practices pose significant environmental and health risks due to unregulated emissions and oil spills. Additionally, they contribute to the loss of revenue for the Nigerian government and legitimate oil companies. The current regulatory frameworks and enforcement mechanisms have proven inadequate in addressing these challenges, resulting in a persistent cycle of environmental degradation and socio-economic instability. The integration of modular refining, a more controlled and efficient approach, into the downstream oil sector presents a potential solution. However, there is a critical need to assess how these modular refiners can be effectively incorporated to mitigate the negative impacts of artisanal refining while promoting sustainable development in the region. To this end, study aims to explore the potential for integrating modular refining techniques with artisanal refining practices to enhance the downstream oil sector in the Niger Delta. The study finds that integrating modular refining could significantly reduce environmental damage and health hazards associated with Kpofire. It also highlights that proper integration could boost local employment and improve the socio-economic conditions of the Niger Delta. The research concludes that with adequate regulatory support and investment, modular refining could serve as a viable alternative to artisanal practices, leading to more sustainable and efficient oil production. Based on the identified findings, the study recommended that the government should establish clear regulatory frameworks and provide financial incentives to encourage the transition from artisanal to modular refining in the Niger Delta.*

**Keywords:** *Downstream Oil Sector, Modular, Artisanal Refining, Integration*

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## **Introduction**

The Niger Delta region of Nigeria is renowned for its abundant oil and gas reserves, making it a crucial hub for the country's energy sector. Within this region, the emergence of modular and artisanal refineries, collectively known as Kpofire, has garnered significant attention due to their potential to revolutionize the country's oil refining landscape. These smaller-scale refineries represent a departure from traditional large-scale refineries, offering a more decentralised and locally-driven approach to petroleum processing.

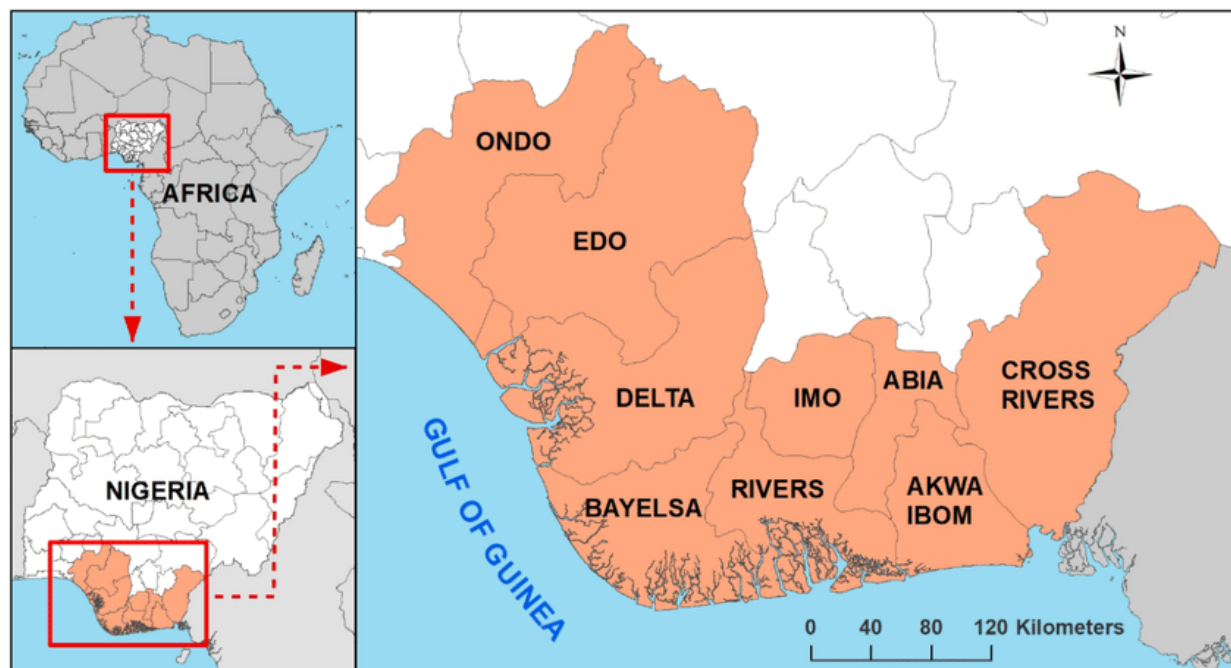
The term "Kpofire" encapsulates a diverse array of refining operations, ranging from small-scale modular refineries to artisanal refineries operated by local communities. These refineries play a vital role in meeting the demand for refined petroleum products in Nigeria, particularly in regions where access to conventional refineries is limited. However, their integration into the mainstream oil sector presents both opportunities and challenges that warrant careful consideration and strategic planning.

In recent years, there has been growing interest in exploring the integrability of Kpofire refineries into the broader Nigerian oil industry. This integration holds the promise of enhancing domestic refining capacity, reducing reliance on imported fuels, and stimulating economic development in the Niger Delta region. However, it also raises complex issues related to regulatory compliance, environmental sustainability, social equity, and technological innovation. As Nigeria seeks to maximise the potential of its indigenous refining capabilities, the integrability of modular and artisanal refineries in the Niger Delta emerges as a critical area of focus for policymakers, industry stakeholders, and local communities alike.

## **Niger Delta Region**

The Niger Delta region, situated in the southern part of Nigeria, stands as a significant geographical and economic area, renowned for its vast oil reserves that have been at the center of Nigeria's economic growth for decades. This region comprises nine states and is inhabited by a diverse array of ethnic groups, each with its unique culture and history. Despite its abundant natural resources, the Niger Delta has been plagued by a myriad of challenges, including environmental degradation, economic disparity, and social unrest, which have been exacerbated by the oil industry's activities (Ihemeson, 2023; Hart, 2022; Hart, 2019). The interplay between these factors has shaped the region's socio-economic landscape, making it a focal point of national and international attention.

### Map of Niger Delta Region



Source:

[https://www.google.com/url?sa=i&url=https%3a%2f%2fwww.researchgate.net%2ffigure%2fmap-of-the-niger-delta-region-in-southern-nigeria\\_fig1\\_344161941&psig=aovvaw2nu1hgyvrflkrowr5pgov&ust=1712123034702000&source=images&cd=vfe&opi=89978449&ved=0cbiqjrxqfwotclignmrpooudfqaaaaadaaaaabae](https://www.google.com/url?sa=i&url=https%3a%2f%2fwww.researchgate.net%2ffigure%2fmap-of-the-niger-delta-region-in-southern-nigeria_fig1_344161941&psig=aovvaw2nu1hgyvrflkrowr5pgov&ust=1712123034702000&source=images&cd=vfe&opi=89978449&ved=0cbiqjrxqfwotclignmrpooudfqaaaaadaaaaabae)

Environmental degradation in the Niger Delta is profound, primarily due to oil exploration and extraction activities that have led to land, air, and water pollution. Oil spills, gas flaring, and deforestation have significantly impacted the region's biodiversity, affecting both terrestrial and aquatic life (Ihemeson, 2023; Hart, 2023; Ihemeson, 2024). These environmental issues have not only disrupted local ecosystems but have also undermined the livelihoods of millions of residents who depend on agriculture and fishing. The resultant effect is a paradox of plenty, where the region's wealth in natural resources contrasts starkly with the poverty and deprivation experienced by its inhabitants (2019). Scholars and environmentalists have extensively documented these impacts, emphasizing the need for sustainable environmental management and stronger regulatory frameworks to mitigate the adverse effects of oil exploitation (Obi, 2010; Idemudia, 2009).

The economic implications of the oil industry in the Niger Delta are vast yet unevenly distributed. While the region contributes significantly to Nigeria's national income, much of the wealth generated from oil has not translated into improved living standards for the local population (Ihemeson, 2023). This disparity has fueled feelings of marginalization and led to numerous conflicts, with local communities demanding a greater share of the oil wealth and more

involvement in decision-making processes related to resource management. The economic grievances in the Niger Delta are further compounded by issues of unemployment, underdevelopment, and a lack of basic social amenities, which contribute to the region's volatility and unrest (Ushie, 2013, Hart, 2022).

The social and political landscape of the Niger Delta is equally complex, characterized by a history of agitation and resistance against perceived exploitation and environmental injustice. Various militant groups have emerged over the years, advocating for resource control and the region's autonomy. While the Nigerian government has implemented several initiatives, including the establishment of the Niger Delta Development Commission (NDDC) and the amnesty program for militants, the effectiveness of these interventions in addressing the root causes of discontent remains a subject of debate. At the heart of the Niger Delta's challenges is a struggle for identity, equity, and sustainable development, reflecting broader issues of governance, human rights, and environmental stewardship in the context of resource-rich regions (Ikelegbe, 2005).

### **Oil Refinery in Nigeria**

The oil refinery sector in Nigeria represents a critical component of the nation's economy, playing a pivotal role in defining its energy landscape and influencing its socio-economic dynamics. Nigeria, as one of Africa's largest oil producers, has historically relied on its vast oil reserves for economic sustenance, with the refinery segment being central to transforming crude oil into valuable products for both domestic consumption and export (Ihemeson, 2023). However, despite the sector's potential to drive economic growth and development, it has faced numerous challenges, including underinvestment, aging infrastructure, and operational inefficiencies. These issues have not only affected the sector's productivity but have also had broader implications for the Nigerian economy, impacting fuel availability, foreign exchange earnings, and industrial growth.

Operational challenges within Nigeria's refinery sector have led to a scenario where the country, despite its abundant crude oil reserves, has been unable to meet domestic demand for refined petroleum products. This paradoxical situation has necessitated substantial imports of refined products, straining the nation's finances and undermining its energy security. The refineries, some of which are state-owned and others privately operated, have struggled with maintenance issues, underutilization, and technical inefficiencies, contributing to frequent fuel shortages and hindering the sector's contribution to national development. The resultant economic implications are significant, affecting everything from transportation costs to industrial productivity, and have spurred debates on the need for comprehensive sectoral reforms (Iwayemi, 2008; Onuoha, 2010).

In response to these challenges, the Nigerian government and private sector stakeholders have initiated various measures aimed at revitalizing the refinery sector. These include plans for refurbishment of existing facilities, encouragement of private investment in refinery operations, and the development of new, modern refineries intended to boost capacity and efficiency. Notably, the Dangote Refinery, poised to be one of the world's largest, symbolizes a significant shift towards enhancing domestic refining capacity and reducing dependency on imported products. These initiatives reflect a broader recognition of the need to harness the refinery sector's potential as a

catalyst for economic diversification and sustainable growth, underscoring its importance in Nigeria's broader economic strategy (Eberendu, 2019; OPEC, 2020).

Furthermore, the refinery sector's evolution in Nigeria is closely linked to global energy trends and the transition towards cleaner energy sources (Ihemeson, 2024). As the world increasingly focuses on reducing carbon emissions and promoting sustainable energy practices, Nigeria's refinery sector faces additional pressures to adapt and innovate. This entails not only upgrading operational efficiencies and environmental standards but also aligning with international best practices and transitioning towards more sustainable refining processes (Hart, 2023). The sector's ability to navigate these global trends will be crucial in determining its future trajectory and its role in Nigeria's economic and environmental landscape (Adeoye & Ebohon, 2021).

### **Relevance of Oil Refinery to National Development of Nigeria**

The oil refinery sector in Nigeria serves as a cornerstone in the country's quest for economic growth and national development. As the largest oil producer in Africa, Nigeria's economic fortune is closely tied to the petroleum industry, with refineries playing a critical role in transforming crude oil into vital products, bolstering energy security, and generating substantial revenue. However, the sector's potential to contribute more significantly to national development has been hindered by various challenges, leading to underperformance and inefficiencies. The relevance of oil refineries extends beyond mere oil processing; it influences various facets of Nigeria's economy, including industrialization, employment, and technological advancement, thus holding a pivotal position in the national development agenda (Olawuyi, 2019).

**Industrialization and Economic Diversification:** Refineries are instrumental in Nigeria's industrialization and economic diversification efforts. By processing crude oil domestically, refineries can provide essential feedstock for petrochemical industries, support downstream industries, and reduce reliance on imported petroleum products. This not only helps in conserving foreign exchange but also stimulates industrial growth and job creation across various sectors. Moreover, a robust refinery sector can attract foreign investment, enhance technology transfer, and develop local expertise, contributing to broader economic diversification and resilience against external shocks. The strategic development of the refinery sector, therefore, is crucial for Nigeria's ambition to reduce its economic dependency on crude oil exports and to build a more diversified and sustainable economy (Onuoha, 2018).

**Energy Security and Socio-economic Stability:** The significance of oil refineries in Nigeria also extends to ensuring energy security and socio-economic stability. Reliable access to refined petroleum products is vital for the functioning of key economic sectors, including transportation, manufacturing, and agriculture. By increasing domestic refining capacity, Nigeria can ensure a steady supply of fuel, mitigate the impacts of global oil price volatility, and reduce the vulnerability associated with import dependencies. This stability is crucial for economic planning, investment confidence, and overall national security, underscoring the direct linkage between refinery performance and the country's socio-economic well-being (Iwayemi, 2012).

**Environmental Sustainability and Community Development:** Finally, the oil refinery sector in Nigeria has a significant role in promoting environmental sustainability and community development. Modernizing refineries to adopt cleaner technologies and more efficient processes can mitigate environmental impacts associated with oil refining, such as emissions, effluents, and waste (Ihemeson, 2023; Ihemeson, 2024). Additionally, socially responsible refinery operations can contribute to community development through corporate social responsibility initiatives, local content development, and stakeholder engagement (Hart, 2024). By addressing the environmental and social dimensions of refinery operations, Nigeria can harness the sector's benefits while minimizing its ecological footprint and fostering community goodwill, which are essential components of sustainable national development (Akpomuvie, 2011).

### **Challenges of Oil Refinery in Nigeria**

The oil refinery sector in Nigeria, a pivotal component of the nation's economy, faces multifaceted challenges that undermine its efficiency and contribution to national development. Despite possessing one of the largest crude oil reserves in Africa, Nigeria struggles to optimize its refining capacity, leading to a paradox where the country exports crude oil only to import refined products. This scenario underscores deeper systemic issues within the sector, ranging from outdated infrastructure and technological deficits to policy inconsistencies and regulatory inadequacies. Addressing these challenges is crucial for enhancing the sector's productivity, ensuring energy security, and maximizing its developmental potential. The ensuing analysis delves into specific challenges that have plagued Nigeria's oil refineries, examining their implications and underlying causes (KPMG, 2020).

**Aging Infrastructure and Maintenance Issues:** One of the critical challenges facing Nigeria's oil refinery sector is the aging infrastructure and lack of regular maintenance, which severely impacts operational efficiency. The refineries, some of which were established several decades ago, have not undergone necessary upgrades or maintenance, leading to frequent breakdowns and sub-optimal performance. The resultant low capacity utilization not only diminishes the sector's profitability but also exacerbates fuel supply shortages within the country. Moreover, the failure to invest in modernizing refinery infrastructure stifles technological advancement and undermines competitiveness, necessitating significant capital injection and strategic planning to revitalize these facilities (NNPC, 2020).

**Regulatory and Policy Inconsistencies:** Another significant challenge is the inconsistency in regulatory frameworks and policies governing the oil refinery sector. Policy flip-flops and regulatory uncertainties create an unpredictable business environment, deterring investment and complicating operational planning. Additionally, the lack of a clear and cohesive policy direction hampers the sector's strategic development and integration into broader economic objectives. For Nigeria's oil refineries to thrive, there is a pressing need for stable, transparent, and enabling policies that align with global best practices and foster a conducive environment for investment and growth (OPEC, 2021).

**Financial Constraints and Investment Shortfalls:** Financial constraints represent a major hurdle for Nigeria's oil refinery sector, affecting both government-owned and private refineries. The capital-intensive nature of refinery operations, coupled with the sector's historical financial underperformance, poses challenges in attracting necessary investments. Limited access to finance hinders not only the maintenance and upgrade of existing facilities but also the establishment of new, more efficient refineries. Furthermore, the investment climate is affected by broader economic factors, including foreign exchange volatility and fiscal uncertainties, which necessitate innovative financing solutions and public-private partnerships to mobilize adequate resources for the sector's revitalization (World Bank, 2021).

**Operational Inefficiencies and Human Resource Constraints:** Operational inefficiencies, compounded by human resource constraints, further challenge Nigeria's oil refinery sector. Inadequate training, skills gaps, and brain drain have impacted the sector's operational standards and productivity. The need for skilled personnel is critical in enhancing operational efficiency, adopting new technologies, and fostering a culture of continuous improvement and innovation. Addressing these human resource challenges requires targeted investments in workforce development, knowledge transfer partnerships, and a strategic focus on building local capacity and expertise to drive the sector forward (Adeoye & Ebohon, 2021).

### **Artisan Refining in the Niger Delta Region**

Artisanal refining in the Niger Delta is a complex and multifaceted issue that has significant implications for the region's socio-economic dynamics and environmental sustainability. This practice involves the crude oil extraction process carried out by local communities using rudimentary and often hazardous methods, leading to environmental degradation, health risks, and social unrest. Despite the Nigerian government's efforts to regulate the oil industry, artisanal refining continues to thrive due to various socio-economic factors, including poverty, unemployment, and inadequate infrastructure. Understanding the drivers and impacts of artisanal refining is crucial for formulating effective policies and interventions to address this pressing issue.

One of the key drivers of artisanal refining in the Niger Delta is the lack of viable economic opportunities for local communities. High levels of poverty and unemployment push individuals towards engaging in artisanal refining as a means of survival and income generation. The lucrative nature of the oil industry, coupled with limited alternative employment options, incentivises many to participate in illegal refining activities despite the associated risks (Nwilo & Badejo, 2011). Moreover, the absence of basic infrastructure, such as electricity and clean water, further exacerbates poverty and drives communities towards illicit activities like artisanal refining. Therefore, addressing the root causes of poverty and providing sustainable livelihood options are essential for reducing the prevalence of artisanal refining in the Niger Delta.

Furthermore, the environmental consequences of artisanal refining are severe and far-reaching. Crude oil theft and illegal refining operations contribute to oil spills, air and water pollution, and ecosystem degradation, posing significant health risks to local populations and exacerbating environmental degradation in the region (Obidairo, 2017). The use of primitive refining

techniques, such as open-air processing and makeshift distillation units, further intensifies environmental damage and increases the likelihood of accidents and explosions. These environmental hazards not only undermine the region's ecological integrity but also hinder sustainable development efforts and perpetuate socio-economic inequalities (Obidairo, 2017). Therefore, addressing the environmental impacts of artisanal refining requires comprehensive strategies that encompass regulatory enforcement, community engagement, and environmental remediation efforts.

### **Socio-economic and Political Implications of Artisan Refinery in Niger Delta Region**

**Economic Implications and Livelihoods:** Artisanal refining has profound economic implications for the Niger Delta, functioning as a double-edged sword. On one hand, it provides essential income and employment opportunities in a region where such prospects are scarce. On the other hand, it undermines the formal economy, particularly the legitimate oil sector, by fostering a parallel market for petroleum products. The revenue loss to the Nigerian government from oil theft and illegal refining is substantial, exacerbating the country's economic challenges. Despite its illegality, artisanal refining is deeply entrenched in the local economy, necessitating targeted policies that address the root causes of this activity without exacerbating local hardships (Idemudia, 2020).

**Environmental and Health Impacts:** The environmental and health impacts of artisanal refining in the Niger Delta are severe and wide-ranging. The process releases toxic pollutants into the air, water, and soil, significantly harming local ecosystems and biodiversity. Communities in proximity to artisanal refining sites suffer from increased health risks, including respiratory and skin diseases, due to exposure to hazardous substances. The environmental degradation also affects agriculture and fisheries, further undermining local livelihoods and food security. Addressing these impacts requires comprehensive environmental monitoring, health interventions, and community engagement to mitigate the adverse effects and promote sustainable alternatives (Nwilo and Badejo, 2020).

**Social and Political Dynamics:** Artisanal refining is deeply intertwined with the social and political fabric of the Niger Delta, reflecting broader issues of resource control, marginalization, and resistance. The practice is not merely an economic activity but also a symbol of local defiance against perceived exploitation and neglect by the state and oil companies. It raises complex questions about governance, equity, and environmental justice in resource-rich regions. Effective policies must therefore consider the social and political context, engaging with local communities to address grievances and collaboratively develop solutions that respect their rights and aspirations (Obi and Rustad, 2020).

**Legal and Regulatory Framework:** The legal and regulatory framework surrounding artisanal refining in Nigeria is characterized by challenges in enforcement and compliance. While the government has taken steps to curtail illegal refining through crackdowns and legislation, these efforts often result in conflict without addressing the underlying motivations for the activity. A more effective approach may involve legal reforms that recognize the realities on the ground,



coupled with enhanced enforcement mechanisms and incentives for legal compliance (Hart, 2024) Strengthening the rule of law, promoting transparency in the oil sector, and providing avenues for legal community-based refining could contribute to resolving this issue (Ako, 2020).

### **Modular Refinery**

The development and deployment of modular refineries represent a significant shift in the approach to refining operations, particularly in regions like Nigeria's Niger Delta, where traditional refining methods have been plagued by inefficiencies and environmental degradation. Modular refineries, characterised by their smaller scale and modular design, offer a more flexible and cost-effective alternative to conventional large-scale refineries. These facilities can be rapidly deployed, require less initial capital investment, and offer greater adaptability to local market conditions and resource availability (Olawale, 2019). As such, modular refineries have emerged as a promising solution to address the challenges facing the oil industry in the Niger Delta and other similar regions.

One of the key advantages of modular refineries is their ability to promote local economic development and empowerment. By decentralising refining operations and encouraging local participation, modular refineries create opportunities for job creation, skill development, and economic diversification in host communities (Ajayi et al., 2018). Additionally, the modular nature of these facilities allows for easier scalability, enabling incremental capacity expansion based on market demand and resource availability. This flexibility not only enhances the resilience of the refining sector but also fosters entrepreneurship and innovation at the local level, contributing to broader economic growth and development in the region (Ajayi, et al., 2018).

Furthermore, modular refineries offer significant environmental benefits compared to their larger counterparts. The smaller footprint and modular design of these facilities result in lower environmental impact and reduced carbon emissions per unit of production (Olawale, 2019). Additionally, modular refineries can incorporate state-of-the-art technologies and best practices in environmental management, including waste minimisation, energy efficiency, and pollution control measures. By adhering to stringent environmental standards and regulatory requirements, modular refineries help mitigate the negative environmental externalities associated with oil refining activities, thereby contributing to sustainable development and environmental conservation efforts in the Niger Delta and beyond (Olawale, 2019).

Thus, modular refineries represent a transformative innovation in the oil refining sector, offering a more sustainable, efficient, and socially responsible approach to hydrocarbon processing. These facilities have the potential to drive local economic development, empower communities, and promote environmental sustainability in regions like the Niger Delta. However, their successful implementation requires supportive policies, adequate infrastructure, and stakeholder engagement to overcome regulatory barriers, financing challenges, and technical constraints. By harnessing the benefits of modular refineries and addressing their inherent challenges, policymakers, industry stakeholders, and local communities can leverage this technology to catalyse inclusive growth, environmental stewardship, and sustainable development in oil-producing regions.

## **Challenges Militating against the Modular Refinery in the Niger Delta Region**

The establishment of modular refineries in the Niger Delta region faces a multitude of challenges spanning systematic, constitutional, and local dimensions. These challenges hinder the realisation of the potential benefits of modular refineries, including economic development, energy security, and environmental sustainability. Addressing these barriers is essential to unlocking the full potential of modular refineries in the Niger Delta and fostering inclusive growth and development in the region.

### **Systematic Challenges**

Systematic challenges pose significant obstacles to the establishment of modular refineries in the Niger Delta. These challenges include regulatory hurdles, bureaucratic red tape, and policy inconsistencies that impede investment and project implementation (Okoro & Ebohon, 2017; Hart, 2024). The complex and opaque regulatory framework governing the oil and gas sector in Nigeria creates uncertainty for investors and delays project approvals, hindering the development of modular refineries. Additionally, the lack of a coherent national energy policy and inadequate institutional capacity further exacerbate these challenges, undermining investor confidence and deterring investment in modular refining projects (Okoro & Ebohon, 2017).

### **Constitutional Challenges**

Constitutional challenges also contribute to the difficulties in establishing modular refineries in the Niger Delta region. The Nigerian constitution allocates control over mineral resources, including oil and gas, to the federal government, limiting the autonomy of state and local governments in regulating and managing the oil industry (Ikelegbe, 2018). This centralised control undermines the participation of local communities and stakeholders in decision-making processes related to oil and gas development, leading to tensions and conflicts in the Niger Delta. Moreover, the lack of adequate revenue allocation and resource-sharing mechanisms exacerbates grievances among oil-producing communities, further complicating efforts to establish modular refineries (Ikelegbe, 2018).

### **Local Challenges**

Local challenges, including security concerns, community resistance, and infrastructure deficiencies, pose additional barriers to the establishment of modular refineries in the Niger Delta. The region's volatile security environment, characterised by militancy, pipeline vandalism, and illegal bunkering, poses significant risks to investment and project operations (Olorunsola, 2016). Moreover, community resistance to oil and gas projects, stemming from perceived environmental injustices, lack of consultation, and unmet development expectations, often leads to project delays and disruptions (Olorunsola, 2016). Additionally, the lack of basic infrastructure, such as roads, power supply, and water, hampers the development and operation of modular refineries, increasing project costs and feasibility risks (Okoro & Ebohon, 2017).

To crown it all, the establishment of modular refineries in the Niger Delta region faces a myriad of challenges, including systematic, constitutional, and local barriers. Addressing these challenges

requires concerted efforts from the government, industry stakeholders, and local communities to reform regulatory frameworks, enhance institutional capacity, and foster inclusive governance processes. By addressing these barriers, policymakers can unlock the potential of modular refineries to promote economic development, enhance energy security, and foster environmental sustainability in the Niger Delta and beyond.

### **The Integrability of Modular and Artisanal Refinings (Kpofire) in the Niger Delta into the Nigeria Mainstream**

The integration of modular and artisanal refineries, known as "Kpofire," into the mainstream oil sector in the Niger Delta holds significant prospects and benefits for Nigeria's energy landscape. Therefore, paper explore into six key areas of potential positive impact, including increased local processing capacity, enhanced energy security, job creation, revenue generation, technology transfer, and empowerment of local communities.

**Enhanced Local Processing Capacity:** One of the primary benefits of integrating Kpofire refineries into the mainstream oil sector is the potential for increased local processing capacity. These smaller-scale refineries can complement larger, conventional refineries by refining crude oil closer to the source, thereby reducing transportation costs and improving efficiency (Udofia et al., 2019). By expanding domestic refining capacity, Nigeria can reduce its reliance on imported petroleum products and enhance its energy self-sufficiency.

**Improved Energy Security:** The integration of modular and artisanal refineries can contribute to enhanced energy security by reducing Nigeria's dependence on imported refined petroleum products. Currently, the country relies heavily on imported fuels to meet domestic demand, making it vulnerable to fluctuations in global oil markets and geopolitical tensions (Olayinka & Amiolemen, 2015). By increasing local refining capacity, Nigeria can mitigate these risks and ensure a more stable and secure energy supply for its citizens.

**Job Creation and Economic Development:** Another significant benefit of integrating Kpofire refineries into the mainstream sector is the potential for job creation and economic development, particularly in the Niger Delta region. These refineries have the capacity to generate employment opportunities for local residents in both upstream and downstream activities, including crude oil extraction, refining, transportation, and distribution (Asumugha & Ibanga, 2013). Additionally, the establishment of ancillary industries and support services can further stimulate economic growth and diversification in the region.

**Revenue Generation and Fiscal Stability:** The integration of modular and artisanal refineries into the mainstream oil sector has the potential to generate additional revenue for the Nigerian government through taxes, royalties, and licensing fees. By formalizing and regulating these operations, the government can capture a greater share of the value generated from the country's natural resources (Obadan & Omojola, 2016; Hart, 2022). This increased revenue can contribute to fiscal stability, enabling the government to invest in essential infrastructure, social services, and poverty alleviation initiatives.

**Technology Transfer and Innovation:** Integrating Kpofire refineries into the mainstream oil sector can facilitate technology transfer and innovation, driving advancements in refining processes, environmental protection measures, and safety standards. As these smaller-scale refineries adopt best practices and adhere to regulatory requirements, they can serve as incubators for new technologies and practices that improve efficiency and sustainability (Ite, 2018). This knowledge-sharing and innovation ecosystem can benefit the entire oil and gas industry in Nigeria and beyond.

**Empowerment of Local Communities:** Finally, the integration of modular and artisanal refineries can empower local communities in the Niger Delta by providing opportunities for entrepreneurship, skills development, and community engagement. By involving local residents in the operation and management of these refineries, the industry can foster inclusive growth and social development (Osadiaye et al., 2017). Additionally, revenue-sharing mechanisms and community development initiatives can ensure that the benefits of refinery integration are equitably distributed among all stakeholders.

To crown it all, the integrability of modular and artisanal refineries (Kpofire) into the Nigeria mainstream offers numerous prospects and benefits across various dimensions, including increased local processing capacity, enhanced energy security, job creation, revenue generation, technology transfer, and empowerment of local communities. By leveraging these opportunities and addressing associated challenges, Nigeria can unlock the full potential of its indigenous refining capabilities and foster sustainable development in the Niger Delta and beyond.

### **Conclusion and Recommendations**

In conclusion, the integrability of modular and artisanal refineries, known as Kpofire, into the Nigeria mainstream offers a transformative opportunity for the country's energy sector and broader economy. Through effective regulatory frameworks, investment in technology and infrastructure, and meaningful engagement with local communities, Nigeria can harness the potential of these refineries to enhance energy security, stimulate economic growth, and foster sustainable development in the Niger Delta and beyond. By addressing challenges such as environmental degradation, social tensions, and regulatory gaps, Nigeria can unlock the full potential of its indigenous refining capabilities while safeguarding the environment and promoting inclusive growth.

Furthermore, the integration of Kpofire refineries into the mainstream oil sector aligns with Nigeria's broader goals of diversifying the economy, reducing dependence on imported petroleum products, and promoting local content development. By leveraging these refineries as catalysts for innovation, job creation, and empowerment of local communities, Nigeria can build a more resilient and inclusive energy sector that benefits all stakeholders. With strategic planning, collaboration between government, industry, and civil society, Nigeria can navigate the complexities of refinery integration and pave the way for a more sustainable and prosperous future.

- 1) The deliberate neglect of host communities' needs has led to frequent protests and conflicts, resulting in loss of lives and significant destruction of company properties. Addressing

these grievances is crucial to preventing further unrest and ensuring safety and security. Additionally, credit facilities and technical assistance face major challenges due to prevailing poverty in the region, incapacitating investors from engaging in legal activities requiring substantial capital and technical resources. Security agencies often destroy captured vessels and illegal refineries without expert supervision, further degrading the environment. A comprehensive approach is needed to address these issues effectively and sustainably.

- 2) Government should priorities the welfare of the citizens particularly those in the rural and urban host-communities in order to provide them meaning employment.
- 3) There should be credit facilities and technical for investors that are willing to invest the in the art of refining activities.
- 4) By addressing regulatory barriers, enhancing stakeholder engagement, and investing in infrastructure development, policymakers can unlock the full potential of integrating artisanal refining to stimulate local economic development, enhance energy security, and mitigate environmental impacts.
- 5) Considering the multifaceted challenges posed by artisanal refining, pathways to integration and sustainability are essential. These may include formalizing artisanal refining through community-based initiatives that adhere to environmental and safety standards, providing alternative livelihood programs, and enhancing local capacity for sustainable development. Such approaches require collaboration between the government, industry stakeholders, and local communities, grounded in mutual trust and commitment to long-term development goals. By addressing artisanal refining within the broader context of Niger Delta's development, it is possible to transform this sector from a source of conflict to an opportunity for inclusive growth and environmental stewardship
- 6) Moreover, by integrating artisanal refining practices into formal regulatory frameworks and promoting alternative livelihood options for affected communities, policymakers can address the root causes of illicit refining activities while harnessing local knowledge and expertise to promote sustainable development in the Niger Delta and beyond.
- 7) Through collaborative efforts between government, industry stakeholders, and local communities, modular refining and artisan refining can coexist synergistically, contributing to the socio-economic prosperity and environmental sustainability of the Niger Delta region for generations to come.
- 8) It is essential to prevent environmental pollution by properly disposing of illegally obtained crude oil from unscrupulous sources.

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