Institutional Framework for Methane Emissions Reduction in Nigeria: Policy Insights and Implementation Strategies

Morufu Olalekan Raimi, Ifeanyichukwu Clinton Ezekwe, Tano Dumoyei Agusomu, Okoro Enyinnaya, Nimisingha Jacob Amakama, Ikimi Charles German

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Morufu Olalekan Raimi[1*] PhD; Ifeanyichukwu Clinton Ezekwe[2*] PhD; Tano Dumoyei Agusomu[3*] PhD; Okoro Enyinnaya[4*] PhD; Nimisingha Jacob Amakama[5*] PhD; Ikimi Charles German[6*] PhD

[1]Federal University Otuoke, Faculty of Sciences, Department of Environmental Management and Toxicology, Ogbia NG
[2]University of Port Harcourt, Department of Geography and Environmental Management, Choba Town, Port Harcourt NG
[3]Niger Delta University, Faculty of Social Sciences, Department of Geography and Environmental Management, Amassoma, Gloryland Campus NG
[4]Federal University Otuoke, Faculty of Sciences, Department of Environmental Management and Toxicology, Otuoke NG
[5]Laboratory for the Science of Risks (LSR), IMT Mines Ales, Mines Ales, FR
[6]Federal University Otuoke, Faculty of Basic Medical Sciences, Department of Medical Biochemistry, Otuoke NG
[*]these authors contributed equally

Corresponding Author:
Morufu Olalekan Raimi PhD
Federal University Otuoke,
Faculty of Sciences,
Department of Environmental Management and Toxicology,
Otuoke
Ogbia
NG

Abstract

This report presents an analysis of the institutional framework for methane emissions reduction in Nigeria, focusing on the Niger Delta region. Methane emissions in this area arise mainly from oil and gas extraction activities, particularly through gas flaring and fugitive emissions. Nigeria stands among the world's leading methane emitters, with the Niger Delta playing a significant role due to its dense oil extraction infrastructure. However, the existing data on methane emissions remains inconsistent, revealing gaps between local assessments and satellite observations. This discrepancy hampers efforts to accurately gauge emissions and implement effective strategies for reduction. The environmental impact of methane emissions in the Niger Delta is profound, affecting air quality and contributing to climate change. Limited monitoring and reporting efforts restrict the ability to assess emissions accurately. Recent studies indicate that capturing gas from flaring could yield economic benefits and enhance public health. Nigeria's initiatives for methane reduction, such as the 2018 Short-Lived Climate Pollutants Action Plan, aim to eliminate gas flaring by 2030. However, slow progress stems from inadequate infrastructure and enforcement challenges, highlighting the need for a more robust institutional framework. To address these challenges, stakeholders, including funding agencies, research institutions, and local communities must adopt actionable strategies to mitigate methane emissions effectively. The development of policy components should include stringent regulations, robust monitoring mechanisms, and incentives for adopting cleaner technologies. This report proposes both national and global policy statements that outline clear goals for reducing methane emissions while fostering collaboration among various stakeholders. By prioritizing transparency, education, and community engagement, Nigeria can create a cohesive framework for effectively tackling methane emissions, advancing both environmental sustainability and economic growth.

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Institutional Framework for Methane Emissions Reduction in Nigeria: Policy Insights and Implementation Strategies

[1]Morufu Olalekan Raimi*
[1]Department of Environmental Management and Toxicology, Faculty of Sciences, Federal University Otuoke, Bayelsa State, Nigeria. raimimo@fuotuoke.edu.ng.

[2]Ifeanyichukwu Clinton Ezekwe https://orcid.org/0000-0002-9573-5178
[2]Department of Geography and Environmental Management, University of Port Harcourt, Choba Town Port Harcourt Nigeria. Clinton.ezekwe@uniport.edu.ng

[3]Tano Dumoyei Agusomu
[3]Department of Geography and Environmental Management, Faculty of Social Sciences, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria. dumoyei@vahoo.com

[1]Okoro, Enyinnaya[1] https://orcid.org/0000-0002-0474-3093
[1]Department of Environmental Management and Toxicology, Faculty of Sciences, Federal University Otuoke, Bayelsa State, Nigeria. okoroee@fuotuoke.edu.ng.

[4]Nimisingha Jacob Amakama[1] https://orcid.org/0000-0001-9172-2866
[4]Laboratory for the Science of Risks (LSR), IMT Mines Ales, France
nimisingha.amakama@mines-ales.fr

[5]Ikimi Charles German
[5]Department of Medical Biochemistry, Faculty of Basic Medical Sciences, Federal University Otuoke, Bayelsa State. Nigeria.
ikimicg@fuotuoke.edu.ng.

Executive Summary
This report presents an analysis of the institutional framework for methane emissions reduction in Nigeria, focusing on the Niger Delta region. Methane emissions in this area arise mainly from oil and gas extraction activities, particularly through gas flaring and fugitive emissions. Nigeria stands among the world's leading methane emitters, with the Niger Delta playing a significant role due to its dense oil extraction infrastructure. However, the existing data on methane emissions remains inconsistent, revealing gaps between local assessments and satellite observations. This discrepancy hampers efforts to accurately gauge emissions and implement effective strategies for reduction. The environmental impact of methane emissions in the Niger Delta is profound, affecting air quality and contributing to climate change. Limited monitoring and reporting efforts restrict the ability to assess emissions accurately. Recent studies indicate that capturing gas from flaring could yield economic benefits and enhance public health. Nigeria's initiatives for methane reduction, such as the 2018 Short-Lived Climate Pollutants Action Plan, aim to eliminate gas flaring by 2030. However, slow progress stems from inadequate infrastructure and enforcement challenges, highlighting the need for a more robust institutional framework. To address these challenges, stakeholders, including funding agencies, research institutions, and local communities must adopt actionable strategies to mitigate methane emissions effectively. The development of policy components should include stringent regulations, robust monitoring mechanisms, and incentives for adopting cleaner technologies. This report proposes both national and global policy statements that outline clear goals for reducing methane emissions while fostering collaboration among various stakeholders. By prioritizing transparency, education, and community engagement, Nigeria can create a cohesive framework for effectively tackling methane emissions, advancing both environmental sustainability and economic growth.
Keywords: Methane emissions**;** Oil and gas extraction**;** Gas flaring**;** Fugitive emissions**;** Policy framework**;** Environmental sustainability**;** Climate change**;** Stakeholder engagement**;** Monitoring strategies; Niger Delta**.**

1. Background

Methane, as a potent greenhouse gas, has come under increasing scrutiny due to its significant short-term global warming potential, which is much higher than carbon dioxide.

Recent research highlights methane's global warming potential as approximately 28 times greater than carbon dioxide over a 100-year period, and over 80 times greater in the short term [1]. These characteristics, along with its relatively short atmospheric lifespan, make it an important target for climate mitigation efforts. Nigeria, as one of Africa's largest oil producers [2-18], is particularly vulnerable to methane emissions, given its heavy involvement in energy production [19, 20], agriculture [21-32], and waste management [33-37]. As such, reducing methane emissions in these sectors has become a priority in addressing the country's climate change responsibilities [38, 39]. The significance of addressing methane emissions is underscored by recent studies which show that quick reductions can have an almost immediate impact on slowing global temperature rise [38-40]. However, despite its relevance, global efforts have historically focused more on carbon dioxide, leaving methane emissions somewhat overlooked [41]. In Nigeria, methane emissions are primarily sourced from the energy sector, particularly through gas flaring [42], livestock farming in agriculture, and waste management activities such as landfills [43]. The Nigeria Methane Emissions Reduction Pilot Programme (NiMERP), launched in collaboration with the United Nations Environment Programme, seeks to address this gap by providing actionable data to inform methane reduction strategies (Table 1 below). Despite the progress made, the absence of comprehensive and reliable data on methane emissions in Nigeria presents a challenge. While some data exists, it is often outdated, incomplete, or lacks the precision necessary to guide mitigation efforts [41]. This gap in knowledge underscores the need for more accurate, sector-specific emission estimates that can be used by policymakers to design and prioritize interventions [44]. To address this, NiMERP has pioneered a dual approach, using both bottom-up and top-down data collection techniques, which includes satellite data, on-ground measurements, and advanced modeling technologies [45].These approaches allow for a more comprehensive understanding of the methane emissions landscape in Nigeria.

The need to close these data gaps and create robust strategies for methane reduction is critical for Nigeria's climate commitments. NiMERP's baseline study shows the potential to significantly reduce methane emissions from energy [19, 20], agriculture [21-32], and waste sectors through targeted intervention [33-37]. The energy sector, for instance, has been identified as a major source of methane emissions, particularly due to flaring in oil production. Agriculture, with emissions from livestock farming, and waste management, particularly landfills and wastewater treatment, are also areas of concern [46]. As a result, NiMERP aims to provide not only baseline data but also actionable insights to guide the development of policies that align with Nigeria's commitment to reducing methane emissions by 30% by 2030 [46]. However, significant gaps still exist in our understanding of methane emissions in Nigeria. While NiMERP's initial findings have provided crucial insights into the sources of emissions, questions remain about the effectiveness of certain mitigation strategies in the Nigerian context. For example, the financial costs associated with methane reduction technologies may differ significantly across regions and sectors, meaning that what works in one area may not necessarily apply in another. Additionally, the program has yet to fully explore the socio-economic impacts of methane reduction, particularly how different communities i.e. urban vs rural, affluent vs underprivileged are affected by methane emissions and mitigation policies. The rationale behind NiMERP is rooted in addressing these uncertainties by collecting data that is both precise and comprehensive. This data is necessary to design and implement targeted reduction strategies (table 1) that are both efficient and equitable. By improving methane monitoring systems, the program aims to fill these knowledge gaps, providing policymakers with the tools needed to address the problem at its root. In terms of impact, the methane problem in Nigeria affects multiple groups differently. For instance, communities in the Niger Delta, where oil production and flaring are prevalent, are disproportionately affected by methane emissions. This has not only

environmental implications but also financial consequences. Gas flaring, for example, represents a significant economic loss for Nigeria, as it burns off natural gas that could otherwise be utilized for energy generation. According to NBS [43], the financial impact of methane emissions from flaring alone is substantial, with billions of cubic feet of gas wasted each year. Additionally, methane emissions from livestock farming in rural areas contribute to both local and national greenhouse gas inventories, and waste management inefficiencies in urban areas exacerbate methane emissions from landfills. NiMERP's objectives are clear: to provide Nigeria with the tools and data necessary to reduce methane emissions in a way that aligns with both national and international climate goals. The program seeks to establish a reliable baseline, enhance data collection technologies, identify high-impact sectors, and translate these findings into actionable policy measures. By adopting a multi-sectoral approach, NiMERP ensures that methane reduction strategies (table 1) are tailored to the unique challenges and opportunities presented by Nigeria's diverse landscape. Ultimately, NiMERP represents a step toward addressing the methane emissions challenge in Nigeria, but there is much work to be done. As research progresses, continued collaboration between governmental agencies, private sector actors, and international organizations will be key to ensuring that methane reduction efforts are both effective and sustainable. With a clear understanding of where emissions are coming from, how much they contribute to Nigeria’s overall greenhouse gas profile, and the best strategies for reducing them, the country can make meaningful strides in reducing its climate impact. This study aligns with ongoing global research but brings a much-needed local perspective. By integrating findings from NiMERP with global methane research efforts, Nigeria can not only meet its own climate goals but also contribute to the broader understanding of methane mitigation in developing economies.

Table 1: Methane Reduction Strategies by Sector in Nigeria

Sector	Methane Reduction Strategy	Key Technologies/Interventions
Energy	Improved flaring practices, leak	Advanced monitoring (infrared, UAVs),

Sector	Methane Reduction Strategy	Key Technologies/Interventions
	detection	methane capture
Agriculture	Enteric fermentation control, manure management	Feed additives, anaerobic digesters for manure
Waste	Improved waste management and methane capture	Landfill gas recovery, wastewater methane control

Adapted from NiMERP [47]

Table 1 outline the methane reduction strategies specific to each sector, focusing on technological and policy interventions.

2. Current Methane Landscape in the Niger Delta, Nigeria, and Africa at Large

Methane emissions are a growing concern across Africa, especially in oil-rich regions like the Niger Delta. This region is one of the key contributors to Nigeria's methane emissions due to extensive oil and gas activities, particularly gas flaring. Methane, a potent greenhouse gas, is emitted in large quantities during the production, processing, and transportation of oil and gas. According to recent data, emissions from oil and gas in Nigeria's Niger Delta represent approximately 30% of the country's total methane emissions, with the majority coming from gas production and flaring [44]. This has placed significant pressure on policymakers to prioritize methane reduction strategies (table 1 above) in the energy sector. The Niger Delta's oil and gas infrastructure plays a major role in these emissions. Field measurements using UAVs and infrared cameras have revealed large methane leaks from aging infrastructure and inefficient flaring practices [48]. This highlights the importance of updating technology and infrastructure to prevent further emissions. Many of the current systems are outdated, contributing to higher methane losses that could otherwise be minimized with more modern practices. Across Nigeria, agriculture is another dominant source of methane emissions, contributing approximately 49% of the country's total methane output. Livestock farming, particularly cattle, is the largest source, producing methane through enteric fermentation and manure management [49]. Rural regions, where livestock farming is most prevalent, contribute significantly to these emissions. Rice

cultivation, which is common in Nigeria, adds an additional 7% of agricultural methane emissions, primarily due to the anaerobic conditions in flooded rice paddies [50]. These agricultural emissions create unique challenges, as they are widespread across rural areas where access to methane-reducing technologies is limited.

In contrast, methane emissions from the waste sector account for 21% of Nigeria's total. Urban areas, where municipal solid waste and wastewater treatment are concentrated, are key hotspots. Emissions from poorly managed landfills in cities like Lagos and Port Harcourt contribute significantly to methane emissions. Data from NiMERP shows that municipal landfills in these areas contribute 11% of the country's methane emissions [49]. This presents a clear opportunity for improvement through better waste management practices and methane capture technologies. The rest of Africa faces similar challenges. In countries such as Angola, South Africa, and Egypt, oil production and agriculture are significant sources of methane emissions. In Angola, for example, oil and gas emissions are substantial due to similar flaring practices seen in Nigeria. Meanwhile, South Africa, with its extensive agricultural sector, sees high methane emissions from livestock and waste management [51]. However, Africa's diverse geography and economic activities mean that different countries face different methane emission challenges. For instance, arid regions of northern Africa have lower methane emissions from agriculture due to limited livestock farming and crop production. Africa's contribution to global methane emissions is relatively small compared to other continents, yet the impact of these emissions on both local and global climate change is substantial. As oil production increases across the continent and agricultural practices expand to meet the demands of growing populations, methane emissions are expected to rise if proper mitigation measures are not implemented [44]. Therefore, reducing emissions from key sectors such as energy, agriculture, and waste management will be critical for achieving long-term climate goals. Tables 2, 3 (Figure 1) and

4 below summarize the methane emissions data across sectors in Nigeria:

Table 2: Methane Emissions by Sector in Nigeria

Sector	Methane Contribution (%)	Methane Emissions (Gg)	Key Sources
Energy	30%	2245.41	Gas production, flaring, transportation
Agriculture	49%	3578.80	Livestock (40%), rice cultivation (7%)
Waste	21%	1562.80	Municipal solid waste, landfills

gigagrams (Gg)

Adapted from FME, [50]

Table 2 presents the methane emissions in Nigeria, broken down by sector. Agriculture is the largest contributor, followed by the energy sector, and finally the waste sector.

Table 3: Methane Emissions by Sector and Sub-Sector in Nigeria

Sector	Sub-Sector	Methane Emissions (Gg)	Contribution (%)
Energy	Gas Production	1796.33	24
Energy	Oil Production	224.54	3
Energy	Gas Flaring	224.54	3
Agriculture	Enteric Fermentation	2863.04	40
Agriculture	Manure Management	71.58	1
Agriculture	Rice Cultivation	250.14	7
Waste	Municipal Solid Waste	171.91	11
Waste	Wastewater	156.28	10

Table 3 detailed breaks down of methane emissions into sub-sectors, highlighting the major contributors such as gas production and enteric fermentation in agriculture.

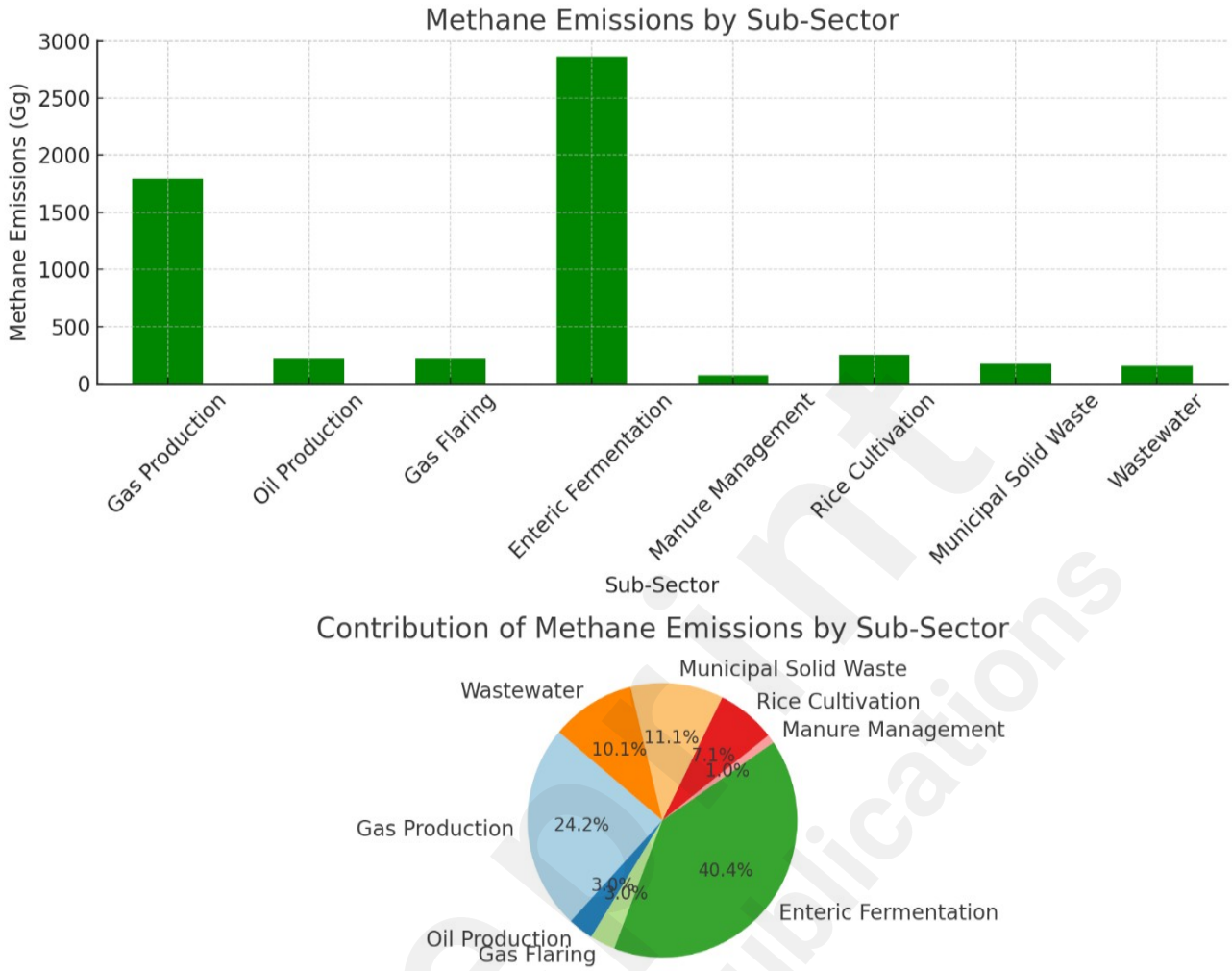

Figure 1: *shows bar chart (Top): Displays the methane emissions (Gg) by sub-sector and Pie chart (Bottom): shows the percentage contribution of each sub-sector to overall methane emissions. These visuals help highlight which sectors contribute the most to methane emissions.*

Table 4: Regional distribution of methane emissions in Nigeria

Sector	Key Regions	Emissions Sources
Energy	Niger Delta	Flaring, oil and gas infrastructure
Agriculture	Rural Northern and Middle Belt	Livestock farming, rice paddies
Waste	Urban areas (Lagos, Port Harcourt)	Landfills, wastewater treatment

Adapted from NBS, [49]

This data offers insight into where methane reduction efforts can have the most impact. In the Niger Delta, improving flaring practices and monitoring gas leaks can help lower emissions in the energy sector. For agriculture, particularly in northern rural areas, the introduction of methane-reducing technologies, such as feed additives for livestock and better manure management systems, could lower emissions from livestock. Finally, improving urban waste management systems in cities will be essential for reducing methane from

landfills. By addressing these key sectors, Nigeria and Africa at large can make significant progress toward methane emission reductions. The work conducted under NiMERP, using both satellite data and on-the-ground measurements, provides a solid foundation for future actions. These efforts, if sustained and expanded, will be essential for helping Africa meet both national and global climate goals.

2. Current Data on Methane Emissions in the Niger Delta

Methane emissions in the Niger Delta are primarily linked to oil and gas extraction activities, notably gas flaring and fugitive emissions. Nigeria, as one of the largest methane emitters globally, has a significant portion of its emissions stemming from the Niger Delta due to its dense concentration of oil infrastructure. Despite its importance, methane emission data from the region remains inconsistent. While national reports and international assessments, such as those from the International Energy Agency (IEA), suggest significant emissions, discrepancies between local data and satellite observations indicate underreporting and notable data gaps [52]. The environmental consequences of methane emissions in the Niger Delta are significant [53-58]. Methane contributes to global warming and forms ground-level ozone, which can cause respiratory health issues and damage ecosystems [38, 39, 42, 60-66]. Despite the region's major role in methane emissions, monitoring efforts have been insufficient, limiting a full understanding of the extent of the emissions (Table 5). Studies suggest that methane capture from flaring could bring both economic gains and public health benefits to the region [52]. However, progress on Nigeria’s methane reduction commitments, such as the 2018 Short-Lived Climate Pollutants (SLCP) Action Plan, has been slow due to infrastructure and enforcement challenges.

Table 5: Regional Distribution of Methane Emissions in Nigeria

Sector	Key Regions	Emissions Sources
Energy	Niger Delta	Flaring, oil and gas infrastructure
Agriculture	Rural Northern and Middle Belt	Livestock farming, rice paddies
Waste	Urban areas (Lagos, Port Harcourt)	Landfills, wastewater treatment

Adapted from NBS [49]

Table 5 reflects methane emissions across different regions in Nigeria, highlighting key sources in each region.

3. Primary Methane Emission Sources in the Niger Delta

The Niger Delta's methane emissions are primarily driven by a few key sources:

i. **Gas flaring**: This process of burning off natural gas during oil extraction is the largest source of methane in the region. Although gas flaring is intended to reduce methane, inefficient combustion allows substantial amounts to escape into the atmosphere [52].

ii. **Fugitive emissions**: Methane leaks from oil pipelines, storage tanks, and other aging infrastructure due to poor maintenance. These leaks are often underreported because advanced monitoring technologies required for detection are not widely available in the Niger Delta [67].

iii. **Abandoned oil wells**: Improperly sealed or maintained wells leak methane, a frequent issue in the Niger Delta's numerous inactive oil fields. This source of methane can continue unchecked for years if not addressed [68].

iv. **Incomplete combustion**: During flaring, incomplete combustion of methane can occur, especially in older or poorly maintained equipment, leading to higher emissions [52].

These emission sources result from operational inefficiencies, outdated technology, and a lack of regulatory oversight. Addressing these challenges will require stronger enforcement of environmental policies, investment in updated infrastructure, and the implementation of advanced monitoring systems.

4. Methods for Long-Term Methane Monitoring and Data Gaps

Monitoring methane emissions in the Niger Delta requires a multi-faceted approach, especially given the geographical and political complexities of the region. There are a few

methods available, each with its own advantages:

i. **Satellite remote sensing**: This approach provides extensive coverage and is particularly useful for monitoring emissions from hard-to-access areas. It has proven valuable in detecting methane from gas flaring and other industrial activities. However, it can be limited by cloud cover, a frequent issue in the Niger Delta [68].

ii. **Ground-based sensors**: These sensors deliver accurate, real-time data on methane leaks at specific sites. However, they require substantial infrastructure, which makes widespread deployment costly [67].

iii. **Mobile monitoring (drones or vehicles)**: Equipped with methane detection sensors, drones can be deployed over pipelines, flare sites, and abandoned wells, providing targeted monitoring. However, this method only offers snapshots rather than continuous data, making it useful for temporary monitoring [52].

iv. **Infrared cameras**: These tools are effective for identifying methane leaks from equipment, pipelines, and flare stacks. While highly efficient, they are costly and their accuracy decreases in certain weather conditions, such as high humidity or fog, which are common in the Niger Delta [68].

Combining these methods would provide a more comprehensive monitoring strategy. A hybrid approach using satellite data for broader coverage and ground-based or mobile sensors for localized monitoring would help capture the full scope of methane emissions.

5. Improving Methane Data Collection for Global Models

Data from the Niger Delta has the potential to enhance global methane emission models, particularly for African oil-producing regions. Global methane models rely on a combination of reported data and satellite observations, but underreporting and gaps in local data have led to an incomplete understanding of emissions from this region [67]. Incorporating more comprehensive data from the Niger Delta would improve the accuracy of

these models. By integrating data from satellite monitoring, ground sensors, and mobile technologies, global methane models could better estimate actual emissions from oil and gas activities in the Niger Delta. This would not only strengthen climate models but also guide the implementation of mitigation efforts where they are most needed [52]. Improving methane monitoring in the Niger Delta could also help Nigeria meet its international climate commitments, such as those outlined in the Global Methane Pledge. Incorporating input from local communities, who often have firsthand knowledge of smaller emission sources like abandoned oil wells, is essential for collecting more accurate data. Engaging with local stakeholders can lead to better data collection and more targeted methane reduction strategies [68].

6. Economic and Health Implications of Methane Reduction

6.1 Economic Benefits of Methane Reduction

Reducing methane emissions in Nigeria offers significant economic benefits, particularly in the energy sector. Methane, the primary component of natural gas, can be captured and monetized instead of being lost through leaks or flaring. This not only reduces waste but also increases efficiency in oil and gas operations. For instance, using methane capture technologies helps companies recover a valuable resource, improving their bottom line while contributing to Nigeria's energy security. In addition to enhancing energy efficiency, investing in methane reduction technologies can stimulate job creation and open new markets. The captured methane can be repurposed for various uses, such as producing biogas in the agricultural and waste sectors, contributing to Nigeria's renewable energy goals (Global Methane Initiative [45]. Moreover, methane reduction investments align with Nigeria's broader economic development objectives. By creating opportunities for innovation in areas such as methane capture, companies can access new technologies, increasing the sector's overall productivity. This not only bolsters Nigeria's economy but also positions the

country to attract foreign investments in clean energy technologies. Table 6a & b summarizes the potential economic gains from methane reduction in key sectors.

Table 6: Economic and Environmental Benefits of Methane Reduction by Sector

Sector	Economic Benefits	Environmental Benefits	Primary Activities
Energy	Improved efficiency, reduced waste, reduced flaring losses	Reduced greenhouse gas emissions, improved air quality	Methane capture in oil and gas production
Agriculture	Renewable energy production, job creation, biogas production	Reduced methane emissions from livestock	Biogas from livestock waste, methane reduction in rice paddies
Waste Management	Energy generation from waste, cost savings	Reduced methane emissions from landfills	Methane capture from landfills

Adapted from GMI [45]

Table 6 detail the benefits of methane reduction across various sectors, focusing on both economic gains and environmental improvements.

6.2 The Link Between Methane Reduction and Public Health

Reducing methane emissions also has direct benefits for public health. Methane is a precursor to ground-level ozone (O_3), which is harmful to human health. High ozone levels contribute to respiratory problems such as asthma, especially in urban areas where air pollution is more concentrated. Reducing methane emissions helps to lower ozone concentrations, leading to cleaner air and better health outcomes [40]. This is particularly relevant for cities like Lagos and Port Harcourt, where the health impacts of air pollution are significant [60-63]. Methane reduction efforts in waste management also help control other public health risks. For example, reducing methane emissions from landfills can decrease odors and limit the spread of pathogens. Improved landfill management, alongside methane

capture technologies, can create a cleaner and healthier environment, reducing the prevalence of diseases linked to poor sanitation. These health benefits make a strong case for integrating public health considerations into methane mitigation strategies.

7 Collaborative Efforts and Funding Mechanisms

7.1 International Collaboration and Funding Opportunities

International collaboration is key to advancing methane reduction efforts in Nigeria. Global initiatives like the Global Methane Pledge, which seeks to reduce methane emissions by 30% by 2030, offer Nigeria access to technical and financial resources. Partnering with organizations such as the United Nations Environment Programme (UNEP) and the Global Methane Initiative provides opportunities for funding methane mitigation projects. These partnerships enable knowledge transfer, allowing Nigeria to adopt best practices from other countries that have successfully reduced methane emissions [41]. Collaboration also positions Nigeria as a leader in methane reduction within the Global South, attracting additional investment and support. International funding mechanisms can help bridge the gap in domestic financing for methane reduction technologies. As shown in Table 7, various programs are available to help fund methane reduction projects, including biogas initiatives and advanced monitoring systems.

Table 7: International methane reduction funding opportunities

Program	Focus	Potential Impact for Nigeria
Global Methane Pledge	30% methane reduction by 2030	Access to funding and technology
UNEP Methane Partnership	Technical support for methane reduction	Knowledge transfer, capacity building
World Bank Gas Flaring Initiative	Reducing methane leaks in energy sector	Funding for infrastructure upgrades

Adapted from UNEP, [41]

7.2 Policy Framework and Regulatory Challenges

For methane reduction to succeed, Nigeria needs a robust policy framework. While the country has committed to international methane reduction goals, translating these commitments into action requires strong regulations, especially in the oil and gas sector. Currently, the enforcement of environmental regulations is weak, and many companies do not comply with gas flaring or methane leak reporting standards. Strengthening regulations and providing incentives for companies to adopt methane capture technologies such as tax breaks can encourage wider participation [50]. Another challenge is building the capacity of regulatory agencies to monitor and enforce compliance. Both national and local levels need stronger oversight mechanisms to ensure that methane reduction targets are met. Addressing these challenges requires improved governance structures, as well as increased investment in regulatory bodies to enhance their ability to enforce policies effectively.

8. Innovations and Awareness in Methane Management

8.1 Technological Innovations for Methane Monitoring and Reduction

Technological advancements are critical to reducing methane emissions in Nigeria. Remote sensing tools such as satellites and UAVs provide real-time monitoring of methane emissions, allowing for better detection of leaks in oil and gas fields. These technologies offer a precise method for tracking emissions and identifying areas that need urgent attention [48]. In addition, infrared cameras and leak detection systems can be used at oil production sites to monitor methane leaks and take corrective actions quickly. In the agricultural and waste sectors, methane-reducing feed additives for livestock and biogas digesters for manure management show promise in reducing emissions. Waste management systems that capture methane from landfills not only lower emissions but also provide an additional energy source. These innovations contribute to creating a sustainable, low-emission economy by improving methane management across various sectors.

8.2 Potential Barriers to Implementation

Several barriers could hinder the successful implementation of methane reduction strategies in Nigeria. One major challenge is the lack of sufficient domestic investment in methane reduction technologies. While international organizations provide some funding, the availability of local financing remains limited, particularly for the agricultural and waste sectors. Additionally, there is a lack of awareness among stakeholders, including local governments and farmers, about the importance of methane reduction [69]. Capacity-building initiatives are necessary to train personnel in methane monitoring and management. Overcoming these challenges will require a coordinated effort to mobilize both domestic and international resources, increase public awareness, and improve training and technical support across sectors.

8.3 The Role of Public Awareness and Education

Public awareness and education are crucial for driving methane reduction efforts. Educating key stakeholders including farmers, industry leaders, and local governments about the benefits of methane reduction can accelerate the adoption of mitigation technologies. For example, training programs that focus on sustainable livestock farming or proper waste management practices can help reduce methane emissions from agriculture and waste [70]. Public campaigns should also highlight the potential economic benefits, such as job creation and renewable energy production. By making the economic and environmental advantages clear, you can foster a culture of sustainability and promote greater participation in methane reduction activities.

8.4 Monitoring Progress and Measuring Success

Tracking progress in methane reduction is essential for keeping Nigeria on course with its goals. Developing a national methane emissions inventory, regularly updated with field data and satellite monitoring, will provide a clear picture of emission trends. Setting

specific benchmarks, such as reducing emissions by 10% by 2025 and 30% by 2030, can help maintain focus and accountability [50]. Regular progress reports can provide transparency and enable adjustments to strategies as needed. Collaborating with international partners will help Nigeria adopt advanced monitoring technologies and make data-driven decisions to improve methane management.

9. Actionable Steps for Stakeholders in the Niger Delta and Nigeria

Stakeholders can take several actionable steps to address methane emissions in the Niger Delta and across Nigeria. Funding agencies should prioritize investments in technology that captures methane from gas flaring and fugitive emissions. These investments can support the development of infrastructure to monitor emissions accurately and implement mitigation strategies. Institutions, including universities and research organizations, can collaborate to study methane emission sources and share best practices for reducing emissions. Engaging local communities in these initiatives can ensure that solutions are culturally appropriate and effective, tapping into local knowledge about less visible methane sources. Individual groups can also play a role by advocating for environmental justice and raising awareness about the effects of methane emissions on public health and the environment. Grassroots movements can pressure local and national governments to enforce existing regulations on gas flaring and methane leaks. Additionally, educational programs focused on sustainable practices can empower communities to adopt methane-reducing technologies. For example, farmers can be trained in improved livestock management practices that decrease methane emissions while also benefiting their productivity. Finally, research institutions should monitor the impact of implemented strategies and publish findings regularly. This transparent sharing of data can help stakeholders assess what works and what doesn’t. By collaborating across sectors, from public institutions to private enterprises, Nigeria can develop a cohesive approach to tackle methane emissions effectively, driving both environmental and economic benefits.

Table 8: Stakeholder Action Plan for Methane Emission Reductions in Nigeria

Stakeholder	Role in Methane Reduction	Actionable Steps
Government	Policy-making, enforcement	Develop and enforce methane capture regulations
Private Sector	Technology investment, methane capture	Invest in methane-reducing technologies
Communities	Local implementation, awareness	Engage in methane reduction education and practices
International Orgs	Funding and technical support	Provide funding and expertise for methane reduction projects

Adapted from UNEP [41]

Table 8 outline the roles of different stakeholders in the methane reduction strategy, focusing on collaboration and implementation.

10. Components of Methane-Related Policies

Developing comprehensive methane-related policies requires a multi-faceted approach that includes regulation, monitoring, and incentives. A key component is the establishment of stringent regulations targeting gas flaring, fugitive emissions, and abandoned oil wells. These regulations must set clear standards for methane emissions, supported by penalties for non-compliance to encourage adherence. Additionally, the government should create incentives for companies that adopt methane capture technologies, such as tax breaks or grants for implementing innovative solutions. This approach can motivate the private sector to invest in cleaner technologies. Monitoring and reporting mechanisms are essential for effective policy implementation. Establishing a national methane emissions inventory can help track progress and identify sources of emissions that need immediate attention. Regularly updated reports can provide transparency and help the public understand how policies are impacting methane emissions. Utilizing both satellite data and ground-based monitoring can enhance the accuracy of these inventories. By making data publicly available, you can foster accountability among stakeholders, ensuring that all parties take their responsibilities seriously. Finally, education and outreach should be a central focus

of methane-related policies. The government and NGOs can collaborate to promote awareness about methane emissions and their impact on health and the environment. Public campaigns can inform stakeholders about best practices for reducing emissions and the benefits of adopting cleaner technologies. By creating a culture of sustainability and environmental responsibility, you can build a community that actively supports methane reduction initiatives.

Table 9: Policy Components for Methane Emission Reductions in Nigeria

Sector	Policy Component	Implementation Strategy
Energy	Enforce stricter flaring regulations, incentivize capture	Tax incentives for methane capture technologies
Agriculture	Promote methane-reducing agricultural practices	Subsidies for sustainable farming and manure management
Waste	Improve waste management policies	Incentivize methane capture in landfills and wastewater

Adapted from FME [50]

Table 9 summarizes the necessary policy components for reducing methane emissions in Nigeria across different sectors.

11. Example of Policy Statements: National and Global

A comprehensive national policy statement could read: “Nigeria commits to reducing methane emissions from the oil and gas sector by 50% by 2030, with specific targets for eliminating gas flaring and addressing fugitive emissions. This will involve enhancing regulatory frameworks, investing in monitoring technologies, and collaborating with local communities to develop effective mitigation strategies.” Such a statement outlines clear goals and accountability measures that engage multiple stakeholders, from government agencies to local communities. On a global scale, the policy statement could be: “Countries participating in the Global Methane Pledge aim to collectively reduce methane emissions by 30% by 2030 from 2020 levels. This includes promoting technological innovations, sharing best practices, and providing funding mechanisms to support developing nations in achieving their methane reduction targets.” This global commitment fosters collaboration among countries,

reinforcing the need for a unified approach to tackle methane emissions and climate change. By clearly articulating both national and global policy goals, you can create frameworks that guide actions across various levels. These policies can serve as a blueprint for addressing methane emissions effectively, aligning local initiatives with international commitments.

12. Significance Statement

The significance of reducing methane emissions in Nigeria, particularly in the Niger Delta, extends beyond local communities to global climate change efforts. Methane is a powerful greenhouse gas that significantly contributes to global warming. Addressing emissions in the Niger Delta is essential for implementing effective strategies that target this issue within a broader context. Focusing on this region allows for the development of targeted interventions that not only enhance local environmental quality but also align with global climate objectives. Additionally, reducing methane emissions in the Niger Delta is vital for improving public health and promoting environmental justice. High methane levels, coupled with related pollutants, can lead to respiratory problems and impact the overall quality of life for local residents. Engaging communities and investing in cleaner technologies can foster healthier living conditions while supporting global climate mitigation initiatives. This integrated approach highlights the importance of prioritizing both environmental sustainability and public health within the institutional framework for methane emissions reduction in Nigeria. Thus, graphically it is represented (Figure 2 & 3) as:

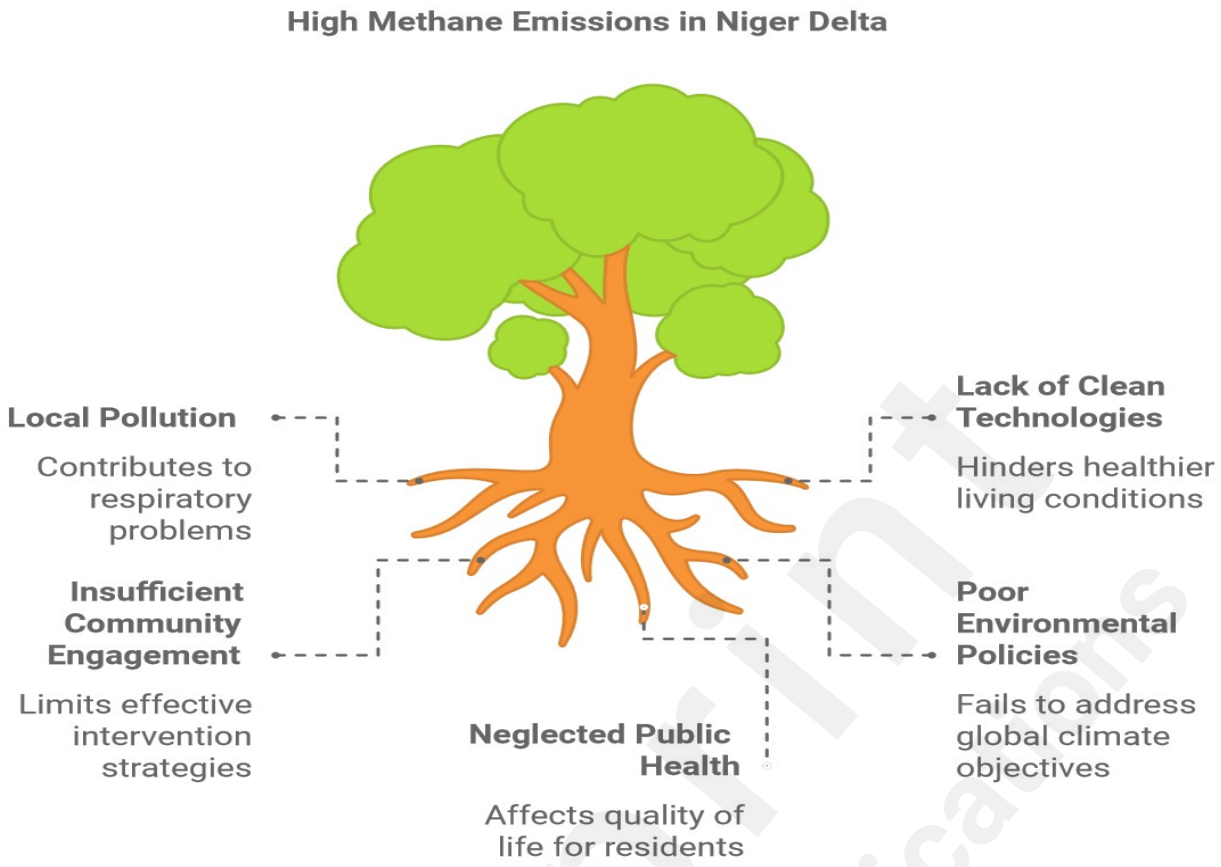

Figure 2: High Methane Emission in the Niger Delta

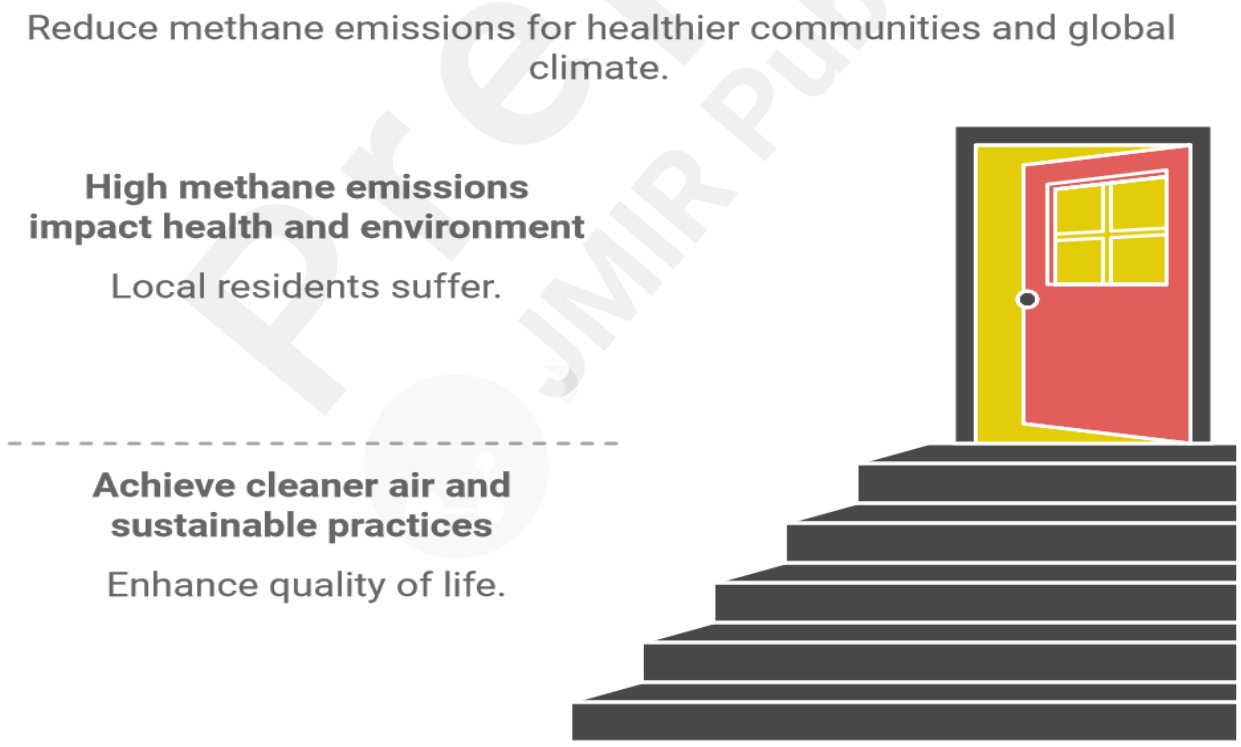

Figure 3: Reduce Methane Emission for Healthier Communities and Global Climate

13. Conclusion

In conclusion, Nigeria faces significant challenges in addressing methane emissions,

particularly in the Niger Delta, where oil and gas extraction activities are prevalent. The inconsistencies in emissions data and limited monitoring efforts highlight the urgent need for a robust institutional framework to effectively tackle these issues. A collaborative approach among stakeholders, including government agencies, funding organizations, and research institutions, is essential for developing actionable strategies centered on effective policies that enforce emissions reductions and promote transparency. The insights from the NiMERP program provide a detailed understanding of methane emissions across the energy, agriculture, and waste sectors, laying the groundwork for targeted mitigation efforts. Reducing methane emissions is not only a national imperative but also a global responsibility, given methane's significant short-term global warming potential. By adopting advanced monitoring technologies and engaging local communities, Nigeria can effectively mitigate methane emissions while enhancing public health and environmental outcomes. The proposed national and global policy statements can set clear targets and promote accountability among all parties involved. Moving forward, the success of these efforts will depend on ongoing collaboration between national stakeholders and international partners, as well as the integration of technologies such as UAVs, infrared cameras, and satellite data for accurate monitoring. By working together to address methane emissions in the Niger Delta, you can contribute not only to climate change mitigation but also to fostering a healthier and more sustainable future for the region. The reductions achieved through targeted strategies will have a significant impact on global efforts to curb climate change, particularly in the near term. Ultimately, the actions taken in Nigeria can serve as a model for other countries in the Global South facing similar challenges in addressing methane emissions. Leveraging the momentum generated by the NiMERP program, Nigeria has the opportunity to significantly reduce its methane footprint and contribute to global climate change mitigation efforts in the years to come.

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