



Journal of Applied Sciences

ISSN 1812-5654

science
alert

ANSI*net*
an open access publisher
<http://ansinet.com>



Review Article

Associated Gas Flaring as a Factor of Dwindling Ecological Integrity in the Niger Delta Region of Nigeria

¹Onyenenwa Cyprian Eneh and ²Smart Ndubisi Uchegbu

¹Institute for Development Studies, Enugu Campus, University of Nigeria, Nsukka, Nigeria

²Department of Urban and Regional Planning, Enugu Campus, University of Nigeria, Nsukka, Nigeria

Abstract

The petroleum-rich River Niger Delta Region of Nigeria has been subject to crude oil exploration since 1958 after the mineral oil was found in commercial quantity in 1956 in Oloibiri in the present Bayelsa State of Nigeria. Petroleum exploration activities, including associated gas flaring, occasion environmental degradation and the attendant dwindling ecological integrity of the region's ecosystem. The review recommends, among others, enactment and enforcement of appropriate bills, remediation projects and explorer-responsibility.

Key words: Petroleum exploration, gas flaring, environmental pollution and degradation, dwindling ecological integrity, remediation, explorer-responsibility, flora and fauna

Citation: Eneh, O.C. and S.N. Uchegbu, 2023. Associated gas flaring as a factor of dwindling ecological integrity in the Niger Delta Region of Nigeria. *J. Appl. Sci.*, 23: 11-15.

Corresponding Author: Onyenenwa Cyprian Eneh, Institute for Development Studies, Enugu Campus, University of Nigeria, Nsukka
Tel: 234-803-338-7472

Copyright: © 2023 Onyenenwa Cyprian Eneh and Smart Ndubisi Uchegbu. This is an open access article distributed under the terms of the creative commons attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

A clean environment is crucial to the well-being of the population because it limits infections, improves self-confidence and leads to higher productivity and a sense of propriety^{1,2}. Petroleum exploration activities, including the flaring of the natural gas associated with petroleum deposits, destroy the ecosystem and the ecological integrity of the River Niger Delta Region of Nigeria. Reviews on this important issue need to be gathered, updated and strengthened to make a case for policies to bring to an end the unsustainable practise of gas flaring. This was the object of this study.

Hogan² submitted that the River Niger Delta Region is on the Gulf of Guinea on the Atlantic Ocean in Nigeria, located within nine southern states: Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and Rivers. Eman³ submits that between 1885 and 1893, the Niger Delta Region was the British Oil Rivers Protectorate known for the production of palm oil. It was then expanded and renamed the Niger Coast Protectorate. Covered in the region are four ecological zones: Coastal barrier islands, mangrove swamp forests, freshwater swamps and lowland rainforests. The region occupies 20,000 km², out of the 70,000 km² of wetlands formed primarily by sedimenting deposition. Being the largest wetland, it makes up 7.5% of Nigeria's total land mass and maintains the third largest drainage basin in Africa. Its population is 20 million people of 40 different ethnic groups. Naturally, it has one of the highest concentrations of biodiversity in the world, within an ecosystem supporting abundant flora and fauna, arable terrain and species of freshwater fish. Since the 1960s, petroleum from the region has remained the mainstay of the Nigerian economy.

Ecosystem or ecological integrity, according to Reza and Abdullah⁴ and Tierney *et al.*⁵, is the ability of the ecologic system to support and maintain a community of species as though in the natural habitats within the region. Dwindling ecologic integrity is attributable to a variety of factors. They include (a) Disturbances such as fire, flood, drought and insects or disease outbreaks, (b) Use of land for development, resources and recreation and (c) The spread of new elements such as pollutants and strange plants and animals. Ecological integrity is critical to the sustainability of environmental

systems, as degradation of ecosystems destabilizes and disorganizes a region's natural habitats and resources and renders them unable to recover and maintain selves. Global ecological integrity, which includes the health of ecosystems and climate change, is a paramount determinant of public health.

Gas flaring and dwindling ecological integrity in the River Niger Delta Region of Nigeria: Wurtzebach and Schultz⁶

opined that crude oil and associated natural gas often exist as joint deposits. Due to a lack of infrastructure to explore the associated gas (AG), oil explorers prefer to tap the oil deposits, but flare the AG. Since 1958, crude oil has been explored in the River Niger Delta Region of Nigeria, after crude oil was found in commercial quantity in 1956 in Oloibiri in the present Bayelsa State of Nigeria. The activity soon spread rapidly to other states in the region.

Ite and Ibok⁷ reported that AG flaring goes alongside crude oil exploration. Nigeria is second to Russia in the amount of gas flared. In the process, Nigeria and Russia release yearly about 110 million metric tons of carbon dioxide. This constitutes about 0.5% of global carbon dioxide emission, which is a major driver of climate change. In 2005, 2.5 billion ft³ of AG was flared every day in the Niger Delta Region of Nigeria. The Nigerian Senate observed that Nigeria accounted for 40% of total gas flared in Africa.

The volume of AG utilized and flared in the Ijaw area of the River Niger Delta Region of Nigeria between 2003 and 2012 is shown in Table 1.

Ajugwo⁸ and Ibitoye¹⁰ observed that about 77.8% of AG produced from Nigerian oil fields are flared. Gas flaring is a combination of two, out of three, factors that adversely affect ecological integrity. First, it is a disturbance of natural processes by burning with fire. Second, it also pollutes the air and natural environment by emitting noxious gaseous products from the burning process and consequently affecting the quality of life and reducing human well-being. Flaring of Nigeria's gas contributes significantly to the world's carbon dioxide emission. Eneh¹¹, Eneh¹² and Ishaku *et al.*¹³ submit that pollution affects urban and rural drinking water supply and open space for socio-economic development.

Table 1: NNPC 2011-gas utilized and flared in the Ijaw area between 2003 and 2012

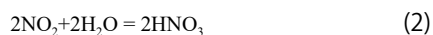
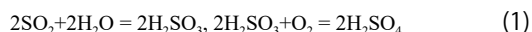
Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Gas utilized (mm ³)	10,000	15,000	34,000	36,000	39,000	41,000	47,000	52,000	55,000	59,000
Gas flared (mm ³)	30,000	50,000	23,000	28,000	25,000	15,000	12,000	10,000	7,000	5,000

Adapted from Ajugwo⁸ and Giwa *et al.*⁹

This unsustainable activity impacts negatively future generations by compromising their ability to meet their needs. The Brundtland criterion affirms the importance of human well-being and responsibility to future generations. Shockley¹⁴ asserts that, like the present generation, the future generations have the right to breathe clean air. This right ought not to be infringed upon, nor can the infringement be by improving other dimensions of well-being. Things of value ought to be calibrated on varying scales. People ought to be free to make value judgments on environmental changes. Ethical objectives include the right to a clean and safe environment. It is a meagre view of humanity to see people in terms of just their needs. Every species ought to be preserved, regardless of whether they serve any practical human needs. Environmental quality is not a means to other ends, but an end in itself.

Ishaku *et al.*¹³ noted that gas flaring causes global warming and contributes to climate change, with serious implications for Nigeria and the rest of the world. According to the Intergovernmental Panel on Climate Change (IPCC), global warming will get worse in the 21st century. Africa is highly vulnerable to climate change and has a low resilience capacity and limited ability to adapt.

According to Eneh¹⁵, gas flaring specifically emits sulphur dioxide (SO₂) and nitrogen oxides. Both gases combine with atmospheric moisture to form sulphuric acid (Eq. 1) and nitric acid (Eq. 2), respectively:



These acids acidify rainwater (to form acid rain). They also acidify lakes and streams. The acidification poisons domestic water sources, aquatic livestock and wildlife, as well as damage vegetation. Gas flaring also releases atmospheric contaminants, such as oxides of nitrogen (NO, N₂O and NO₂), carbon (CO₂ and CO) and sulphur (SO and SO₂), as well as particulate matter, hydrocarbons and ash, photochemical oxidants and hydrogen sulphide (H₂S). By acidifying the soil, these contaminants deplete soil nutrients, thereby diminishing the nutritional values of crops. Gas flaring also produces tremendous heat that clears vegetation in surrounding areas of the flare. By corroding corrugated roofs, through the emission of oxides of sulphur and nitrogen and the formation of acid rain, AG flaring occasions economic wastes. Furthermore, much of the gas flared can be channelled to electricity generation and domestic use or sold to fetch the nation some billions of dollars on daily basis.

Aside from degrading visibility, sulphates and nitrates are potentially harmful and therefore, pose public health risks.

Incomplete combustion during gas flaring emits hazardous air pollutants with serious implications for human health, including cancer, neurological disorder, reproductive and developmental effects, as well as deformities in children, lung damage and skin problems. Hydrocarbon compounds, such as benzene, naphthalene, styrene, toluene and xylene, also released during gas flaring, affect haematological parameters that can negatively impact blood and blood-forming cells and also give rise to pneumonia, anaemia and leukaemia. Air pollution by gas flaring leads to suffocation and irritation of the eye, lungs, skin and respiratory system.

Obi *et al.*¹⁶ and Eneh¹⁷ observed that flaring has impoverished host communities, with attendant environmental, economic and health challenges. Soil contamination by oil spills and leaks, increased deforestation, as well as economic loss and environmental degradation, abound. About 5-10% of Nigerian mangrove forests and ecosystems have been wiped out in the Niger Delta Region of Nigeria. A year's supply of food can be destroyed instantaneously. The environment in the region is increasingly uninhabitable. The population suffers dwindling quality of life and loss of basic human rights, such as health, access to food, clean water and the ability to work.

Weak legal infrastructure for gas flaring in Nigeria:

Legislations to curb gas flaring in Nigeria since 1969 notwithstanding, successive governments lack the political will to enforce them through compromised law enforcement institutions. Fuelling concerns point to a lack of seriousness on the part of the government to curb gas flaring. Eneh and Agbazue¹⁸ observed that Nigerian laws are dated, fragmented, absent and/or poorly implemented. Eneh¹⁹ observed that the draft petroleum industry bill (PIB) proposes that "natural gas shall not be flared or vented after 31st December, 2012, in any oil and gas production operation, block or field, onshore or offshore or gas facility, except under exceptional and temporary circumstances". Governmental politics is lacking and preventive and remediation actions are at large. The Nigerian Government is interested mainly to maximize economic and political profits from oil production, rather than caring about the resulting damage to the environment and human health. Moreso, the compradors reside with their families in Abuja—far away from the environmentally degraded Niger Delta Region. Again, it is more convenient for oil companies to pay or evade the insignificant fine for AG flaring than to re-inject the gas back into the oil wells or seek the economic incentive to collect the gas. In all this mess, the victims are rural dwellers, who constitute about 80% of the Nigerian population.

Human rights contradictions and violations amidst sanctity of life, social contract and corporate social responsibility:

The pro-life theorists reject abortion, contraception, euthanasia, embryonic stem-cell research and the 'right to die on the ground that human life is sacred and holy and precious. In ethics and religion, the sanctity of life demands that sentient life should be held as holy and sacred, with the implied principle of protection from violation. If anything, this principle is neglected in the oil and gas operations in the Niger Delta Region of Nigeria¹³.

Social contract vests human life protection on government. Eneh²⁰ noted that the general feature of the social contract theory is unrestricted personal freedom which the individuals surrender to the government to ensure the safety of their lives and private property and other personal rights. Notwithstanding, oil operation in the Niger Delta Region of Nigeria ignores this contract and freely unleashes untold ecological damages to present and future generations of the citizenry, while the government consents and claps for it and supervises the destructions that negate the principles of sustainable development.

Corporate social responsibility demands that corporations ought to improve and not impair the well-being of dwellers in host communities. Yet, gas flaring remains environmental harms, health hazards and risks and economic losses perpetrated by oil exploring corporations in collusion with host governments and the compradors whose priority is to protect their economic interests and thereby perpetuate underdevelopment and poverty in the Niger Delta Region of Nigeria for both the present and future generations of its inhabitants. Eneh²¹ observed that external and internal operations of the Neoclassical Dependence Model of development widen crippling poverty in the Niger Delta Region of Nigeria. At the external level, the rich countries (the "centre") that own the oil and gas corporations in Nigeria use and reward the "comprador elite groups" in the Nigerian host country to protect their economic interests and thereby, perpetuate underdevelopment and poverty in the region through the unlevelled ground of play between the rich countries and the Federal Government of Nigeria (FGN). At the internal level, the FGN plays the role of the "centre" (or the Government at the centre) in using and rewarding the "comprador elite groups" of the Niger Delta Region to protect its economic interests through the unlevelled ground of play between the FGN and the Niger Delta inhabitants and thereby perpetuate underdevelopment and poverty in the region.

Government and its institutions need to get the oil exploration organizations to meet their environmental commitments or be shut down. Legal infrastructure needs to be created where they are lacking, updated where they are obsolete and inculcated and implemented by reinforced

appropriate institutions. The government needs to give priority attention to remediation projects. Lip service at the expense of life ought to be avoided, to give way to actions that go beyond the rhetoric and defensive realm. Cultivation of an ethic of moral responsibility to other people is crucial to safeguarding the natural environment, particularly when future generations will bear the brunt of environmental harm. A balanced relationship between nature and fellow humans is urgently required.

CONCLUSION

Several environmental, socio-economic and political problems in the River Niger Delta Region of Nigeria are direct consequences of petroleum exploitation and production in the crude oil-rich region. In particular, gas flaring causes severe environmental pollution and degradation and loss of biodiversity and ecological integrity, as well as revenue. Removal of vegetation to make way for seismic lines and sites increases deforestation, environmental degradation and economic losses. Oil spills and leaks contaminate arable soil, while both surface and groundwater are contaminated by hydrocarbons (benzene, xylene, toluene and ethylbenzene) released by gas flaring.

SIGNIFICANCE STATEMENT

The paper gathers, updates and strengthens existing reviews to make a case for policies to bring to an end the unsustainable practise of gas flaring which leads to several environmental, socio-economic and political problems in the crude oil-rich and petroleum exploitation and production Niger Delta Region of Nigeria. The article also highlights severe environmental pollution and degradation, loss of biodiversity and ecological integrity and loss of revenue as consequences of gas flaring, which also leads to the removal of vegetation to create seismic lines, deforestation, environmental degradation, economic losses, contamination of arable soil by oil spills and leaks and contamination of both surface and groundwater by hydrocarbons released by gas flaring.

REFERENCES

1. Hendryx, M., M.M. Ahern and K.J. Zullig, 2013. Improving the environmental quality component of the county health rankings model. *Am. J. Public Health*, 103: 727-732.
2. Afinotan, L.A. and V. Ojatorotu, 2009. The Niger Delta crisis: Issues, challenges and prospects. *Afr. J. Political Sci. Int. Relations*, 3: 191-198.
3. Emam, E.A., 2015. Gas flaring in industry: An overview. *Pet. Coal*, 57: 532-555.

4. Reza, M.I.H. and S.A. Abdullah, 2011. Regional index of ecological integrity: A need for sustainable management of natural resources. *Ecol. Indic.*, 11: 220-229.
5. Tierney, G.L., D. Faber-Langendoen, B.R. Mitchell, W.G. Shriver and J.P. Gibbs, 2009. Monitoring and evaluating the ecological integrity of forest ecosystems. *Front. Ecol. Environ.*, 7: 308-316.
6. Wurtzebach, Z. and C. Schultz, 2016. Measuring ecological integrity: History, practical applications, and research opportunities. *BioScience*, 66: 446-457.
7. Ite, A.E. and U.J. Ibok, 2013. Gas flaring and venting associated with petroleum exploration and production in the Nigeria's Niger Delta. *Am. J. Environ. Prot.*, 1: 70-77.
8. Ajugwo, A.O., 2013. Negative effects of gas flaring: The Nigerian experience. *J. Environ. Pollut. Hum. Health*, 1: 6-8.
9. Giwa, S.O., O.O. Adama and O.O. Akinyemi, 2014. Baseline black carbon emissions for gas flaring in the Niger Delta Region of Nigeria. *J. Nat. Gas Sci. Eng.*, 20: 373-379.
10. Ibitoye, F.I., 2014. Ending natural gas flaring in Nigeria's oil fields. *J. Sustainable Dev.*, 7: 13-22.
11. Eneh, O.C., 2011. A review on petroleum: Source, uses, processing, products and the environment. *J. Appl. Sci.*, 11: 2084-2091.
12. Eneh, O.C., 2011. Effects of water and sanitation crisis on infants and under-five children in Africa. *J. Environ. Sci. Technol.*, 4: 103-111.
13. Ishaku, H.T., M.R. Majid, A.A. Ajayi and A. Haruna, 2011. Water supply dilemma in Nigerian rural communities: Looking towards the sky for an answer. *J. Water Resour. Prot.*, 3: 598-606.
14. Shockley, K., 2022. The environmental constituents of flourishing: Rethinking external goods and the ecological systems that provide them. *Ethics Policy Environ.*, 25: 1-20.
15. Eneh, O.C., 2021. Nagging food insecurity amidst numerous public agricultural policies, strategies, programmes and projects in Nigeria: Identifying and fixing the key issues. *Int. J. Environ. Agric. Biotechnol.*, 6: 103-112.
16. Obi, N., A. Akuirene, P. Bwititi, J. Adjene and E. Nwose, 2021. Impact of gas flaring on communities in Delta Region of Nigeria, narrative review part 1: Environmental health perspective. *Int. J. Sci. Rep.*, 7: 186-193.
17. Eneh, O.C., 2011. Environmental significance of the combustion of liquid petroleum fuels: A review. *J. Appl. Sci.*, 11: 2680-2685.
18. Eneh, O.C. and V.C. Agbazue, 2011. Protection of Nigeria's environment: A critical policy review. *J. Environ. Sci. Technol.*, 4: 490-497.
19. Eneh, O.C., 2011. Enhancing Africa's environmental management: Integrated pest management for minimization of agricultural pesticides pollution. *Res. J. Environ. Sci.*, 5: 521-529.
20. Eneh, O.C., 2011. Managing Nigeria's environment: The unresolved issues. *J. Environ. Sci. Technol.*, 4: 250-263.
21. Eneh, O.C., 2011. Crippling poverty amidst corporate social actions: A critique of peripheral corporate community involvement in the Niger Delta Region of Nigeria. *Asian J. Rural Dev.*, 1: 1-20.