



doi:10.5281/zenodo.14753089

# **Analysis of Risk and Risk Management Strategies in Nigeria's Oil and Gas Industry**

**Mark Abraham Enumah**

**Oil and Gas Management, School of Business Law, University of East London, United Kingdom  
Correspondence email address: [enumah.mark@yahoo.co.uk](mailto:enumah.mark@yahoo.co.uk)**

## **ABSTRACT**

The oil and gas industry in Nigeria, a critical driver of the nation's economy, is inherently exposed to numerous risks that threaten its stability, profitability, and sustainability. This paper explores the multifaceted risks confronting Nigeria's oil and gas sector and evaluates the effectiveness of current risk management strategies. The analysis categorizes risks into operational, financial, regulatory, environmental, geopolitical, and market-based challenges, each contributing to the sector's volatility. Key risks include oil theft, pipeline vandalism, fluctuating global oil prices, environmental hazards, regulatory inconsistencies, and security challenges in oil-producing regions. These risks not only impact production efficiency and revenue generation but also deter foreign and local investments, further exacerbating the sector's vulnerabilities. The study assesses risk management strategies employed by industry stakeholders, such as regulatory reforms, advanced surveillance technologies, and community engagement programs. Despite these efforts, implementation gaps, corruption, and inadequate funding often hinder their effectiveness. To address these challenges, the paper recommends a holistic risk management framework that integrates proactive measures, such as enhanced technological adoption, improved regulatory consistency, and robust contingency planning. Strengthening collaboration between government agencies, industry players, and host communities is emphasized to ensure a cohesive approach to mitigating risks. Additionally, the adoption of global best practices and diversification into renewable energy sources are highlighted as long-term solutions. By systematically analyzing risks and proposing targeted strategies, this paper aims to contribute to a more resilient and sustainable oil and gas industry in Nigeria, capable of navigating its complex risk landscape.

**Keywords:** Oil and gas, Midstream, Upstream, Downstream, Risk, Exploration

## **1.0 INTRODUCTION**

Oil and gas (O&G) sector is an essential industry to Nigeria's economic expansion, it has helped to lower poverty and brought about national development (Rui *et al.*, 2018). Oil and gas sector like other businesses or industries also face certain risk in their operations because risks are generally inevitable in any business operations (Yavorskyi *et al.*, 2017). The primary operational phases in the O&G industry in Nigeria are broadly categories into; upstream, midstream and downstream subsectors. According to Patidar *et al.* (2024), the upstream constitutes exploration and drilling, midstream involves conveying crude oil to refineries and storage while downstream involves distributions of finished products to the end consumers. At every phase of these operations, certain risks are involved, these risks involved in the Nigeria's O&G include; security policies, technology, pipeline vandalism, oil theft, lack of storage facilities and poor road infrastructure. For the purpose of this assessment, emphasis will be given on the upstream subsector.

Additionally, due to the complex nature of risk, humanity has continued to create strategies to minimize, if not completely eliminate risk that come with life and business at every stage of its evolution (Badida *et al.*, 2019). Although risks are not completely inevitable, economic damages resulting from risks can be minimized especially with carefully management strategies in place (Fan and Stevenson, 2018). Therefore, risk is considered as the range of potential outcomes, uncertainty and the possibility of harm or loss, or vulnerability to risk or loss due to business variances (Van Thuyet *et al.*, 2019). Although there will always be risk in business, managing it is crucial to reducing its frequency and effect to the lowest possible level. Therefore, the aim of this assessment is to analyze the risks and risk management strategies adopted by Nigeria's O&G industry in the midstream subsector.

## **2.0 Definitions and Analysis of Key Risk Associated with the Nigeria's O&G Industry**

The O&G industry in Nigeria like any other business or industry across the globe is faced with quite a number of risks, however for the purpose of this assessment, the risk involved in the midstream subsector will be considered. According to Patidar *et al.* (2024), the midstream O&G subsector is the phase of the industry that transports, stores, and distributes crude oil, natural gas, and refined products. Al-Janabi (2020) posited that the midstream O&G phase serves as a critical link between upstream (exploration and production) and downstream (refining and distribution). It transports and stores oil and natural gas via enormous networks of pipelines, railway lines, and storage facilities (Aniebo and Mogbo, 2024). The risk associated with the Nigeria's O&G midstream subsector can be summed-up and discussed under two main subheadings; they are environmental and logistics related risks.

### **2.1.1 Environmental related risks**

According to Oti *et al.* (2018), the term environmental risks in the context of the O&G midstream industry refers to the possible harm that the transportation, storage, and processing of natural gas, crude oil, and associated products may bring to the environment. Ukhurebor *et al.* (2021), state that the major risks associated with O&G midstream subsector mainly constitute oil spills, particularly during transportation and leaks due to infrastructural failure or intentional vandalism of pipelines. Oil spills can cause potential contamination to soil and water, and may sometimes causes explosions and fire outbreak (Adekola *et al.*, 2017). Additionally, the midstream subsector of the O&G industry is a potential source of air pollution which may affects human health, biodiversity and the ecosystem (Okotie *et al.*, 2018). When the movement of O&G products from production sites to refineries, involves barges, tankers and trucks, substantial number of emissions is release into the atmosphere during this process. The releases or emissions (greenhouse gases) causes climate change and air pollution in the surrounding environment (Okolie *et al.*, 2024).

Additionally, environmental hazards, land use changes, and potential geohazards all pose risks to this infrastructure, potentially disrupting operations, increasing costs, and endangering people's lives and the environment (Aniebo and Mogbo, 2024). Environmental damage brought on by pollutants and oil spills, as well as the host community conflicts that follow poses a potential risk to O&G firms (Ibikunle, 2024). Ecosystems are devastated and public health is put at risk by oil spills caused by pipeline breaks or sabotage which frequently results in demonstrations, legal action, and interruptions to operations (Onwurah and Obialor, 2023). For instance, in the year 2022 in Nigeria, the Nembe Creek oil leak occurred which had a major negative influence on surrounding ecosystems, populations and sparked widespread protests (Akeju and Oguntimein, 2023). Comparable to Ecuador, where indigenous communities have obstructed oil pipelines due to worries about environmental damage and inadequate community benefits (Salazar-Bano *et al.*, 2024).

### **2.1.2 Logistic and policy related risks**

Logistic risk in the O&G sector refers to the possible dangers and obstacles connected with transporting, storing, and delivering equipment, materials, and products required for the industry's operations (Lu *et al.*, 2019). These risks can interrupt supply chain, result in financial losses, or pose safety and environmental problems. Given Nigeria's position as a major oil producer in Sub-Saharan Africa, logistical risks pose considerable problems to the country's O&G industry (Graham and Ovadia, 2019). These risks stem from a combination of infrastructural deficiencies, security issues, and regulatory complexities (Rui *et al.*,

2018). One major concern is inadequate transportation infrastructure, poorly maintained roads, limited rail networks, and ageing pipelines all impede the effective movement of O&G products, resulting in delays and higher prices (Sakib, 2021).

Furthermore, the reliance on offshore production demands strong marine logistics, which are frequently disrupted by piracy in the Gulf of Guinea and other waterways, endangering the safety of personnel and cargoes (Woldesellasse and Tesfamariam, 2023). Storage concerns are also common, insufficient or antiquated storage facilities can result in spills, pollution, or losses, which are aggravated by Nigeria's tropical heat also necessitates meticulous care (Merem *et al.*, 2017). Moreover, pipeline theft and vandalism, which has long been a concern in the Niger Delta (the oil producing host community) poses a risk which result in considerable product losses and environmental damage (Panle, 2024). Crude oil theft in Nigeria is among the worst in the world, which increases losses and security risks in the midstream industry, this problem is exacerbated by insufficient enforcement and monitoring (Wizor and Wali, 2020). For instance, Nigeria's O&G industry lost billions of dollars in revenue in 2022 as a result of theft that caused the Trans Niger Pipeline, a vital oil export route, to be regularly shut down (Romsom, 2022). Like the fuel theft on Pemex-managed pipelines which have been a major problem for Mexico's midstream businesses worldwide (Gomez Balboa, 2018).

Additionally, regulatory concerns also exacerbate these risks, inefficient customs procedures, uneven policies, and bureaucratic delays all contribute to bottlenecks in the supply chain which in turn constitute a potential risk in the Nigeria's O&G industry (Patterson *et al.*, 2017). From the above, it can be concluded that the O&G industry in Nigeria faces potential risks from logistics, oil theft, pipeline vandalism and inconsistent regulations. These risks can potentially affect their operations which also have a great influence on the supply chain and profitability of the O&G industries. Therefore, to mitigate the above-mentioned risks, proactive risks management strategies need to be provided which are going to discuss in the subsequent subheadings.

## **2.2 Discussion on the Risks Management Strategies Adopted by O&G industry in Nigeria**

Fan and Stevenson (2018) defined risk management strategies as a firm's strategy for identifying, evaluating, responding to, monitoring, and controlling risks within a certain category. It comprises risk management-related procedures, risk tolerance levels, policies, decision-making standards, and information flows (Ojuekaiye, 2024). As discussed earlier in the previous section, the major potentials risks facing the midstream subsector of the O&G industry in Nigeria are grouped into; logistic and environmental related risks. There are quite a number of strategies that may be utilized by O&G industry in Nigeria to mitigate risks in the midstream subsector. Therefore, to mitigate logistics risk in the midstream O&G industry even though risk mitigation calls for a multifaceted strategy. Rahman *et al.* (2019) noted that investing in new refineries, storage facilities, and pipelines strengthens infrastructure and lowers inefficiencies and interruptions. According to Emelu *et al.* (2021), vandalism and oil theft can be discouraged by improved security measures including surveillance drones, leak detection systems, and the use of surveillance personnel. Bakreski (2018) also emphasize that strong cooperation between local security forces and private security companies is essential to reducing security risk. While Ojuekaiye *et al.* (2024) advocates the use of cutting-edge security technology and staff training, as well as interacting with specific residents and community stakeholders, as way to foster trust and lessen conflict. However, Bello *et al.* (2023) suggest that artificial intelligence (AI) and robotics have emerged as crucial technology for pipeline monitoring in recent years. Because they enable operators to perform assessments remotely and without interfering with pipeline operations, robotic inspection devices are especially useful in dangerous or hard-to-reach locations. While Eissa (2020), proposes that effective use of big data analytics in midstream O&G operations can maximizes profitability, minimizes idle time, increases efficiency and reduces risks. From the foregoing, it can be concluded that deploying technology can be utilized to reduce risks of oil theft, pipeline vandalism, and provide data for decision making. However, the use of these technologies in Nigerian O&G midstream sector is low, pipeline security contracts are mostly awarded to private individuals and security forces who sometimes collaborates and engage in oil theft and pipeline vandalism themselves.

Furthermore, environmental risks can be mitigated by investing in clean technology and sustainable practices, conducting thorough environmental impact assessments that include action steps to be implemented, mitigation plans, and participating in corporate social responsibility programs to address persistent environmental concerns are all ways that risk managers can deploy to reduce environmental risk management in the O&G midstream subsector (Landi *et al.*, 2022). Programs for community engagement that guarantee equitable remuneration, the development of jobs, and environmental restoration foster trust and lessen social discontent (Erakpotobo and Omo, 2022). Implementing cleaner technology and cutting-edge environmental protections reduces spills and harmonizes operations with international sustainability requirements can also be utilize to reduce environmental risks.

### **2.3 Application of Technology in Risk Management Strategies in the O&G Industry in Nigeria**

Nigeria's O&G sector is a vital component of the country's economy, making a substantial contribution to both its GDP and foreign exchange profits (Ikein, 2017). Complex risks, such as operational dangers, environmental difficulties, market instability, and problems with regulatory compliance, are present in this industry (Agness, 2022). Technology has become a revolutionary instrument in risk management strategies to tackle these complex issues (Lu *et al.*, 2019). The sector may more efficiently identify, evaluate, and reduce risks by utilizing cutting-edge technology like artificial intelligence (AI), the Internet of Things (IoT), geospatial systems, and predictive analytics (Elijah *et al.*, 2021). In one of the most active O&G markets in the world, this integration not only improves operational efficiency and safety but also guarantees environmental sustainability and regulatory compliance (Akinwale *et al.*, 2018). Although technology such as drones, LiDER (Light Detection and Ranging) have been effective in managing pipelines leaks and damages (Day, 2017; Marathe, 2018). However, findings revealed that pipelines surveillance in Nigerian O&G industry are usually carried out by private individuals' security firms and Nigerian military who sometimes collaborate and engaged in oil theft themselves (Tade and Ayodele, 2018). Additionally, in order to combat recurring risks of vandalism, oil theft, and sabotage, the Nigerian government and oil firms have turned to pipeline surveillance contracts as a key management strategy (Adibe *et al.*, 2024). To monitor and safeguard pipelines, these contracts usually entail hiring private security companies, local communities, or former militia organizations (Okafor and Olaniyan, 2017). Although this strategy has showed some potential, its efficacy depends on a number of elements, such as implementation, supervision, and the larger sociopolitical context (Iwuoha, 2024). The pipeline surveillance contracts also lack transparency and thus drawn criticism and the claims of favouritism and inflated contracts damage the program's reputation. While some contractors are suspected of protecting illicit activities rather than stopping them, which has led to accusations of complicity in oil theft (Iwuoha, 2024). From the above, it can be concluded that deployment of technology has emerged as sustainable and effective way of risk management strategy in the oil and gas sector however, the adoption and application of these cutting-edge technology in the oil and gas midstream subsector in Nigerian oil and gas industry is limited.

### **3.1 CONCLUSIONS**

The Nigeria's O&G industry serves as an important sector that contribute to the countries' GDP and foreign exchanges earnings. However, the midstream subsector of the industry faces a variety of risks, ranging from infrastructure deficiencies to regulatory uncertainty; logistics and environmental concerns were identified as the major risks facing the O&G industry. Additionally, O&G companies operating in Nigeria face a variety of risks due to the country's complex and unpredictable operating environment. In order to survive and prosper in this difficult environment, these companies use a variety of risk management strategies that are specific to the risks they face. The O&G industry in Nigeria depends on the effective management of political, security, environmental, and economic risks.

To address these risks, strong government policies, targeted investments, and community collaboration are all required. Also, the use of cutting-edge technology such as internet of things, geospatial systems, data analytics can be used to enhance, mitigate or reduces all forms of risks involved in the midstream subsector of the O&G in Nigeria.

### 3.2 RECOMMENDATIONS

Based on this study, the following measures were suggested, O&G industry in Nigeria should;

- i. Repeatedly recognize potential risks, put in place strategies to address the risks, review and update their risks management strategies.
- ii. Revolutionize the midstream O&G subsector using cutting edge technology such as internet of things, Big data, surveillance drones etc.
- iii. Formulate and review a comprehensive law on oil pipeline security; a review of pertinent laws pertaining to Nigerian oil pipeline security;
- iv. Provide adequate funding for the security agencies tasked with managing and protecting the pipelines to ensure their productivity;
- v. Engage in a complete overhaul of the security apparatus established to protect Nigerian oil pipelines by taking a long-term and strategic approach to addressing oil pipeline insecurity

### 4.0 REFERENCES

- Adekola, J., Fischbacher-Smith, M., Fischbacher-Smith, D. and Adekola, O. (2017) Health risks from environmental degradation in the Niger Delta, Nigeria. *Environment and Planning C: Politics and Space*, 35(2), pp.334-354.
- Adibe, R., Nwagwu, E. and Albert, O. (2024) Rentierism and security privatization in the Nigerian petroleum industry: assessment of oil pipeline surveillance and protection contracts (2018). In *Capitalism and Economic Crime in Africa* (pp. 431-439). Routledge.
- Agnes, K. (2022) An Analysis of the Legal Framework Relating to Risk Management and Project Performance in Midstream Activities of Oil and Gas Industry in Uganda (Doctoral dissertation, Institute of Petroleum Studies-Kampala).
- Akeju, F.B. and Oguntimein, G.B. (2023) Environmental Impact of Oil Exploration in Nigeria: A Case Study of Nembe Local Government. *International Journal of Research and Innovation in Applied Science*, 8(9), pp.75-89.
- Akinwale, Y.O., Akinbami, J.F.K. and Akarakiri, J.B. (2018). Factors influencing technology and innovation capability in the Nigerian indigenous oil firms. *International Journal of Business Innovation and Research*, 15(2), pp.247-268.
- Al-Janabi, Y.T. (2020) An overview of corrosion in oil and gas industry: upstream, midstream, and downstream sectors. *Corrosion inhibitors in the oil and gas industry*, pp.1-39.
- Aniebo, I.N. and Mogbo, O. (2024) Energy Economics of Midstream and Downstream Petroleum Sectors in Nigeria: A Review of Potential Optimizations. In *SPE Nigeria Annual International Conference and Exhibition* (p. D031S015R003). SPE.
- Aniebo, I.N. and Mogbo, O. (2024) Energy Economics of Midstream and Downstream Petroleum Sectors in Nigeria: A Review of Potential Optimizations. In *SPE Nigeria Annual International Conference and Exhibition* (p. D031S015R003). SPE.
- Badida, P., Balasubramaniam, Y. and Jayaprakash, J. (2019) Risk evaluation of oil and natural gas pipelines due to natural hazards using fuzzy fault tree analysis. *Journal of Natural Gas Science and Engineering*, 66, pp.284-292.
- Bello, S., Amadi, M.D. and Rawayau, A.H. (2023) Internet of Things-Based Wireless Sensor Network System for Early Detection and Prevention of Vandalism/Leakage on Pipeline Installations in The Oil and Gas Industry in Nigeria. *Fudma journal of sciences*, 7(5), pp.240-246.
- Day, D. (2017) Drones for transmission infrastructure inspection and mapping improve efficiency. *Natural Gas & Electricity*, 33(12), pp.7-11.
- Eissa, H. (2020) Unleashing industry 4.0 opportunities: Big data analytics in the midstream oil & gas sector. In *International Petroleum Technology Conference* (p. D033S076R002). IPTC.
- Elijah, O., Ling, P.A., Rahim, S.K.A., Geok, T.K., Arsad, A., Kadir, E.A., Abdurrahman, M., Junin, R., Agi, A. and Abdulfatah, M.Y. (2021) A survey on industry 4.0 for the oil and gas industry: upstream sector. *IEEE Access*, 9, pp.144438-144468.

- Emelu, V.O., Eludoyin, O.S. and Oyegun, C.U. (2021) Preparedness and Mitigation Measures for Oil and Gas Pipeline Vandalization in the Niger Delta Region of Nigeria. *Environmental Management and Sustainable Development*, 10(4), pp.16-28.
- Erakpotobo, V.O. and Omo, O.K.E.I. (2022) The Mitigating Effect of Supply Chain Risk Management in Marginal Field Oil and Gas Companies in Nigeria. *International Journal of Research and Innovation in Social Science*, 6, pp.520-525.
- Fan, Y. and Stevenson, M. (2018) A review of supply chain risk management: definition, theory, and research agenda", *International Journal of Physical Distribution and Logistics Management*, 48(3), pp. 205-230.
- Fan, Y. and Stevenson, M. (2018) A review of supply chain risk management: definition, theory, and research agenda. *International journal of physical distribution & logistics management*, 48(3), pp.205-230.
- Gomez Balboa, A. (2018). Hydrocarbon spills in continental waters: a new regulatory approach in light of Mexico's energy reform. M.Sc. thesis. University of Cambridge.
- Graham, E. and Ovadia, J.S. (2019) Oil exploration and production in Sub-Saharan Africa, 1990-present: Trends and developments. *The Extractive Industries and Society*, 6(2), pp.593-609.
- Ibikunle, J.B., 2024. Legal Perspectives on The Midstream Sector in Nigeria: Challenges and Opportunities for Sustainable Growth. *Legal Perspectives on The Midstream Sector in Nigeria: Challenges and Opportunities for Sustainable Growth (July 31, 2024)*.
- Ikein, A.A. (2017) Nigeria oil & external exposure: the crude gains and crude pains of crude export dependence economy. *The Business & Management Review*, 8(4), p.396.
- Iwuoha, V.C. (2021) Strategic Security Planning and Protection of Multinational Oil Pipeline Assets in the Niger Delta. *The International Journal of Intelligence, Security, and Public Affairs*, 23(3), pp.343-366.
- Landi, G.C., Iandolo, F., Renzi, A. and Rey, A. (2022) Embedding sustainability in risk management: The impact of environmental, social, and governance ratings on corporate financial risk. *Corporate Social Responsibility and Environmental Management*, 29(4), pp.1096-1107.
- Lu, H., Guo, L., Azimi, M. and Huang, K. (2019) Oil and Gas 4.0 era: A systematic review and outlook. *Computers in Industry*, 111, pp.68-90.
- Lu, H., Huang, K., Azimi, M. and Guo, L. (2019) Blockchain technology in the oil and gas industry: A review of applications, opportunities, challenges, and risks. *Ieee Access*, 7, pp.41426-41444.
- Marathe, S. (2019) Leveraging drone-based imaging technology for pipeline and RoU monitoring survey. In *SPE Asia Pacific Health, Safety, Security, Environment and Social Responsibility Symposium?* (p. D021S006R001). SPE.
- Merem, E.C., Twumasi, Y., Wesley, J., Isokpehi, P., Shenge, M., Fageir, S., Crisler, M., Romorno, C., Hines, A., Hirse, G. and Ochai, S. (2017) Assessing ecosystem liabilities of oil and gas activities in southern Nigeria. *Public Health Research*, 7(1), pp.3-26.
- Ojuekaiye, O.S. (2024) Petroleum Industry Value Chain Optimization: The Inevitability of Midstream and Downstream Development. Asset Management and Information. In *SPE Nigeria Annual International Conference and Exhibition* (p. D031S022R007). SPE.
- Okafor, A. and Olaniyan, A. (2017) Legal and institutional framework for promoting oil pipeline security in Nigeria. *Journal of Sustainable Development Law and Policy (The)*, 8(2), pp.209-224.
- Okolie, A.C., Ojialor, C., Adenusi, F. and Okeyode, A. (2024) Sustainable Safety and Environmental Protection Technologies in Oil and Gas Industry. *Asian Journal of Environment & Ecology*, 23(6), pp.21-29.
- Okotie, S., Ogarode, N.O. and Ikporo, B. (2018) The oil and gas industry and the Nigerian environment. In *The political ecology of oil and gas activities in the Nigerian aquatic ecosystem* (pp. 47-69). Academic Press.
- Onwurah, O.O. and Obialor, N.I. (2023) The Potentials of ADR for Corporate Remediation in the Midstream and Downstream Petroleum Sector of Nigeria.

- Oti, P.A. and Mbu-Ogar, G.B.M. (2018) Analysis of environmental and social disclosure and financial performance of selected quoted oil and gas companies in Nigeria (2012-2016). *Journal of Accounting and Financial Management ISSN*, 4(2), p.2018.
- Panle, R.A. (2024) Improving Supply Chain Strategies towards Mitigating the Effect of Crude Oil Theft and Pipeline Vandalism in the Nigerian Oil and Gas Industry: A Case Study of the Nigerian National Petroleum Corporation (NNPC). *Open Journal of Yangtze Oil and Gas*, 9(3), pp.75-93.
- Patidar, A.K., Agarwal, U., Das, U. and Choudhury, T. (2024) Understanding the Oil and Gas Sector and Its Processes: Upstream, Downstream. In *Understanding Data Analytics and Predictive Modelling in the Oil and Gas Industry* (pp. 1-20). CRC Press.
- Patterson, L.A., Konschnik, K.E., Wiseman, H., Fargione, J., Maloney, K.O., Kiesecker, J., Nicot, J.P., Baruch-Mordo, S., Entekin, S., Trainor, A. and Saiers, J.E. (2017) Unconventional oil and gas spills: risks, mitigation priorities, and state reporting requirements. *Environmental science & technology*, 51(5), pp.2563-2573.
- Rahman, M.S., Khan, F., Shaikh, A., Ahmed, S. and Imtiaz, S. (2019) Development of risk model for marine logistics support to offshore oil and gas operations in remote and harsh environments. *Ocean Engineering*, 174, pp.125-134.
- Romsom, E. (2022) *Global oil theft: impact and policy responses* (No. 2022/16). WIDER Working Paper.
- Rui, Z., Cui, K., Wang, X., Chun, J.H., Li, Y., Zhang, Z., Lu, J., Chen, G., Zhou, X. and Patil, S. (2018) A comprehensive investigation on performance of oil and gas development in Nigeria: Technical and non-technical analyses. *Energy*, 158, pp.666-680.
- Rui, Z., Cui, K., Wang, X., Chun, J.H., Li, Y., Zhang, Z., Lu, J., Chen, G., Zhou, X. and Patil, S. (2018) A comprehensive investigation on performance of oil and gas development in Nigeria: Technical and non-technical analyses. *Energy*, 158, pp.666-680.
- Sakib, S.M. (2021) The impact of oil and gas development on the landscape and surface in Nigeria. *Asian Pacific Journal of Environment and Cancer*, 4(1), 9-17.
- Salazar-Baño, A.G., Chas-Amil, M.L. and Soliño, M. (2024) The invisible risks of the trans-Ecuadorian oil pipeline system: An analysis of social preferences in Quito. *Resources Policy*, 94, p.105128.
- Tade, O. and Ayodele, A. (2019) Bleeding Nigeria through the Pipelines': Understanding Oil pipeline Vandalism in Arepo, Southwest Nigeria. *The Nigerian Journal of Sociology and Anthropology*, 17(1), pp.121-132.
- Ukhurebor, K.E., Athar, H., Adetunji, C.O., Aigbe, U.O., Onyancha, R.B. and Abifarin, O. (2021) Environmental implications of petroleum spillages in the Niger Delta region of Nigeria: a review. *Journal of Environmental Management*, 293, p.112872.
- Van Thuyet, N., Ogunlana, S.O. and Dey, P.K. (2019). Risk management in oil and gas construction projects in Vietnam. In *Risk Management in Engineering and Construction* (pp. 225-247). Routledge.
- Wizor, C.H. and Wali, E. (2020) Crude oil theft in the Niger Delta: the oil companies and host community's conundrum. *International Journal of Research and Scientific Innovation*, 6(1), pp.22-32.
- Woldesellasse, H. and Tesfamariam, S. (2023) Risk analysis of onshore oil and gas pipelines: Literature review and bibliometric analysis. *Journal of Infrastructure Intelligence and Resilience*, 2(4), 100052.
- Yavorskyi, A.V., Karpash, M.O., Zhovtulia, L.Y., Poberezhny, L.Y. and Maruschak, P.O. (2017) Safe operation of engineering structures in the oil and gas industry. *Journal of Natural Gas Science and Engineering*, 46, pp.289-295.