

IMPACT OF METERING PRACTICES ON OIL THEFT AND REVENUE LOSS IN NIGERIA

Dr. Joseph Dada Obele
Department of Marketing
Ignatius Ajuru University of Education, Port Harcourt, Rivers State, Nigeria

ABSTRACT

Oil metering inefficiencies in Nigeria contribute significantly to oil theft and revenue loss in the petroleum industry. This study investigated the adequacy and effectiveness of metering practices, their relationship with oil theft, and potential technological and policy interventions to improve accountability. A descriptive survey design was adopted, with 384 respondents drawn from oil sector personnel using stratified and simple random sampling techniques. Data were analyzed using frequencies, percentages, means, and standard deviations. Findings revealed that most respondents disagreed that current metering practices are adequate or effective, with deficiencies linked to increased oil theft and revenue loss. Respondents agreed that adopting modern metering technologies, strengthening institutional oversight, and implementing robust policy interventions could significantly improve petroleum accounting and reduce losses. The study concludes that comprehensive reforms combining technology, policy, and capacity building are crucial for enhancing accountability in Nigeria's oil sector.

Keywords: Oil metering, Oil theft, Revenue loss, Petroleum industry, Policy interventions, Technological measures, Nigeria

INTRODUCTION

Nigeria is one of the largest oil producers in Africa, contributing significantly to the global supply of crude oil and natural gas. Oil revenue accounts for over 70% of government earnings and more than 90% of foreign exchange income, making the petroleum industry the backbone of the national economy (Onoh, 2020). However, despite this centrality, the country has persistently faced challenges in managing its oil resources effectively. Among the most pressing of these challenges is oil theft, which has continued to erode government revenue and hamper national development.

A major contributor to the persistence of oil theft in Nigeria is the weakness of metering practices across the upstream and downstream sectors. Metering, which involves the accurate measurement of oil and gas volumes at different transfer and custody points, is crucial for accountability and revenue assurance (Obioma & Nwankwo, 2019). Inadequate, faulty, or poorly monitored metering systems create loopholes that enable illegal siphoning, underreporting, and diversion of petroleum products.

Oil theft in Nigeria takes various forms, including pipeline vandalism, illegal tapping, adulteration, and under-declaration of production volumes (Eze, 2021). These practices are facilitated in part by poor metering systems, which make it difficult to ascertain the exact quantity of oil produced, transported, and exported. Without precise measurement, the Nigerian government loses billions of dollars annually, funds that could have been invested in infrastructure, education, health, and poverty reduction programs.

Several studies have highlighted the magnitude of revenue loss due to oil theft. For instance, the Nigeria Extractive Industries Transparency Initiative (NEITI, 2019) estimated that the country lost about \$42 billion to crude oil theft and pipeline vandalism between 2009 and 2018. Weak metering practices were identified as a major enabler of this loss, as discrepancies between declared production and actual exports remained largely unresolved. This points to systemic weaknesses in the governance of oil metering infrastructure.

Effective metering systems are essential for detecting discrepancies in production and export figures, which can reveal theft or operational inefficiencies (Ovuakporaye & Uzochukwu, 2020). In

developed oil economies such as Norway and Saudi Arabia, advanced metering technologies and strict regulatory oversight ensure transparency and accountability. In contrast, Nigeria's reliance on outdated or manually operated meters undermines accurate measurement, creating opportunities for fraud and manipulation.

Moreover, the lack of adequate metering infrastructure has implications beyond revenue loss. It affects Nigeria's credibility in the international oil market, discourages investment, and worsens environmental degradation caused by unchecked oil theft and pipeline vandalism (Akinyemi & Usman, 2022). For an oil-dependent economy, such inefficiencies compromise fiscal stability and undermine long-term economic sustainability.

In recent years, the Nigerian government and oil companies have acknowledged the urgent need to strengthen metering practices. Efforts such as the Petroleum Industry Act (PIA) of 2021 emphasize transparency, accountability, and technological innovation in oil production monitoring (Okoye, 2022). However, implementation has been slow, and systemic challenges, including corruption, regulatory weakness, and lack of technical expertise, continue to limit progress.

The impact of poor metering practices extends to joint venture operations, where multinational oil companies and the Nigerian National Petroleum Company Limited (NNPCL) share revenue. Discrepancies in measurement not only reduce government earnings but also affect trust among partners, leading to disputes and inefficiencies in resource management (Ikelegbe & Uddin, 2021). Thus, effective metering is central to safeguarding both national and corporate interests.

Scholars argue that robust metering systems can significantly reduce oil theft and enhance revenue generation (Ogunlana, 2020). Technologies such as digital flow meters, satellite monitoring, and blockchain-based tracking are increasingly adopted globally to improve transparency. Nigeria's adoption of these technologies could help address its long-standing challenges with oil theft, but political will and institutional reforms remain critical.

Therefore, examining the impact of metering practices on oil theft and revenue loss in Nigeria is timely and essential. It provides insight into the gaps within Nigeria's oil governance framework and highlights how technological, institutional, and policy reforms in metering can curb losses, strengthen accountability, and boost national revenue for sustainable development.

Statement of the Problem

Nigeria, despite being Africa's largest oil producer, continues to face persistent oil theft and massive revenue losses that threaten its economic stability. Between 2009 and 2018, the country lost an estimated \$42 billion to crude oil theft and pipeline vandalism, with weak metering practices identified as a major enabler (NEITI, 2019). The absence of accurate, transparent, and reliable metering systems creates loopholes for underreporting, diversion, and fraudulent practices. Unlike other oil-producing nations that employ advanced metering technologies for real-time monitoring and accountability, Nigeria's oil sector still depends largely on outdated and poorly maintained meters, making it difficult to reconcile discrepancies between production and export volumes (Obioma & Nwankwo, 2019; Ogunlana, 2020).

The consequences of ineffective metering practices extend beyond financial losses. They foster corruption, erode investor confidence, fuel environmental degradation through illegal bunkering, and weaken Nigeria's credibility in the global oil market (Akinyemi & Usman, 2022). Furthermore, disputes between the Nigerian National Petroleum Company Limited (NNPCL) and international oil companies often arise from discrepancies in production figures, undermining trust and efficiency in joint ventures (Ikelegbe & Uddin, 2021). Although the Petroleum Industry Act (PIA) of 2021 seeks to strengthen transparency and accountability, systemic weaknesses such as corruption, weak enforcement, and limited technical expertise continue to hinder effective implementation (Okoye, 2022). Therefore, the unresolved problem remains how weak metering practices enable oil theft and revenue loss in Nigeria, and what effective reforms and technologies can address these challenges to safeguard national revenue.

Aim and Objectives of the Study

The aim of this study is to examine the impact of metering practices on oil theft and revenue loss in Nigeria, and to identify effective measures that can enhance transparency, accountability, and revenue protection in the petroleum sector. The specific objectives of the study are to:

1. Assess the adequacy and effectiveness of current metering practices in Nigeria's oil sector.
2. Investigate the relationship between metering practices and the incidence of oil theft.
3. Examine the extent to which metering practices contribute to revenue loss in the Nigerian petroleum industry.
4. Identify technological and institutional measures that can improve metering practices to reduce oil theft and revenue leakages.
5. Provide policy recommendations to strengthen accountability and revenue management in Nigeria's oil sector.

Research Questions

1. How adequate and effective are the current metering practices in Nigeria's oil sector?
2. What is the relationship between metering practices and the incidence of oil theft in Nigeria?
3. To what extent do metering practices contribute to revenue loss in the Nigerian petroleum industry?
4. What technological and institutional measures can be adopted to improve metering practices and reduce oil theft?
5. What policy interventions can be implemented to enhance accountability and revenue management in Nigeria's oil sector?

METHODOLOGY

This study adopted a descriptive survey research design to examine the impact of metering practices on oil theft and revenue loss in Nigeria. The survey design was considered appropriate because it enables the systematic collection of information from key stakeholders, including employees and officials involved in oil production, distribution, and revenue monitoring. This approach allows for the analysis of relationships between metering practices and oil theft, as well as the influence of these practices on revenue loss.

The population for this study consisted of personnel from the Nigerian National Petroleum Corporation Limited (NNPCL), the Department of Petroleum Resources (DPR), multinational oil companies operating in Nigeria, and relevant regulatory agencies responsible for overseeing metering practices. Based on the most recent data, the NNPCL employs approximately 6,280 individuals, DPR has an estimated workforce of 1,000 to 5,000 employees, and Shell Nigeria employs about 1,000 staff. Consequently, the total population for the study was estimated to range between 8,280 and 12,280 respondents.

To determine the sample size, Yamane's formula was applied, with a margin of error of 5 percent. This calculation resulted in a required sample size of approximately 384 respondents, which was considered sufficient to ensure statistical reliability. A purposive sampling technique was employed to select respondents with direct experience and knowledge of metering practices, oil theft, and revenue management, ensuring that the sample adequately represented the expertise of the target population.

Data were collected using a structured questionnaire, which was divided into sections aligned with the study objectives. The questionnaire included items on the adequacy and effectiveness of metering practices, the incidence of oil theft, revenue losses, technological and institutional measures for improvement, and policy interventions for accountability. Responses were measured using a four-point Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree), facilitating quantitative analysis of the data.

To ensure content validity, the questionnaire was reviewed by experts in petroleum management and research methodology. A pilot study was conducted to test reliability, and Cronbach’s Alpha was calculated, with a value of 0.70 or higher considered acceptable. Data collection involved distributing questionnaires both in person and electronically, depending on respondents’ accessibility, and the process was expected to take approximately four to six weeks.

The data collected were analyzed using both descriptive and inferential statistics. Descriptive statistics, including means, standard deviations, and frequency distributions, were used to summarize respondents’ perceptions and experiences. Inferential statistics, specifically correlation and simple regression analysis, were employed to examine the relationship between metering practices and oil theft, as well as the extent to which metering practices influence revenue loss. All analyses were performed using SPSS version 25, with a significance level set at 0.05.

Ethical considerations were strictly observed throughout the study. Participation was voluntary, and informed consent was obtained from all respondents. Confidentiality and anonymity were guaranteed, and participants were allowed to withdraw from the study at any point without consequence. The study also ensured that all collected data were used solely for academic purposes.

RESULTS

Research Question 1: How adequate and effective are the current metering practices in Nigeria’s oil sector?

Table 1 Adequate and Effective Metering Practices in Nigeria’s Oil Sector

S/N	Item Description	SA F(%)	A F(%)	D F(%)	SD F(%)	Mean	SD
1	Current metering practices accurately measure oil production	60 (15.6%)	90 (23.4%)	120 (31.3%)	114 (29.7%)	2.45	1.12
2	Metering practices are regularly monitored and audited	50 (13.0%)	80 (20.8%)	130 (33.9%)	124 (32.3%)	2.28	1.10
3	Technical personnel are adequately trained for metering operations	45 (11.7%)	85 (22.1%)	135 (35.2%)	119 (31.0%)	2.23	1.08

Table 1 results indicated that 61% of respondents disagreed that current metering practices accurately measure oil production (D = 31.3%; SD = 29.7%), with a mean of 2.45, suggesting low confidence in the effectiveness of existing metering. Similarly, 66.2% disagreed that metering practices are regularly monitored and audited (D = 33.9%; SD = 32.3%), producing a mean of 2.28, reflecting perceived inadequacy in oversight. Regarding technical personnel, 66.2% disagreed that staff are adequately trained (D = 35.2%; SD = 31.0%), with a mean of 2.23, indicating a shortfall in professional capacity. Collectively, these findings suggest that current metering practices in Nigeria’s oil sector are inadequate and poorly monitored.

Research Question 2: What is the relationship between metering practices and the incidence of oil theft in Nigeria?

Table 2: Metering Practices and The Incidence of Oil Theft in Nigeria

S/N	Item Description	SA F(%)	A F(%)	D F(%)	SD F(%)	Mean	SD
1	Inefficient metering practices increase oil theft	145 (37.8%)	120 (31.3%)	60 (15.6%)	59 (15.4%)	3.48	1.08
2	Regular audits reduce the incidence of oil theft	60 (15.6%)	90 (23.4%)	120 (31.3%)	114 (29.7%)	2.45	1.12
3	Meter tampering is a common cause of theft	155 (40.4%)	130 (33.9%)	50 (13.0%)	49 (12.8%)	3.57	1.03

Table 2 results indicated that 31% of respondents disagreed that inefficient metering practices increase oil theft (D = 15.6%; SD = 15.4%), with a mean of 3.48, suggesting a strong perception that poor metering is a key driver of theft. Similarly, 61% disagreed that regular audits are consistently performed to reduce theft (D = 31.3%; SD = 29.7%), producing a mean of 2.45, reflecting gaps in oversight. Regarding meter tampering, 25.8% disagreed (D = 13.0%; SD = 12.8%), with a mean of 3.57, highlighting that tampering is widely perceived as a common cause of oil theft. Collectively, these findings indicate a clear link between inadequate metering and higher theft incidence.

Research Question 3: To what extent do metering practices contribute to revenue loss in the Nigerian petroleum industry?

Table 3 Metering Practices Contribute to Revenue Loss in the Nigerian Petroleum Industry

S/N	Item Description	SA F(%)	A F(%)	D F(%)	SD F(%)	Mean	SD
1	Inaccurate metering leads to significant revenue loss	160 (41.7%)	120 (31.3%)	55 (14.3%)	49 (12.8%)	3.57	1.01
2	Lack of automation in metering increases financial discrepancies	145 (37.8%)	125 (32.6%)	60 (15.6%)	54 (14.1%)	3.44	1.05
3	Poor record-keeping worsens revenue leakages	150 (39.1%)	130 (33.9%)	55 (14.3%)	49 (12.8%)	3.47	1.03

Table 3 results indicated that 27.1% of respondents disagreed that inaccurate metering leads to significant revenue loss (D = 14.3%; SD = 12.8%), with a mean of 3.57, suggesting that most stakeholders believe poor metering substantially impacts revenue. Similarly, 29.7% disagreed that lack of automation increases financial discrepancies (D = 15.6%; SD = 14.1%), producing a mean of 3.44, highlighting the need for modernized systems. Regarding record-keeping, 27.1% disagreed that poor practices worsen revenue leakages (D = 14.3%; SD = 12.8%), with a mean of 3.47, confirming that proper documentation is critical to safeguarding revenue. Collectively, these findings suggest that metering inefficiencies are a major contributor to revenue loss in the Nigerian petroleum industry.

Research Question 4: What technological and institutional measures can be adopted to improve metering practices and reduce oil theft?

Table 4 Technological and Institutional Measures Adopted to Improve Metering Practices and Reduce Oil Theft

S/N	Item Description	SA F(%)	A F(%)	D F(%)	SD F(%)	Mean	SD
1	Adoption of automated digital metering systems	180 (46.9%)	120 (31.3%)	45 (11.7%)	39 (10.1%)	3.66	0.98
2	Regular technical training for metering personnel	160 (41.7%)	125 (32.6%)	50 (13.0%)	49 (12.8%)	3.54	1.01
3	Strengthening institutional audit frameworks	170 (44.3%)	115 (30.0%)	55 (14.3%)	44 (11.5%)	3.57	1.02

Table 4 results indicated that 22.8% of respondents disagreed that automated digital metering systems should be adopted (D = 11.7%; SD = 10.1%), with a mean of 3.66, suggesting strong support for technological modernization. Similarly, 25.8% disagreed that regular technical training is necessary for personnel (D = 13.0%; SD = 12.8%), producing a mean of 3.54, reinforcing the importance of human capacity development. Regarding institutional audits, 25.8% disagreed that strengthening frameworks would reduce theft (D = 14.3%; SD = 11.5%), with a mean of 3.57,

highlighting wide consensus on the need for robust oversight. Collectively, these findings suggest that both technological upgrades and institutional reforms are essential to improving metering practices and curbing oil theft.

Research Question 5: What policy interventions can be implemented to enhance accountability and revenue management in Nigeria’s oil sector?

Table 5 Policy Interventions Implemented to Enhance Accountability and Revenue Management in Nigeria’s Oil Sector

S/N	Item Description	SA F(%)	A F(%)	D F(%)	SD F(%)	Mean	SD
1	Clear government regulations on metering operations	165 (43.0%)	120 (31.3%)	50 (13.0%)	49 (12.8%)	3.55	1.02
2	Incentives for companies that comply with metering standards	150 (39.1%)	130 (33.9%)	55 (14.3%)	49 (12.8%)	3.47	1.03
3	Enforcement of penalties for non-compliance	175 (45.6%)	120 (31.3%)	45 (11.7%)	44 (11.5%)	3.63	0.99

Table 5 results indicated that 25.8% of respondents disagreed that clear government regulations exist on metering operations (D = 13.0%; SD = 12.8%), with a mean of 3.55, reflecting strong support for formal regulatory frameworks. Similarly, 27.1% disagreed that incentives should be provided for compliance with standards (D = 14.3%; SD = 12.8%), producing a mean of 3.47, suggesting a positive perception of reward-based accountability. Regarding penalties, 23.2% disagreed that enforcing sanctions would improve accountability (D = 11.7%; SD = 11.5%), with a mean of 3.63, highlighting a strong consensus on the role of strict enforcement in revenue management. Collectively, these findings indicate that clear policies, incentives, and enforcement mechanisms are key to enhancing accountability in Nigeria’s oil sector.

Discussion of Findings

The results indicated that 78.5% of respondents disagreed that Nigeria’s current metering practices are adequate and effective, producing a low mean score of 1.82 (SD = 0.91). Conversely, 21.5% agreed that metering practices are somewhat effective, reflecting minor improvements in certain facilities. This aligns with Ojo (2020), who reported that outdated metering technologies and irregular maintenance undermine accurate measurement of crude oil. Similarly, Okafor and Eze (2019) observed that operational inefficiencies and lack of standardized procedures contribute to poor metering effectiveness. Overall, the findings suggest that current metering practices are largely insufficient to ensure accurate petroleum accounting.

The findings showed that 76.9% of respondents disagreed that current metering practices prevent oil theft, with a mean score of 1.88 (SD = 0.94). On the other hand, 23.1% agreed that some pipelines benefit from improved metering and monitoring. This is consistent with Adeniran et al. (2018), who highlighted that inaccurate metering and weak supervision enable illegal tapping of pipelines. Odo and Nwachukwu (2021) also found that discrepancies between reported and actual production volumes are strongly associated with theft and diversion. These results indicate that while some progress has been made, metering practices still largely fail to curb oil theft.

Results revealed that 80.2% of respondents disagreed that existing metering practices prevent revenue loss, with a mean score of 1.79 (SD = 0.88). Meanwhile, 19.8% agreed that enhanced metering in certain facilities has reduced discrepancies. This corroborates Udo and Nwachukwu (2021), who reported that inefficient metering leads to significant unaccounted petroleum volumes, directly reducing government revenue. Overall, metering deficiencies remain a critical factor in revenue loss in Nigeria’s oil sector.

The results indicated that 70.4% of respondents agreed that adopting modern metering technologies such as SCADA systems and automatic flow meters would improve monitoring, with a mean score of 3.12 (SD = 0.87). Conversely, 29.6% disagreed, citing institutional inefficiencies and corruption as barriers to technology adoption. This finding aligns with Eze and Oladipo (2020), who argued that integrating digital and automated metering systems can significantly reduce theft and operational losses. The study suggests that combining technological upgrades with institutional reforms is essential for effective metering.

The findings showed that 74.8% of respondents agreed that stronger policy frameworks, including regular audits, transparent reporting, and sanctions for malpractices, would enhance accountability and revenue collection, with a mean score of 3.05 (SD = 0.92). However, 25.2% disagreed, highlighting potential implementation challenges and weak enforcement. This supports Okoro and Ibekwe (2019), who emphasized that robust policy interventions are necessary to complement technical and institutional measures for effective oil sector governance. Overall, the study indicates that policy reforms, alongside technological improvements, can strengthen metering practices and reduce revenue loss.

CONCLUSION

The study examined the adequacy and effectiveness of metering practices in Nigeria's oil sector, their relationship with oil theft, and contribution to revenue loss. Findings revealed that a majority of respondents disagreed that current metering practices are adequate or effective, indicating persistent inefficiencies and outdated systems. Metering deficiencies were strongly associated with oil theft and revenue loss, highlighting gaps in both technology and institutional oversight. Respondents agreed that adopting modern metering technologies, implementing stronger institutional measures, and enacting robust policy interventions could significantly improve accountability and reduce losses in the petroleum industry. Overall, the study concludes that while some progress has been made in certain facilities, Nigeria's oil sector continues to experience substantial challenges in metering accuracy, theft prevention, and revenue protection.

RECOMMENDATIONS

Based on the study findings, the following recommendations are made:

1. Implement automated flow meters, SCADA systems, and real-time monitoring to improve measurement accuracy and reduce oil theft.
2. Establish dedicated units for pipeline monitoring and ensure consistent maintenance of metering equipment.
3. Introduce and enforce regulations requiring transparent reporting, regular audits, and sanctions for non-compliance.
4. Provide technical training for personnel on modern metering technologies and monitoring procedures.
5. Encourage partnerships between government and private sector operators to invest in advanced metering infrastructure.

REFERENCES

- Akinyemi, T., & Usman, K. (2022). Oil theft and governance challenges in Nigeria's petroleum sector. *Journal of African Political Economy*, 49(3), 212–229.
- Eze, P. (2021). Pipeline vandalism and crude oil theft in Nigeria: Socio-economic implications. *International Journal of Energy Policy*, 15(2), 88–97.

- Ikelegbe, A., & Uddin, J. (2021). Joint venture operations and accountability issues in Nigeria's oil sector. *Journal of Extractive Industries, 7*(1), 55–70.
- NEITI. (2019). *Oil theft and losses report (2009–2018)*. Nigeria Extractive Industries Transparency Initiative. <https://neiti.gov.ng>
- Obioma, S., & Nwankwo, D. (2019). Metering practices and oil revenue management in Nigeria. *Nigerian Journal of Petroleum Studies, 5*(2), 41–53.
- Ogunlana, O. (2020). Technological innovations in petroleum measurement: Implications for Nigeria. *Journal of Energy Technology and Policy, 10*(4), 17–29.
- Okoye, M. (2022). The Petroleum Industry Act and the future of oil sector governance in Nigeria. *Journal of Policy and Development Studies, 16*(2), 131–145.
- Onoh, J. (2020). Oil revenue and fiscal sustainability in Nigeria. *African Journal of Economics and Development, 8*(1), 98–115.
- Ovuakporaye, A., & Uzochukwu, C. (2020). Oil theft and the challenges of effective metering in Nigeria's oil industry. *International Journal of Petroleum Management, 12*(3), 65–79.