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Enhancing Environmental Impact Assessments through AI-Driven App: App Review of the EIA Report for Proposed Erection of High Communication Towers in Obajana, Kogi State, Nigeria

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Abstract

This study addresses the growing need for innovative solutions in Environmental Impact Assessments (EIAs), particularly in light of increasing infrastructure development and environmental concerns. By integrating advanced technology, such as Artificial Intelligence (AI), into the EIA process, the study aims to enhance data accuracy and stakeholder engagement, ultimately improving environmental governance. It explores the integration of an AI-driven EIA Review App to enhance the evaluation of EIA reports, focussing on a project involving the installation of two 45-meter lattice towers in Obajana, Kogi State, Nigeria. The app was utilised to assess air quality and identify significant environmental impacts, including alterations to the soil profile. While the app's data revealed that air quality generally met acceptable standards, it identified elevated particulate matter (PM) levels at two monitoring stations, signalling localised pollution concerns. The EIA study employed data acquisition, impact assessment, and Environmental Management Plan (EMP) development, incorporating stakeholder feedback throughout the process. The primary environmental impact identified was the alteration of soil profiles across all project phases. The app's ability to pinpoint critical environmental concerns, combined with its capacity to engage stakeholders and ensure regulatory compliance, underscores its potential to revolutionise the preparation and evaluation of EIAs. The findings highlight the importance of continuous monitoring and proactive mitigation efforts to maintain environmental quality. This research contributes to the growing body of knowledge on the application of AI in environmental governance, offering a novel approach to improving EIA processes through advanced technology.

Keywords: *Environmental monitoring tools; Pollution monitoring; Regulatory compliance; Sustainable development; Technological innovation; EIA*

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1. Introduction

Evaluating the potential environmental and social consequences of proposed projects is a critical phase in the Environmental Impact Assessment (EIA) process (Elias, 2010; Kaur, 2012). This evaluation is essential for informed decision-making, which supports sustainable development while minimizing adverse environmental impacts. Research by Pope *et al*. (2004), Nwoko (2013), Glasson and Therivel (2019), and Liu *et al*. (2021) emphasizes that the goal is achieved by providing relevant information to decision-makers. The EIA process involves several key components: scoping, data collection, impact assessment, and mitigation strategy design (Noble, 2011; Rao *et al*., 2017). The effectiveness of this process relies on the active participation of a diverse range of stakeholders, including professionals, governmental bodies, and local communities (Ogunba, 2004). Factors such as the quality of data, the extent of stakeholder engagement, and the effectiveness of mitigation measures significantly influence the success of the EIA.

However, the EIA system faces considerable challenges, especially in developing nations like Nigeria (Ogunba, 2004). Major concerns include insufficient information, limited resources, and inadequate public participation. In Nigeria, the reliability of EIA studies can be compromised by a lack of knowledge and understanding (Nwoko, 2013). Financial constraints and ineffective policy implementation further complicate the completion of comprehensive EIA investigations, often resulting in incomplete or poor-quality outcomes. Developing countries face unique challenges within the EIA framework, which can be categorized into three main areas: data and information, stakeholder participation, and resource constraints. The difficulty in obtaining relevant and reliable data diminishes the

effectiveness of EIA processes. In Nigeria, there is a shortage of up-to-date environmental data, making it challenging to predict potential impacts accurately. The credibility and accuracy of available data are sometimes questioned, which impairs the ability to forecast, analyze, and mitigate environmental hazards effectively (Nwoko, 2013).

Effective EIA implementation also relies on proficient stakeholder engagement. In Nigeria, involving local communities and indigenous populations in decision-making remains a challenge (Ogunba, 2004). Many communities affected by projects may lack awareness of their rights or the potential impacts of such projects. This lack of understanding can lead to opposition and objections, underscoring the need for effective communication and engagement strategies. Adequate allocation of human and financial resources is crucial for successful EIA implementation. However, Nigeria's limited resources pose challenges for proper EIA execution (Harelimana *et al*., 2020). Government agencies responsible for monitoring EIAs often struggle due to insufficient financial and human resources, leading to incomplete studies and ineffective enforcement of regulations (Nwoko, 2013). Inconsistent implementation of EIA policies can exacerbate resource scarcity issues.

To address these challenges and enhance the EIA process in Nigeria, several strategies can be considered. First, Nigeria should prioritize the establishment of environmental monitoring and data collection facilities as part of its infrastructure investment. This involves creating reliable foundational data, conducting regular environmental assessments, and making this data readily accessible to EIA professionals. Training programs and seminars for EIA professionals can also improve the quality of evaluations (Rathi, 2023). Public awareness campaigns are essential to educate local stakeholders about the importance of the EIA process, enabling them to make meaningful contributions and articulate their concerns effectively (Rajvanshi, 2003; Kaitei *et al*., 2022). Government agencies should ensure stringent and consistent enforcement of environmental regulations, including penalties for non-compliance, to establish accountability.

International collaboration offers another avenue for improving EIA practices. By partnering with international organizations and neighboring countries, Nigeria can enhance its understanding of environmental assessment methodologies, tools, and best practices (Abubakar *et al*., 2023). This collaboration can improve the overall efficacy of the EIA process and address resource limitations. Public participation is a critical element of the EIA process, and its absence in less developed countries presents significant challenges (Olokesusi, 1998; Ogunba, 2004; Nadeem & Hameed, 2008). Engaging local communities in the EIA process ensures that their concerns and perspectives are considered. The lack of local engagement can lead to conflicts between project proponents and affected communities, potentially resulting in project delays or cancellations. The integration of advanced data analysis, modeling methodologies, and visualization technologies into the EIA process can significantly improve its effectiveness (Gerassis *et al*., 2021; Saheb *et al*., 2022; Debrah *et al*., 2022). Artificial Intelligence (AI) technology, for example, enhances decision-making by processing large datasets and providing accurate predictions of environmental impacts (Rohde *et al*., 2021; Chapman, 2022). AI can also improve stakeholder engagement by facilitating communication through chatbots and virtual assistants, thus ensuring that all relevant voices are heard.

AI-enabled systems can efficiently disseminate information about projects and their potential impacts, bridging information gaps through targeted communication strategies (Kumar *et al*., 2019; Campbell *et al*., 2020; Ramnarayan, 2021). Virtual assistants and chatbots can serve as inclusive forums for community members to express concerns and seek information (Gupta, 2020; Mleczko, 2021). AI can also perform sentiment analysis to gauge public support or resistance and use predictive models to assess potential environmental impacts (Fernandes *et al*., 2019; Koyamparambath *et al*., 2022). The use of AI in the EIA process offers several advantages, including enhanced data analysis, improved stakeholder engagement, and more accurate predictions of environmental impacts (Guisande *et al*., 2018; Gerassis *et al*., 2021; Zdravković & Panetto, 2022). By integrating AI technologies, developing countries like Nigeria can overcome challenges related to data accessibility, resource limitations, and public participation. However, it is crucial to approach AI integration with caution, addressing ethical concerns, privacy issues, and the need for human oversight (Huriye, 2023).

The aim of this study is to explore how AI technology can provide a promising solution to various challenges faced during the EIA process, particularly in developing countries. Specifically, the study seeks to examine how AI can improve data quality, enhance stakeholder engagement, and automate resource-intensive tasks, ultimately supporting more effective, transparent, and sustainable environmental assessments.

2. Materials and Methods

2.1 Research Design and Methodological Approach

The research design for this study utilized a mixed-method approach, integrating both quantitative and qualitative techniques to explore stakeholders' perspectives on incorporating artificial intelligence (AI) into Nigeria's Environmental Impact Assessment (EIA) process. This approach was chosen to capture the complexity of stakeholders' views and experiences with AI in EIA, providing a comprehensive analysis from multiple angles (Osuizugbo & Nnodu, 2023). Quantitative methods involved deploying a survey questionnaire to collect structured data from a diverse sample of stakeholders across various industries and regions in Nigeria. The survey was meticulously designed to obtain standardized responses regarding stakeholders' familiarity with AI, perceptions of its benefits, and views on its application in different EIA phases. Statistical analysis of this data revealed patterns, trends, and correlations, offering insights into the distribution of attitudes and opinions among stakeholders (Gilbert & Calhoun, 2019).

Simultaneously, qualitative methods, including semi-structured interviews, were employed to gain deeper,

nuanced insights into stakeholders' opinions on AI integration. These interviews allowed participants to provide detailed narratives and examples, which were systematically analyzed through coding, classification, and interpretation. This process identified emergent themes and patterns, offering a richer understanding of stakeholders' perspectives (Belina, 2023). The integration of quantitative and qualitative data enabled the study to triangulate findings, enhancing the validity, reliability, and depth of the research. By correlating quantitative data with qualitative insights, the study offered a holistic view of stakeholders' attitudes and experiences, highlighting both the opportunities and challenges of AI adoption in Nigeria's EIA process.

For data collection, the survey included both closed-ended and open-ended questions. Closed-ended questions provided quantifiable data on stakeholders' engagement with AI and perceptions of its benefits, facilitating statistical analysis. Open-ended questions allowed participants to elaborate on their views, resulting in rich qualitative data that complemented the quantitative findings. This mixed-method approach provided a comprehensive exploration of the issues related to AI in EIA. The sample comprised 307 stakeholders, including government officials, environmental practitioners, academic researchers, Non-Governmental Organizations (NGOs), and community members. Purposeful sampling ensured representation from various stakeholder groups and geographic regions, enhancing the reliability and applicability of the research findings.

2.2 App Development

The development of the app involved selecting appropriate technology, processing data, and designing the user interface, with a focus on employing advanced AI techniques such as natural language processing and machine learning to analyze complex EIA reports. Data privacy and security measures were also crucial, given the sensitive nature of environmental information. The app is designed to be transparent, accessible, and engaging for stakeholders. It aims to clarify environmental reporting by simplifying complex EIA reports, thereby facilitating informed decision-making and promoting active participation in environmental processes. Accessibility is prioritized to make the intricate details of EIA reports understandable for non-experts, thus democratizing access to environmental knowledge. This inclusivity supports community members and advocacy groups, fostering broader participation in environmental governance.

Stakeholder engagement is central to the app's mission, not only providing information but also encouraging dialogue and collaboration. Users can ask specific questions and receive timely, accurate responses, which enhances understanding and trust among project proponents, regulators, and communities. The app integrates advanced AI technologies to improve EIA report analysis. It utilizes OpenAI's GPT-3.5 for natural language processing, LangChain for query optimization, and FAISS for quick retrieval of relevant information. OpenAI Embeddings convert text into numerical vectors to enhance search accuracy.

Key development stages included using Docker for environment setup, Python with Streamlit and PyPDF2 for backend development, and employing tools like LangChain's Character Text Splitter for detailed document analysis. Despite some limitations, such as reliance on the quality of EIA reports and AI constraints, the app's strengths in accessibility and accuracy make it a valuable tool. Future enhancements may involve improved document processing, multilingual support, and enhanced data privacy measures, further supporting diverse stakeholders in environmental decision-making.

2.3 Data Analysis

Quantitative data from the survey were analyzed using statistical software to produce descriptive statistics, including frequencies, percentages, and measures of central tendency. This analysis revealed stakeholders' awareness, perceptions, and attitudes toward AI integration in the EIA process. Descriptive statistics summarize responses and offer insights into trends and relationships among variables. The mean (μ) is calculated by summing all individual responses and dividing by the total number of responses as given in equation 1 below:

$$\mu = \frac{\sum_i^n x_i}{n} \qquad 1$$

Quantitative data analysis provides valuable insights into stakeholders' awareness, perceptions, and attitudes towards AI integration in the EIA process. By employing descriptive statistics, correlation, and regression analyses, researchers can uncover patterns, relationships, and predictive models that enhance our understanding of stakeholders' viewpoints and inform decision-making in environmental assessments.

Qualitative analysis of interview data is essential for understanding stakeholders' perspectives on integrating AI into Nigeria's EIA process. The analysis begins with coding, where interview transcripts are systematically labeled with descriptive codes to capture key ideas and experiences related to AI integration. This initial step involves identifying relevant passages and assigning codes that highlight emerging themes. Following coding, the data is organized into broader categories or themes. This categorization process groups related codes together, revealing overarching patterns and recurring ideas, such as the benefits, challenges, and concerns associated with AI in EIA. Researchers then interpret these categories to extract deeper insights. This interpretive phase examines relationships between themes and considers the broader context, uncovering the underlying motivations and values that shape stakeholders' views. Through this process of coding, categorization, and interpretation, researchers identify significant themes and patterns, providing a nuanced understanding of stakeholders' perspectives on AI's impact on EIA processes.

2.4 Limitations and Ethical Considerations

Despite efforts to ensure reliability and validity, the study has limitations, including biases in self-reported data, sample representativeness issues, and challenges in integrating mixed-methods data. Self-reported data may be skewed by social desirability or memory issues. The sample may not fully represent all stakeholder groups. The mixed-

methods approach posed difficulties in data integration. Ethical considerations were addressed with informed consent, confidentiality, and adherence to ethical guidelines.

3. Results and Discussion

The study surveyed 307 respondents, with the demographic data outlined in Figure 1 offering insights into gender distribution, age groups, and occupations. All responses were complete and valid, and thus all 307 were included in the analysis. The survey revealed a gender disparity with 62% male (190) and 38% female (117). Age-wise, the majority were 35-44 years old (112), followed by 25-34 (68), with fewer younger (18-24) and older participants (55+), potentially limiting diverse perspectives. The occupational breakdown included 73 academics/researchers, 78 NGO representatives, and 50 environmental consultants. This distribution highlights the need for broader age representation and reinforces the practical insights gained from the diverse occupational backgrounds in evaluating AI integration in EIA processes.

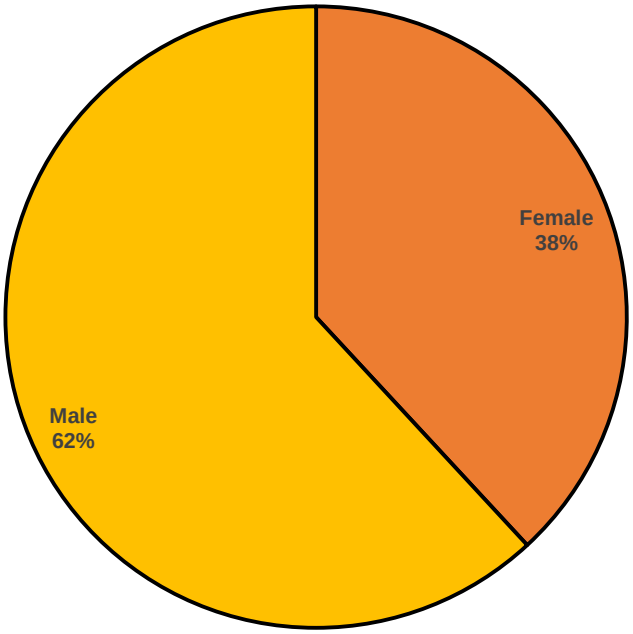

Figure 1: Demographic data of the study respondents

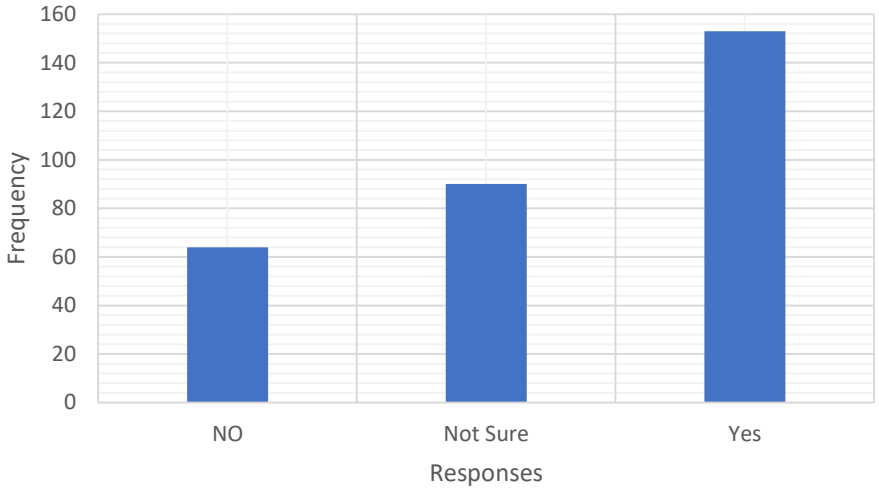

Figure 2**:** Perceived Technological Barriers to AI Integration

3.1 Technological Barriers to AI Integration in the EIA

The successful integration of AI into the EIA process in Nigeria is contingent upon overcoming various technological barriers. Figure 2 shed light on stakeholders' perceptions regarding the anticipated technological challenges in incorporating AI into the EIA process. This discussion delves into these barriers and proposes strategies to address them. Figure 2 highlights significant uncertainty among stakeholders about the technological barriers to AI integration in Nigeria's EIA process. While 153 respondents anticipate barriers, 90 are unsure, and 64 believe there are none. This uncertainty reflects the evolving nature of AI and its implications for EIA.

Key technological barriers identified include inadequate infrastructure, such as limited internet access, power outages, and outdated systems, which hinder AI deployment. Data availability issues, including silos, inconsistent formats, and privacy concerns, further complicate integration. The shortage of skilled professionals in data science and AI, coupled with the high costs of AI technologies, poses challenges for adoption.

Overcoming these barriers requires a collaborative, multi-faceted approach. Prioritizing investments in technological infrastructure and data governance is essential. Establishing robust data frameworks and investing in training programs to build a skilled workforce are critical steps. Encouraging open data initiatives and fostering public-private partnerships can enhance data sharing, knowledge transfer, and resource pooling. By addressing these challenges, Nigeria can better harness AI technologies to improve its EIA process.

3.2 Legal Considerations in AI Implementation for EIA

Understanding and addressing legal considerations is crucial for the successful integration of AI into the EIA process in Nigeria. While 59 respondents recognize potential legal issues, 118 express uncertainties, and 130 report no awareness. This range of responses highlights the need for greater awareness and understanding of the legal landscape surrounding AI in EIA. Despite the prevalent uncertainty, some respondents foresee legal challenges associated with AI use in EIA, including data privacy, security, liability, intellectual property rights, and ethical considerations. Data privacy is a significant concern, as AI in EIA processes sensitive environmental data, potentially including personal or commercially sensitive information. Compliance with data protection regulations, such as the Nigerian Data Protection Regulation (NDPR), is crucial to safeguarding privacy and preventing data misuse.

Another legal challenge is determining liability and accountability in cases of AI-related errors, biases, or malfunctions. Establishing clear guidelines for liability attribution is essential for maintaining transparency and fairness in AI-driven decision-making. Intellectual property issues also arise, particularly concerning the ownership and licensing of AI algorithms, models, and datasets. Addressing these legal considerations requires proactive measures, including comprehensive legal reviews, robust data governance frameworks, and adherence to ethical guidelines like the IEEE Ethically Aligned Design framework. Engaging stakeholders in the AI development process and providing training on legal and ethical aspects of AI in EIA are crucial for promoting responsible and compliant AI use in environmental assessments.

3.3 Capacity Building for AI Implementation in the EIA Process

The integration of AI into the EIA process in Nigeria presents both significant opportunities and challenges. The data shows a strong consensus among stakeholders on the need for capacity building to implement AI in the EIA process, with 136 respondents agreeing and 94 strongly agreeing. This majority underscores the importance of training programs and skill development, while the smaller group of neutral (36) or disagreeing (41) respondents highlights the need to address potential skepticism. AI technologies involve complex algorithms and data analytics, requiring specialized skills. Environmental practitioners, policymakers, and regulators must be trained to effectively use AI tools, interpret insights, and integrate AI into traditional EIA workflows. An interdisciplinary approach, combining environmental science, data science, and regulatory knowledge, is essential for success.

Although the majority support capacity building, some stakeholders remain neutral or skeptical. Demonstrating successful case studies and tangible benefits can help build confidence. Inclusive and accessible training programs are crucial, ensuring that stakeholders at various expertise levels and regions can participate. Tailoring these programs to specific needs enhances their effectiveness. Engaging stakeholders in designing and implementing capacity-building initiatives fosters ownership and increases support for AI integration in EIA.

3.4 Robust Data Infrastructure for AI Integration in the EIA Process

This analysis delves into stakeholder perspectives on the necessity of such infrastructure, highlights challenges in its development, and proposes strategies for effective implementation. Strong consensus among stakeholders, with 277 respondents affirming the need for robust data infrastructure in the EIA process. Only 13 respondents disagreed, and 17 were uncertain, emphasizing the critical importance of high-quality, reliable, and relevant environmental data for AI-driven analysis and decision-making.

AI systems require high-quality data to generate accurate and reliable outcomes. Ensuring data quality involves addressing completeness, accuracy, consistency, and timeliness, all essential for training AI models and validating outputs. Reliable data sources, including environmental monitoring systems and remote sensing technologies, are necessary for providing continuous and up-to-date information. Relevance is crucial, as data must pertain to the specific environmental parameters being assessed.

However, environmental data in Nigeria is often fragmented across various organizations, leading to integration challenges. Overcoming these barriers requires coordinated efforts to standardize data formats, create centralized repositories, and ensure accessibility for all stakeholders.

Inadequate technological infrastructure, including limited access to high-speed internet, outdated data storage systems, and insufficient computational resources, can impede the establishment of robust data infrastructure. Addressing these limitations involves investing in modern data infrastructure, including cloud-based storage solutions and high-performance computing systems. Ensuring data privacy and security is crucial for protecting sensitive environmental data and complying with legal and regulatory requirements. Robust data infrastructure must include measures for data encryption, access control, and secure data transmission. Adherence to data protection regulations, such as the Nigerian Data Protection Regulation (NDPR), is essential for safeguarding data privacy (Omotubora, 2021). Building and maintaining robust data infrastructure requires significant financial and human resources. Resource constraints, particularly in developing regions, can pose challenges to investing in and sustaining the necessary data infrastructure. Securing funding and resources through public-private partnerships and international collaborations is vital for overcoming these constraints.

3.5 Data Privacy, Transparency, and Ethical Considerations in AI Adoption for the EIA

The adoption of AI technologies in the EIA process holds immense potential for enhancing efficiency, accuracy, and decision-making. However, as highlighted by the responses in Figure 3, this adoption also raises significant concerns related to data privacy, transparency, and ethical considerations. With 153 respondents agreeing and 75 strongly agreeing, a majority of stakeholders recognize potential issues related to data privacy, transparency, and ethics. Conversely, a smaller number of respondents are neutral (48), disagree (27), or strongly disagree (4), indicating that while concerns are prevalent, there is also some diversity in perspectives.

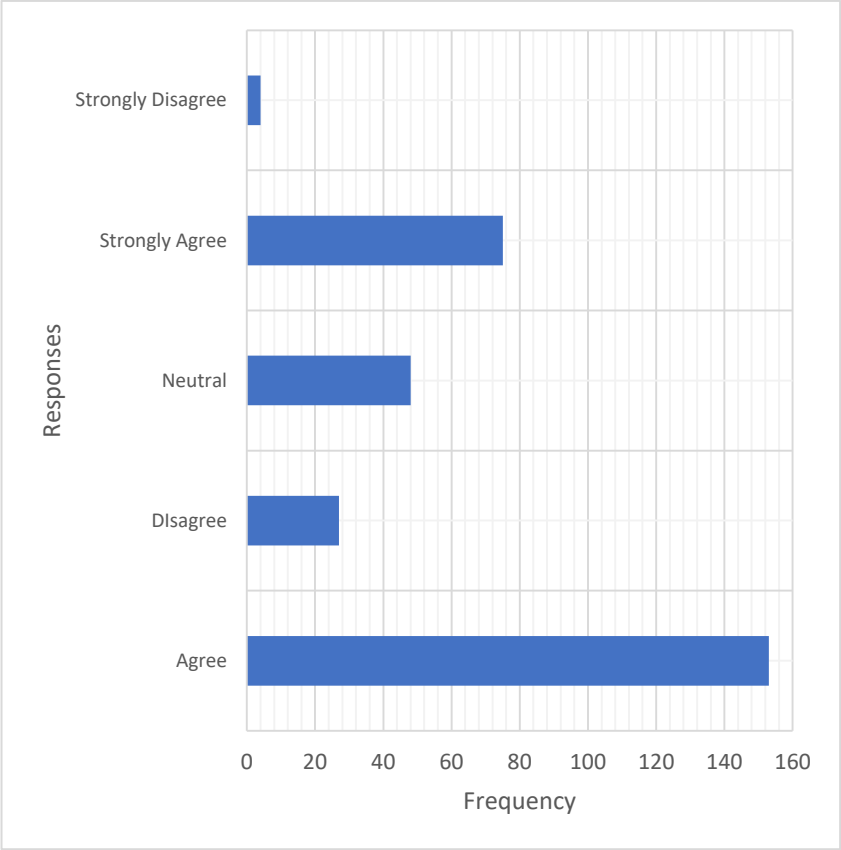

Figure 3: Perspectives on AI Adoption Concerns

One of the primary concerns related to AI adoption in the Environmental Impact Assessment (EIA) process is data privacy. AI systems require vast amounts of data to function effectively, often including sensitive environmental information and potentially personally identifiable information (PII). The methods used for data collection and storage must comply with data protection regulations, such as the Nigerian Data Protection Regulation (NDPR). It is critical to ensure that data is collected lawfully, stored securely, and accessed only by authorized personnel. To mitigate privacy risks, data used in AI analysis should be anonymized when possible. Anonymization, which involves removing or obscuring personal identifiers, helps balance the need for data utility with privacy protection. Obtaining informed consent from individuals whose data may be used in AI-driven EIA processes is essential. Stakeholders must be informed about how their data will be used, the purposes of data processing, and their rights regarding data privacy (Bressane *et al*., 2020).

Transparency is another critical concern in AI adoption. AI systems, especially those based on complex machine

learning algorithms, can operate as "black boxes," making it difficult to understand how decisions are made. AI developers must provide clear documentation and explanations of how AI algorithms work, including the data inputs, decision-making processes, and factors influencing AI outputs. This transparency is essential for accountability, as environmental practitioners and policymakers must be able to explain how AI-generated insights inform EIA decisions. Engaging stakeholders in AI system development and implementation can enhance transparency, foster trust, and increase acceptance of AI technologies (Zhou *et al*., 2022).

Ethical considerations are paramount in AI adoption within the EIA process. Ensuring ethical AI use involves addressing issues related to fairness, accountability, and societal impact. AI systems can inadvertently perpetuate biases present in the data they are trained on, so ensuring fairness involves identifying and mitigating biases in AI algorithms. Establishing clear accountability for AI-driven decisions is crucial, with frameworks ensuring that humans remain in control and responsible for AI-generated decisions. Considering the broader societal impact of AI technologies is also essential, as AI applications in the EIA process should promote positive environmental outcomes, support sustainable development, and avoid harm to communities. Ethical guidelines and standards provided by organizations like IEEE or OECD can guide responsible AI use (Bressane *et al*., 2020; Zhou *et al*., 2022).

3.6 AI in the EIA Process for Sustainable Environmental Practices

The integration of AI into the EIA process holds significant potential for enhancing sustainable environmental practices in Nigeria. Figure 4 provide insights into stakeholders' beliefs about how AI could contribute to sustainability in the EIA process. This discussion delves into the various dimensions of AI's impact on accuracy, decision-making, efficiency, environmental outcomes, and time savings, highlighting the potential benefits and addressing potential challenges.

One of the most significant benefits of integrating AI into the EIA process is the enhancement of accuracy. AI technologies, particularly those involving machine learning and data analytics, can analyze vast amounts of environmental data with precision, reducing the likelihood of human error and oversight. AI can process and analyze large datasets, identifying patterns and trends that may not be apparent through traditional analysis methods. AI can predict potential environmental impacts more accurately by considering a wide range of variables and historical data. This predictive capability is crucial for proactive environmental management and mitigation planning. AI-powered remote sensing and GIS technologies can enhance the accuracy of environmental assessments. These tools can provide high-resolution imagery and detailed spatial data, allowing for precise mapping and monitoring of environmental changes. Accurate data collection and analysis are fundamental for reliable EIA reports.

AI's ability to process complex datasets and generate actionable insights significantly improves decision-making in the EIA process. Enhanced decision-making capabilities can lead to more informed and sustainable environmental practices. AI-driven decision support systems can assist environmental practitioners and policymakers by providing evidence-based recommendations. These systems can simulate different scenarios, evaluate the potential impacts of various projects, and suggest optimal mitigation measures. DSS helps in making well-informed decisions that balance development and environmental protection. AI can improve risk assessment by identifying potential environmental hazards and assessing their likelihood and severity. This capability allows for better risk management strategies, ensuring that environmental risks are addressed proactively. Improved risk management contributes to the sustainability and resilience of environmental projects.

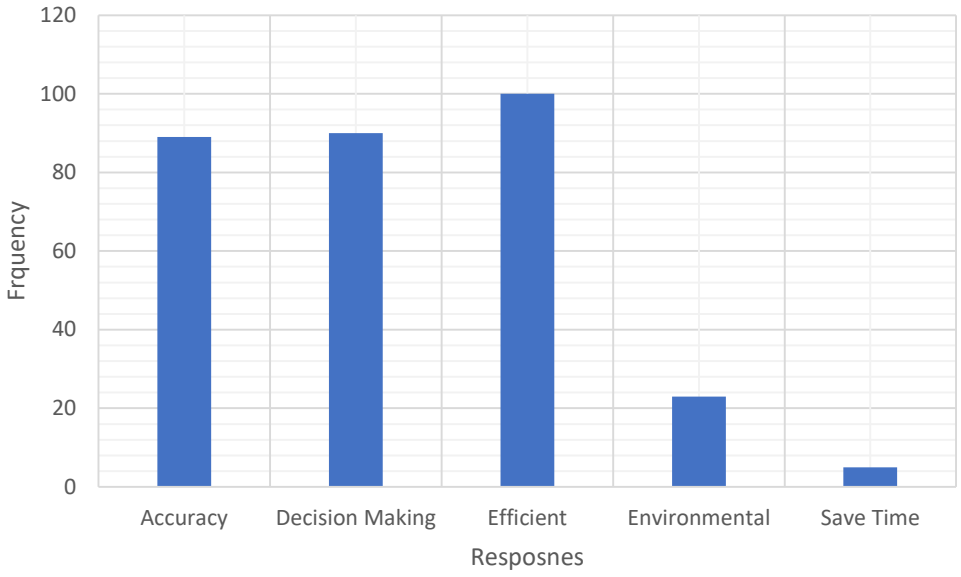

Figure 4: Stakeholder Perspectives on AI Integration in EIA

Efficiency is another key benefit of integrating AI into the EIA process. AI technologies can streamline various aspects of environmental assessment, reducing the time and resources required for data collection, analysis, and reporting. AI can automate routine and repetitive tasks, such as data entry, data cleaning, and initial data analysis. Automation reduces the workload on environmental practitioners, allowing them to focus on more complex and critical aspects of the EIA process (Gerassis *et al.*, 2021). This leads to faster project turnaround times and cost savings. By optimizing the use of resources, AI can enhance the efficiency of environmental assessments. AI algorithms can optimize sampling strategies, ensuring that data collection efforts are both comprehensive and cost-effective. Efficient resource utilization is essential for conducting thorough and timely EIAs.

While fewer respondents explicitly highlighted environmental outcomes, the integration of AI in the EIA process has significant potential to promote environmental sustainability. AI can support sustainable practices through improved monitoring, impact prediction, and adaptive management.

Although only a small number of respondents (5) explicitly mentioned time savings, the ability of AI to save time in the EIA process is a noteworthy benefit. Time efficiency is critical for meeting project deadlines and regulatory requirements. AI can accelerate various stages of the EIA process, from initial data collection to final reporting. Faster assessments enable quicker decision-making and project approvals, which is particularly important for large-scale infrastructure and development projects. Time savings contribute to overall project efficiency and cost-effectiveness. By improving the accuracy and efficiency of environmental assessments, AI can help reduce delays caused by data discrepancies, errors, or incomplete information. Timely and accurate assessments prevent costly project delays and ensure compliance with environmental regulations.

The integration of AI into the EIA process in Nigeria offers substantial potential to enhance accuracy, decision-making, efficiency, environmental sustainability, and time savings. As indicated by stakeholder perspectives the benefits of AI adoption are multifaceted and far-reaching. However, addressing challenges related to data quality, ethical considerations, capacity building, and interdisciplinary collaboration is essential to realize these benefits fully.

3.8 App testing and deployment

The EIA Report Review App data reveals that while the air quality in the project location generally meets acceptable standards, there are exceptions with particulate matter (PM) levels surpassing limits at two monitoring stations, indicating some pollution presence. Recommendations include heightened monitoring and mitigation efforts. The project involves installing two 45-meter lattice towers in Obajana, Kogi State, aiming to engage stakeholders and integrate their feedback into operations. It will entail data acquisition, impact assessment, and Environmental Management Plan (EMP) development, having secured approval from the Federal Ministry of Environment. Notably, the primary environmental impact identified across all phases of the project is the alteration of soil profile.

3.8.1 What is the status of air quality in the project location?

The data collected from the EIA Report Review App indicates that the air quality in the project location is generally within acceptable limits. However, there are exceptions noted for particulate matter (PM), which exceeded limits at two monitoring stations. This suggests the presence of some level of air pollution, though not significant enough to cause major harm. Recommendations include further monitoring and the implementation of mitigation measures to maintain air quality at safe levels.

3.8.2 Describe the project briefly

The project involves the installation of two 45-meter lattice towers in Obajana, Lokoja LGA of Kogi State. Its objectives include facilitating dialogue among stakeholders, seeking participation from interested parties, and identifying stakeholder interests and issues. The project aims to integrate stakeholder feedback into project design and operations, utilizing their expertise and experiences. Activities will encompass baseline data acquisition, impact assessment, and the development of an EMP. Notably, the project has received Environmental Use Approval (EUA) from the Federal Ministry of Environment.

3.8.3 What is the major environmental impact of this project?

Data collected through the EIA Report Review App identifies the alteration of soil profile as the major environmental impact of the project. This impact is considered significant throughout all phases of the project.

Figure 5: Overview of Air Quality and Environmental Impact for the Obajana EIA Report

3.9 Environmental Impact Assessment and Regulatory Compliance

The EIA Report Review App is crucial for evaluating environmental impacts, particularly in analyzing air quality for the Obajana project in Kogi State. The app generally indicates acceptable air quality but detects elevated particulate matter (PM) levels at two stations, highlighting localized pollution concerns. This underscores the app's ability to support proactive environmental management by recommending enhanced monitoring and mitigation.

The Obajana project, which involves installing lattice towers, emphasizes stakeholder engagement and feedback, aligning with environmental governance principles. By integrating stakeholder perspectives into project design, the initiative ensures comprehensive environmental understanding and inclusive decision-making. The project's approval by the Federal Ministry of Environment confirms regulatory compliance and underscores its commitment to environmental best practices. The app's identification of soil profile changes as a key impact further demonstrates its effectiveness in guiding responsible development.

4. Conclusion

The EIA Report Review App's deployment and testing have provided valuable insights into the environmental conditions and stakeholder engagement associated with installing two 45-meter lattice towers in Obajana, Kogi State. The app proved effective in assessing air quality, revealing that while air quality generally meets standards, particulate matter (PM) levels exceed limits at two monitoring stations. This indicates localised pollution, highlighting the need for ongoing monitoring and targeted mitigation. The project's primary environmental impact, identified through the app, is the alteration of soil profiles, emphasising the importance of soil conservation and management during all project phases. The app's ability to pinpoint such critical impacts demonstrates its value in guiding responsible environmental stewardship and minimising adverse effects. Stakeholder engagement has been a key aspect of this project, with the app facilitating input from various stakeholders, including government officials, environmental practitioners, and community members. This ensures the project aligns with local needs and adheres to environmental governance principles. The project's commitment to environmental best practices was reflected in the data acquisition, impact assessment, and Environmental Management Plan (EMP) developed, which was further supported by approval from the Federal Ministry of Environment. The app's broader potential extends beyond this project, supporting proactive environmental management in various contexts. By identifying impacts such as air quality concerns and soil alterations, it provides a framework for monitoring and mitigation strategies for future projects. The EIA Report Review App is an essential tool for assessing and managing environmental impacts. It enhances assessment accuracy, promotes stakeholder engagement, and ensures compliance with regulations. We recommend continued air quality monitoring, soil conservation efforts, and ongoing stakeholder engagement to align the project with sustainable development goals.

Declarations

Ethics approval and consent to participate

Not Applicable

Consent for publication

All authors have read and consented to the submission of the manuscript.

Availability of data and material

Not Applicable.

Competing interests

All authors declare no competing interests.

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