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Evaluation of environmental impact assessment compliance in public construction projects and its implications for sustainable development

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Abstract: *Environmental Impact Assessment (EIA) has become a central instrument for integrating environmental, social, and economic considerations into public construction projects. This article evaluates EIA compliance in public infrastructure development and examines its implications for sustainable development. Drawing on international and local literature, the review synthesizes evidence on EIA concepts and principles, legal and institutional frameworks, methods for assessing compliance, and the outcomes of effective or weak implementation. The findings show that although many countries have established mandatory EIA regulations for major public works, practical compliance remains inadequate. Key barriers include institutional weaknesses, limited technical capacity, corruption and political interference, poor-quality documentation, and low levels of public participation. These constraints result in incomplete implementation of mitigation measures, inadequate monitoring and follow-up, and a persistent gap between EIA prescriptions and on-site practice. Consequently, non-compliance contributes to environmental degradation, loss of biodiversity, heightened public health risks, and slower progress toward relevant Sustainable Development Goals. The article proposes a set of integrated strategies to improve EIA compliance: strengthening regulatory enforcement, enhancing institutional and professional capacity, leveraging geospatial and digital monitoring technologies, and deepening public participation and transparency. It concludes by identifying priority areas for future research, including quantitative assessment of compliance levels, sector-specific challenges, community-based monitoring models, and the application of emerging technologies such as artificial intelligence and IoT-enabled systems to EIA enforcement.*
Keywords: *Environmental Impact Assessment, Public construction projects, Compliance and enforcement, Sustainable development, Monitoring technologies*

1.0 Introduction

1.1 Background to Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a systematic, decision-support process for identifying and evaluating the potential environmental consequences of proposed development prior to approval or implementation (Butt et al., 2024; Marrero et al., 2020; Nwamekwe & Chikwendu, 2025). Originally developed as part of modern environmental governance in the latter twentieth century, EIA was conceived to integrate environmental considerations into project planning and execution and to reduce adverse impacts from large infrastructure and public construction works (Butt et al., 2024; Okeagu et al., 2024). Contemporary studies emphasize EIA's role in guiding mitigation and compliance measures particularly in regions experiencing increased vulnerability due to population growth and climate variability (Butt et al., 2024).

Over time, EIA has matured into an internationally recognized tool for promoting responsible and sustainable development—especially across public-private partnership (PPP) construction projects—by aligning project design with environmental, social, and economic objectives (Babatunde et al., 2020; , Nilsson et al., 2018). Advances in methods and digital technologies (e.g., Building Information Modelling (BIM), Life Cycle Assessment (LCA) integration, and Geographic Information Systems (GIS)) now enable more rigorous, quantitative EIA, improving impact quantification, compliance monitoring, and sustainability outcomes in construction delivery (Marrero et al., 2020; Nwamekwe & Chikwendu, 2025; Datta et al., 2023; Olawumi & Chan, 2018; Emeka et al., 20222025).

1.2 Importance of EIA in Public Construction Projects

Public construction projects (highways, bridges, dams, housing, and utilities) typically involve significant land disturbance, resource extraction, and alterations to hydrological and ecological systems, which can lead to various environmental consequences that necessitate thorough assessment and management (Morozov et al., 2022; , Aung et al., 2020).. These projects are associated with not only biophysical impacts such as habitat fragmentation, biodiversity loss, and changes in water quality but also social and economic repercussions, including displacement, disruption of livelihoods, and pressures for infrastructure-driven development. Numerous empirical studies have documented these effects and have linked them to insufficient evaluation or mitigation measures when

environmental impact assessments (EIA) are absent or inadequate (Chidiebube et al., 2025).

Rigorous EIA procedures thus play a critical role by systematically identifying, predicting, and prescribing mitigation strategies for these impacts, incorporating environmental safeguards into design and permitting processes, and informing monitoring and adaptive management throughout construction and operations. Compliance with EIA requirements has been shown to facilitate the mitigation of pollution and resource overuse, decrease ecological harm, and enhance community well-being when effectively implemented and enforced within public infrastructure projects (Kumar et al., 2022; Chidiebube et al., 2025).

1.3 Statement of the Problem

Despite the existence of mandatory Environmental Impact Assessment (EIA) frameworks, empirical studies document chronic non-compliance in public construction projects across various jurisdictions. This non-compliance is often attributed to weak enforcement, institutional fragmentation, and political or economic pressures that undermine legal mandates (Nkemakonam et al., 2024). Evidence from project-level audits and sectoral reviews highlights a frequent divergence between documented EIA procedures and actual practices, such as significant gaps between EIA documentation and implementation. This reflects inadequate monitoring, poor recordkeeping, and limited technical capacity within implementing agencies.

The implementation gap poses substantial risks to environmental integrity, biodiversity, and local livelihoods, with non-compliance linked to measurable socio-economic harms from infrastructure projects and reduced community resilience (Santos et al., 2025). Public health risks and diminished welfare stemming from inadequately mitigated construction impacts, such as noise and pollution, have also been reported where EIA prescriptions are not enforced. This underscores the notion that weak compliance converts legislative intent into environmental and social vulnerabilities rather than achieving sustainable development gains (Santos et al., 2025).

1.4 Purpose and Scope of the Review

This article examines the level of Environmental Impact Assessment compliance in public construction projects, identifies the major challenges affecting compliance, and discusses their implications for sustainable development. The

review also synthesizes evidence from global and local studies to highlight gaps and offer actionable strategies for improving compliance.

1.5 Structure of the Paper

The paper is structured into eight sections, beginning with an introduction, followed by the conceptual framework, legal and institutional review, evaluation of EIA compliance, implications for sustainable development, challenges, strategies for improvement, and concluding recommendations.

2.0 Conceptual and Theoretical Framework

2.1 Concept of Environmental Impact Assessment

Environmental Impact Assessment (EIA) is conceptualized as a planning and decision-support instrument that identifies, predicts, and evaluates the biophysical, social, and other relevant effects of proposed developments, compares alternatives, and prescribes mitigation before major commitments are made (Aljareo et al., 2023; Moses et al., 2024). Core EIA stages—screening, scoping, baseline studies, impact prediction, mitigation design, decision-making, and follow-up monitoring—operationalize this proactive management intent, thereby enabling early identification and avoidance or minimization of adverse outcomes during project design and prior to construction (Moses et al., 2024; Nwamekwe et al., 2025).

Contemporary EIA practice increasingly integrates analytical tools and frameworks to strengthen prediction and mitigation: life-cycle and systems approach (LCA/integrated modelling) extend assessment across project stages. GIS and spatial analyses improve site-specific impact mapping species distribution and connectivity modelling enhance biodiversity appraisal and mitigation design, while cumulative-effects and resilience frameworks address aggregated and long-term risks to sustainability (Ezeanyim et al., 2025).

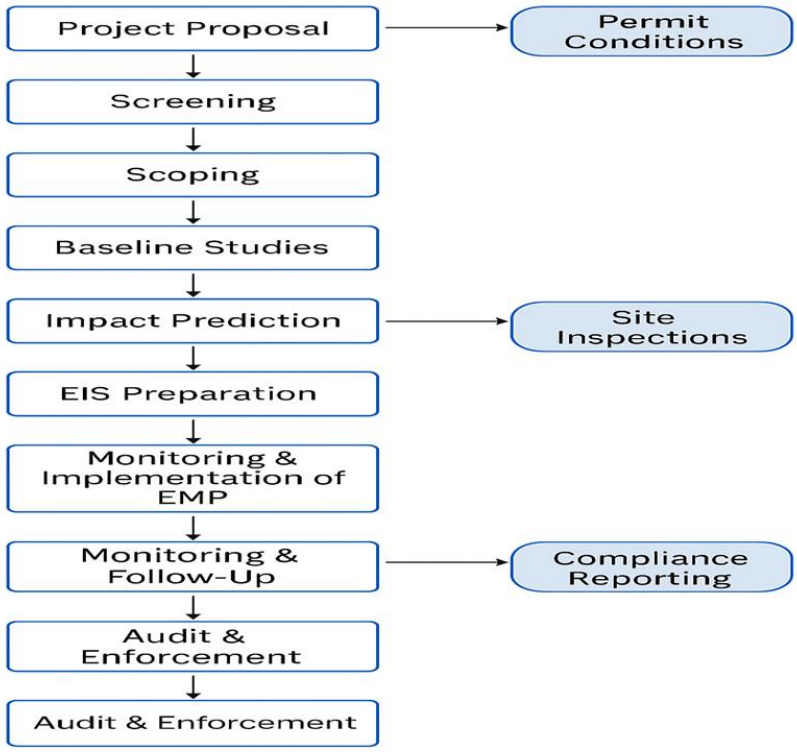

Figure 1: Flowchart of the EIA Process for Public Construction Projects with Compliance Checkpoints

Figure 1 illustrates the complete Environmental Impact Assessment (EIA) process for public construction projects, showing the sequential flow from project proposal to final audit and enforcement. Key compliance checkpoints—permit conditions, site inspections, and compliance reporting—are highlighted distinctly to emphasize regulatory control points. This flowchart supports clearer understanding of where deviations, non-compliance, or enforcement actions typically occur within the EIA lifecycle.

2.2 Principles Guiding Effective EIA Practice

Effective Environmental Impact Assessment (EIA) practice is underpinned by normative principles—transparency, public participation, accountability, scientific integrity, early integration into planning, and sustained monitoring—that collectively ensure assessment outcomes inform decisions safeguarding environmental and social values while enabling development (Wang et al., 2023). Transparency and participation embed legitimacy and local knowledge into decision-making, while accountability and scientific rigor help prevent ineffectual

assessments by aligning legal requirements with credible baseline studies and predictive models (Nwamekwe et al., 2025). Early integration of EIA into project design and explicit treatment of cumulative and resilience dimensions strengthens anticipatory mitigation and aligns assessments with sustainable-development objectives (Paulo & Montaño, 2024).

Operationalizing these principles requires robust methods and institutional mechanisms: spatial and modelling tools (GIS, LCA, predictive ecology) improve impact quantification and alternatives appraisal. Formalized follow-up, compliance monitoring, and documentation are necessary to close the implementation gap observed in many EIAs (Nwamekwe et al., 2025; Paulo & Montaño, 2024). Equally important are governance measures—clear enforcement, stakeholder collaboration, and safeguards against greenwashing—to translate assessment prescriptions into effective mitigation and long-term sustainability outcomes (Wang et al., 2023).

2.3 Theoretical Basis for EIA Compliance

Two main theoretical perspectives guide EIA compliance:

Sustainability theory frames Environmental Impact Assessment (EIA) as an instrument to reconcile environmental, social, and economic objectives by incorporating long-term ecological limits and human well-being into development decisions. Scholars argue that sustainability functions as an integrative norm shaping EIA content and the incorporation of Sustainable Development Goal (SDG)-aligned criteria, thereby positioning EIA as a mechanism to facilitate balanced development outcomes and legitimacy in governance processes (Stupak et al., 2021). Empirical reviews indicate that when EIA is explicitly linked to sustainability frameworks, it strengthens multi-criteria appraisal (environmental, social, economic) and supports anticipatory mitigation and design alternatives consistent with sustainable development (Stupak et al., 2021).

Regulatory compliance theory identifies EIA effectiveness in institutional design: compliance depends on clear laws, credible enforcement, incentives, administrative capacity, and judicial or oversight remedies. Studies indicate that factors such as sanctions, monitoring, procurement governance, and political leadership significantly affect compliance with EIA conditions (Mwelu et al., 2018; Mwanga, 2022). Conversely, political interference or weak institutions can undermine compliance, demonstrating that legal mandates alone are insufficient

without coherent enforcement and capacity-building mechanisms (Mwanga, 2022).

2.4 Overview of Sustainable Development Goals (SDGs) Relevant to Construction

SDG 6 (Clean Water and Sanitation): public construction affects water quality and hydrology; EIA compliance that assesses nutrient loads, pollution sources, and implementing mitigation strategies can enhance water quality recovery, such as through runoff control and wastewater treatment. SDG 9 (Industry, Innovation and Infrastructure): integrating digital tools (e.g., Building Information Modelling - BIM) and supply-chain sustainability into EIA improves design efficiency, material selection, and lifecycle impacts of infrastructure, aligning construction with resilient, low-impact industrialization. SDG 11 (Sustainable Cities): EIA compliance that embeds participatory urban regeneration, along with stormwater and transport planning, supports inclusive and resilient urban infrastructure while reducing localized environmental risks. SDG 13 (Climate Action): incorporating climate considerations into EIA—such as emissions, vulnerability, and adaptation—guides effective mitigation and adaptation in public projects, empowering construction to contribute to climate resilience and mitigation targets (Matemilola et al., 2019). SDG 15 (Life on Land): rigorous biodiversity assessments and mitigation strategies within EIA minimize habitat loss and fragmentation due to linear and large-scale projects, thereby protecting terrestrial ecosystems and species. Effective follow-up and enforceable approval conditions are crucial for translating EIA prescriptions into tangible SDG outcomes (Pinto et al., 2019; Rathi, 2023).

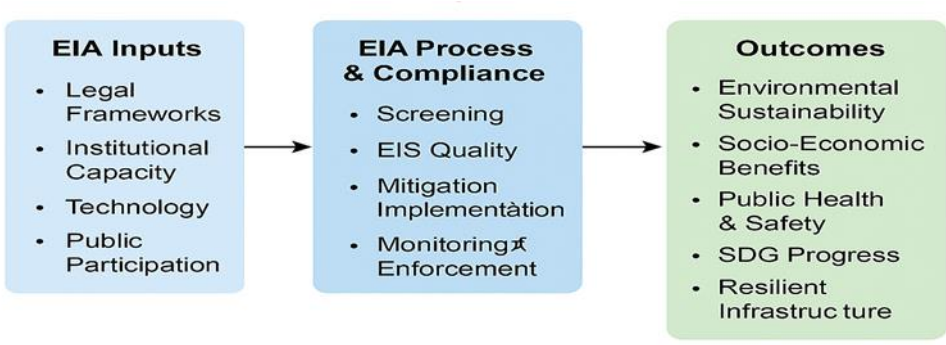

Figure 2: Conceptual Framework Linking EIA Compliance to Sustainable Development Outcomes

Figure 2 illustrates how foundational EIA inputs—legal frameworks, institutional capacity, technology, and public participation—feed into the EIA process, shaping compliance quality across screening, scoping, EIS preparation, mitigation, and monitoring. Strong compliance directly drives sustainable development outcomes, including environmental protection, improved socio-economic conditions, enhanced public health and safety, resilient infrastructure, and measurable progress toward national and global SDGs.

3.0 Overview of EIA Legal and Institutional Frameworks

3.1 National and International EIA Policy Instruments

International EIA instruments — embodied in UNEP guidance, the EU EIA Directive, and frameworks from multilateral lenders such as the World Bank and IFC — establish common procedural and substantive standards for screening, scoping, impact analysis, mitigation planning, and monitoring for major infrastructure projects. These instruments are frequently referenced when evaluating national regimes and sectoral guidance for hydropower, renewable energy, and transboundary activities (Butt et al., 2024). Comparative studies indicate that these instruments provide model clauses and performance standards that national agencies adapt to local contexts while promoting consistency in baseline studies, risk appraisal, and follow-up obligations required of public construction proponents (Butt et al., 2024).

National frameworks, however, vary in scope and implementation: many countries formally mandate EIA for significant public works but differ markedly in procedural detail, institutional roles, permitting timelines, and enforcement capacity, as documented in case studies of countries such as Uganda, Indonesia, Malaysia, and Nigeria (George et al., 2024). Consequently, policy instruments must be evaluated both for their normative content and for institutional capacity to effectively implement screening, scoping, mitigation, and monitoring across public construction programs (George et al., 2024).

Table 1: Comparison of International and National EIA Policy Instruments and Requirements

Instrument / Framework	Jurisdiction / Scope	Key Requirements (Screening,	Strengths	Implementation Challenges

		Scoping, EIS, Follow-Up)		
UNEP EIA Guidance	Global, voluntary guidance for member states	Promotes early screening and scoping; outlines minimum EIS contents; encourages monitoring, public participation, and periodic review	Widely recognized reference; flexible; supports capacity building and harmonisation of national systems	Non-binding; uptake and enforcement depend on national political will and institutional capacity
EU EIA Directive	European Union member states	Mandatory screening and scoping; detailed EIS structure; consideration of alternatives; public consultation; monitoring and reporting of significant adverse effects	Legally enforceable; strong procedural clarity; case law; integration with other EU environmental laws	Resource-intensive; varying capacity among member states; complex procedures may delay project approvals
World Bank / IFC Standards	Borrowing countries and private projects with WB/IFC	Environmental and Social Assessment; risk categorisation; EIS/ESIA preparation;	Strong safeguards; explicit performance standards; links finance to	Applies mainly to funded projects; may exceed local legal requirements; implementatio

		Environmental and Social Management Plan (ESMP); supervision, monitoring, and independent audits	compliance; encourages best practice	n depends on borrower capacity
National EIA Act (e.g., Nigeria)	National territory and major public/private projects	Mandatory EIA for listed projects; screening and scoping; EIS submission; review and approval; implementation of mitigation/EMP; periodic monitoring and compliance inspections	Provides legal basis for enforcement; aligns with international norms; offers context-specific provisions	Weak enforcement, limited funding, political interference, inadequate technical expertise, and poor public awareness

Table 1 contrasts major international EIA instruments with a typical national framework, highlighting similarities in core requirements—screening, scoping, EIS preparation, and follow-up—while revealing differences in enforcement strength, technical guidance, and resourcing. The comparison underscores that although national systems often borrow from global best practice, weak implementation capacity and political constraints frequently limit effective compliance in public construction projects.

3.2 Regulatory Institutions and Their Roles

Environmental ministries, national environmental protection agencies, and local planning authorities constitute the primary institutional actors charged with

Environmental Impact Assessment (EIA) appraisal, permitting, public consultation facilitation, compliance monitoring, and sanctioning of public construction projects. Empirical reviews document these roles while noting persistent gaps between statutory mandates and practice (George et al., 2024). These agencies are responsible for reviewing EIA reports, setting permit conditions, organizing consultations to incorporate stakeholder inputs, and instituting monitoring regimes to verify the implementation of mitigation measures (George et al., 2024).

However, institutional studies highlight chronic constraints—limited technical capacity, inadequate funding, weak inter-agency coordination, and inconsistent enforcement—that reduce the effectiveness of these functions and allow non-compliance to persist in many jurisdictions (Onyeka et al., 2024). Strengthening EIA outcomes, therefore, requires targeted capacity building, clearer enforcement powers (including administrative sanctions), improved recordkeeping, and resourced follow-up systems to translate EIA decisions into environmentally sustainable construction practice (Onyeka et al., 2024).

3.3 Compliance Requirements for Public Sector Construction Projects

Public-sector Environmental Impact Assessment (EIA) compliance for construction typically requires formal submission of an Environmental Impact Statement (EIS)/report, regulatory screening and scoping, legally specified mitigation commitments, environmental monitoring plans, periodic compliance reporting, and strict observance of permit conditions and authorizations issued by environmental agencies and planning authorities (George et al., 2024). Regulatory agencies are charged with reviewing EIS documentation, registering and screening projects, issuing certificates/permits, and specifying enforceable conditions (including monitoring and reporting schedules) that developers must implement throughout construction and operation (George et al., 2024).

Enforcement and effective compliance depend on robust follow-up systems—site inspections, independent monitoring, transparent reporting, and sanctions for breaches—but empirical studies document recurrent weaknesses (poor follow-up, incomplete reporting, weak institutional capacity and variable EIS quality) that undermine these requirements in many jurisdictions, reducing the likelihood that mitigation measures and permit conditions are implemented as intended (George et al., 2024). Strengthening documentation, resourced monitoring, and legal enforcement are therefore central to converting EIS

commitments into real environmental protection on public construction projects (George et al., 2024).

3.4 Common Challenges in EIA Enforcement

Weak enforcement and procedural delays are frequently reported obstacles to effective Environmental Impact Assessment (EIA) implementation in public construction. Studies describe environmental law as a "paper tiger" due to review bottlenecks, weak sanctions, and regulatory inefficiencies that allow projects to proceed without full compliance (Nkemakonam et al., 2025). Resource constraints—such as insufficient funding, a shortage of qualified EIA personnel, and weak inter-agency coordination—exacerbate these issues, limiting capable review, monitoring, and follow-up activities (Mwelu et al., 2018). Political interference and procurement distortions further erode compliance incentives, while corruption and unethical behaviour in contracting undermine transparency and accountability in permit decisions (Ijaiya, 2025).

These challenges manifest as incomplete Environmental Impact Statement (EIS) implementation, poor monitoring, contractor resistance, and occasional data manipulation, which collectively reduce the likelihood that mitigation measures are enacted and sustained during construction. This situation undermines both environmental protection and public trust (Mwelu et al., 2018; Vitalis et al., 2024). Addressing enforcement deficits necessitates strengthening institutional capacity, employing robust enforcement tools, ensuring transparent procurement and accountability mechanisms, and providing adequate resources for follow-up and sanctioning.

4.0 Evaluation of EIA Compliance in Public Construction Projects

4.1 Methods and Criteria Used in Assessing EIA Compliance

Methods for assessing Environmental Impact Assessment (EIA) compliance in public construction combine documentary and empirical techniques: a systematic review of Environmental Impact Statements and permits, desk audits, and stakeholder interviews to verify declared mitigation and monitoring plans. Field inspections and independent environmental monitoring—including remote sensing and satellite imagery for post-clearance verification—are essential to detect deviations from approved footprints and activities (Ezeanyim et al., 2025). Complementary approaches include third-party compliance audits, review of internal audit records, and deployment of Regulatory Technology (RegTech) and

AI tools to automate data capture, flag anomalies, and enhance transparency in reporting (Nwamekwe & Nwabunwanne, 2025).

Key assessment criteria centre on (a) actual implementation of prescribed mitigation and Environmental Management Plans (EMP), (b) adherence to permit conditions and authorized project limits, and (c) completeness, reliability, and independence of documentation and monitoring data, especially considering risks of biased self-reporting. Effective evaluation, therefore, integrates documentary evidence, on-site verification, independent sampling/audits, and continuous digital monitoring to translate EIA commitments into enforceable performance outcomes.

4.2 Factors Influencing EIA Compliance in Public Projects

Political commitment, institutional capacity, funding, and professional competence are principal determinants of Environmental Impact Assessment (EIA) compliance in public construction. Political interference or weak autonomy shapes enforcement outcomes and discretionary approvals (Rathi, 2023), understaffed or technically weak environmental agencies and poor inter-agency coordination degrade review, monitoring, and follow-up functions (George et al., 2024; Igbokwe et al., 2025); limited budgetary allocation and governance issues in procurement constrain inspection and enforcement resources, undermining compliance incentives. Finally, the expertise and diligence of EIA consultants determine the quality of Environmental Impact Statements (EIS) and practicable mitigation, while discretionary interpretation of approval conditions poses a risk of non-implementation where oversight is weak (Rathi, 2023).

Community awareness, participation, and governance integrity further influence compliance trajectories: inclusive and informed stakeholder engagement improves transparency and accountability and raises the likelihood of adherence to mitigation measures on site. Conversely, corruption, data manipulation, and weak oversight reduce enforcement credibility, often leading to unmet permit conditions. This highlights the need for independent inspections, adequately resourced follow-up, and stronger legal enforcement to ensure that EIA commitments lead to sustainable operational outcomes (Ijaiya, 2025; Vitalis et al., 2024).

4.3 Evidence from Empirical Studies (Global and Local Perspectives)

Empirical studies from Africa, Asia, and Europe confirm that Environmental Impact Assessment (EIA) legal frameworks are widely established; however, practical compliance is frequently weak. Reviews of developing-country practices report routine gaps between statutory procedures and on-the-ground implementation (Bhatt, 2023; Igbokwe et al., 2025). Sectoral peer-reviews indicate limited enforcement and instances where formally required assessments or conditions are inadequately applied or bypassed altogether (Igbokwe et al., 2025; Morrison-Saunders et al., 2021). Comparative and regional analyses therefore characterize EIA systems as procedurally present but operationally fragile, particularly where institutional capacity or third-party oversight is limited (Bhatt, 2023; Igbokwe et al., 2025; Morrison-Saunders et al., 2021).

Common empirical findings identify incomplete implementation of mitigation plans, deficient reporting, and inadequate monitoring as pervasive problems, undermining EIA effectiveness (Pinto et al., 2019). Multiple case studies show that in many developing contexts, EIA studies are hurried or lack scientific rigor—resulting in poor baseline data, weak impact predictions, and insufficient follow-up—which exacerbates non-compliance and diminishes prospects for sustainable outcomes from public construction projects (Bhatt, 2023).

4.4 Key Gaps in EIA Practice and Documentation

EIA practice exhibits recurrent technical and documentary deficiencies: baseline studies are often insufficient or poorly aligned with predictive and monitoring needs, producing weak impact characterization and rushed assessments that cannot support robust mitigation design (Nwamekwe et al., 2025; Bhatt, 2023). Mitigation planning is frequently generic or untested, and the effectiveness of prescribed measures is seldom demonstrated because EIS documents remain static deliverables rather than adaptive, data-linked management tools—a gap highlighted by benchmarking and case reviews of EIS quality and post-implementation evidence.

Governance and follow-up shortfalls compound technical gaps: post-EIA monitoring and follow-up are widely documented as the weakest elements of EIA systems, producing incomplete verification of mitigation and limited adaptive management (Pinto et al., 2019; Paulo & Montaño, 2024; George et al., 2024). Inadequate early and meaningful stakeholder engagement and inconsistent enforcement of permit conditions further reduce accountability and the

likelihood that documented measures are implemented effectively on public construction sites.

5.0 Implications of EIA Compliance for Sustainable Development

5.1 Environmental Sustainability Outcomes

Effective compliance with Environmental Impact Assessment (EIA) conditions reduces environmental degradation by ensuring that mitigation measures are implemented, which limits habitat loss and deforestation, and helps preserve species and genetic diversity. This is evidenced in contexts such as hydropower projects where thorough EIA compliance is critical (Butt et al., 2024). Rigorous follow-up and enforcement transform EIA prescriptions into tangible ecological protection; best-practice frameworks and criteria for follow-up are essential to verify mitigation effectiveness and sustain biodiversity outcomes (Pinto et al., 2019).

EIA compliance also mitigates pollution and protects water resources by mandating the implementation of pollution controls, monitoring, and adaptive management—methods that have been shown to improve water quality when properly enforced within project cycles (Kumar et al., 2022). Additionally, integrating climate considerations and enforced permit conditions enhances resilience and reduces emissions in public construction projects, as long as effective monitoring, reporting, and sanctioning mechanisms are in place (Matemilola et al., 2019; Pinto et al., 2019; Rathi, 2023).

5.2 Socio-Economic Benefits of Effective EIA Compliance

Good EIA compliance delivers measurable socio-economic benefits by protecting local livelihoods and public health, and by embedding sustainable design that reduces resource depletion and project risks (Nwamekwe & Igbokwe, 2025; Nwamekwe et al., 2024; Okpala et al., 2025). Case studies of public-private partnerships (PPP) and public works show that quality EIA practice—including rigorous scoping, health inclusion, and stakeholder engagement—improves project performance, legitimacy, and community acceptance, thereby preserving employment, ecosystem services, and social capital that underpin local livelihoods (Nwamekwe & Igbokwe, 2025; Nwamekwe et al., 2024; Okpala et al., 2025).

Moreover, compliant EIA processes can generate cost savings through avoided remediation, reduced delays, and improved contract performance. Studies link

stronger EIA and contract governance, as well as technical integration (e.g., Building Information Modelling BIM, lifecycle approaches), to lower lifecycle costs and enhanced risk management. Robust follow-up and enforceable conditions can further convert mitigation commitments into tangible economic gains by reducing pollution-related health burdens and long-term environmental liabilities (Pinto et al., 2019).

5.3 Public Health and Community Safety Considerations

EIA compliance in public construction can reduce population exposure to environmental hazards such as air and water pollution, noise, increased flood risk, and improper waste disposal. This is achieved by ensuring that project designs incorporate pollution controls, runoff and erosion management, and adaptive measures informed by ongoing monitoring (Kumar et al., 2022; Nwamekwe et al., 2024). Rigorous follow-up and enforcement of EIA prescriptions are essential for translating these measures into practical operational controls, which limit contaminant loads, safeguard water quality, and prevent unauthorized site expansions or resource-extractive practices that may worsen environmental hazards (Kumar et al., 2022; Nwamekwe et al., 2024).

The benefits from these reductions disproportionately advantage vulnerable groups, including children, low-income communities, and the elderly. EIA processes that incorporate health criteria, participatory safeguards, and enforceable mitigation measures notably decrease exposures leading to adverse health outcomes and social disruption. Therefore, integrating health considerations into assessments and maintaining robust follow-up can enhance community welfare and resilience (Nwamekwe & Igbokwe, 2025).

5.4 Long-Term National Development Implications

Sustained compliance with Environmental Impact Assessment (EIA) requirements strengthens long term national development by producing more resilient infrastructure, reducing disaster and environmental risks, and aligning capital projects with sustainability objectives: integration of design tools such as Building Information Modelling (BIM) and lifecycle thinking improves infrastructure resilience and resource efficiency, while evidence from water-sector public-private partnership (PPP) projects and public works assessments shows that robust EIA practices support service sustainability and risk reduction in complex socio-ecological systems (Okpala et al., 2025). Consistent EIA

enforcement also enhances investor confidence and the bankability of projects—especially in PPPs—by lowering regulatory and reputational risk and by embedding measurable sustainability criteria into procurement and project delivery (Nwamekwe et al., 2024).

Over time these benefits translate into national gains: avoided remediation and disaster costs, improved public health and ecosystem services, and accelerated progress toward Sustainable Development Goals (SDGs) through better planning and monitoring (George et al., 2024). Realizing these gains requires enforceable permit conditions, effective follow-up, and procurement standards that operationalize EIA outcomes within infrastructure planning and financing frameworks (Rathi, 2023).

6.0 Challenges and Barriers to Effective EIA Compliance

6.1 Institutional Weaknesses and Poor Enforcement

Many environmental agencies lack the technical capacity, human resources, and contextual adaptability required to enforce Environmental Impact Assessment (EIA) conditions. Country-context analyses identify deficits in leadership, specialist skills, funding, and institutional arrangements that reduce EIA performance and enable developer-led processes that undermine transparency (Aljareo et al., 2023; George et al., 2024). Decentralization without matched capacity and coordination mechanisms exacerbates local enforcement gaps, while systematic reviews of environmental law enforcement point to recurring shortages of monitoring tools and resources that constrain regulatory action.

Weak enforcement is compounded by limited institutional independence, political interference, procurement weaknesses, and corruption, which attenuate sanctions and follow-up, permitting the non-implementation of mitigation measures. Empirical studies link enforcement shortfalls directly to greater environmental and socio-economic impacts where monitoring and sanctioning are weak (Kim, 2025; Santos et al., 2025).

Table 2: Summary of Key Challenges and Barriers to Effective EIA Compliance

Challenge Category	Specific Issues	Illustrative Consequences	Example Evidence/Studies
Institutional Weaknesses &	Insufficient regulatory oversight,	Low compliance rates, ecosystem	Lee (2025); Arif (2025); Santos et al. (2025)

Poor Enforcement	irregular inspections, weak sanctions for non-compliance	degradation, public health risks	
Corruption & Political Influence	Permit approvals influenced by bribery; political pressure on EIA decision-making	Biased approvals; compromised environmental integrity	Nandemehar & Marah (2025); Oklander et al. (2022)
Technical Capacity Constraints	Lack of expertise in impact prediction and monitoring; inadequate scientific data	Poor-quality EIAs; failures in mitigation design and implementation	Bwala et al. (2021); Eni et al. (2024)
Public Participation & Awareness Issues	Limited stakeholder consultation; poor access to EIA information; low awareness of rights	Opposition to projects; missed opportunities for community input; weakened accountability	Mekonnen (2023); Ogwang & Vanclay (2021)

Table 2 summarizes the major barriers hindering effective EIA compliance in public construction projects. It highlights how institutional weaknesses, corruption, limited technical capacity, and poor public participation collectively reduce regulatory effectiveness, undermine mitigation implementation, and weaken environmental governance. By linking each challenge to its consequences and supporting evidence, the table strengthens understanding of the systemic factors driving persistent non-compliance.

6.2 Corruption, Political Influence, and Policy Gaps

Political interference and corruption systematically weaken Environmental Impact Assessment (EIA) processes in public construction by inducing hurried approvals, compromised technical reviews, and selective enforcement of permit conditions. Case studies document instances where political priorities dominate decision-making, leading to approvals without adequate assessment or follow-up. Empirical work shows that opportunistic behaviour in procurement and contracting, including relationship-oriented favouritism in Public-Private Partnerships (PPPs), can create incentives to bypass or dilute EIA constraints, ultimately reducing transparency and technical rigor in report preparation and review.

Corruption undermines accountability and data integrity, resulting in manipulated monitoring records, weak sanctions, and limited public access to EIA outcomes. Governance deficits are systematically linked to poorer enforcement and larger environmental harms in affected communities (Ijaiya, 2025). Policy gaps, such as unclear mandates and inadequate sanctioning regimes, compound these issues, underscoring the necessity of strengthening institutional autonomy, establishing auditable monitoring systems, and implementing anti-corruption safeguards to restore EIA credibility and protect sustainable development objectives (Onyeka et al., 2024).

6.3 Technical Capacity Constraints

Technical capacity constraints significantly weaken the quality of Environmental Impact Assessments (EIAs). Many jurisdictions lack sufficient trained EIA practitioners and specialized expertise, resulting in subpar Environmental Impact Statement (EIS) documents, developer-driven consultations, and insufficient monitoring frameworks that struggle to implement on-site mitigation measures. This phenomenon has been documented in various sectoral and country-level analyses (Nwamekwe et al., 2025; Bhatt, 2023; Aljareo et al., 2023; George et al., 2024). Such capacity deficits diminish the rigor in baseline characterization, predictive modelling, and the design of feasible mitigation strategies, consequently increasing the risk of ineffective assessments for public construction projects (Nwamekwe et al., 2025; Bhatt, 2023; George et al., 2024). Inadequate scientific data and poorly defined baseline/monitoring indicators further undermine post-approval verification and can facilitate data manipulation

or gaps in reporting, as highlighted in enforcement studies (Nwamekwe et al., 2025; Kim, 2025; Santos et al., 2025). Emerging technical solutions—such as satellite post-clearance verification, regulatory technology (RegTech) and artificial intelligence (AI) for automated monitoring, and integrated digital EIA frameworks—present opportunities for enhancing data quality, transparency, and practitioner efficiency. However, these solutions necessitate substantial investment and skilled personnel to achieve their potential (Ezeanyim et al., 2025; Nwamekwe & Nwabunwanne, 2025).

6.4 Public Participation and Awareness Issues

Many communities lack awareness of environmental impact assessment (EIA) rights and procedures, which limits their ability to contest project decisions or contribute substantive local knowledge. This deficit is documented in studies where public participation in urban planning and stakeholder engagement is weak or tokenistic. Limited early involvement undermines procedural legitimacy and reduces the effectiveness of consultations, particularly in contexts where citizens distrust institutions or face barriers to accessing information that prevents meaningful engagement.

Consequently, reduced stakeholder involvement diminishes EIA effectiveness: decisions are less informed by local risk perceptions, mitigation measures receive weaker social endorsement, and monitoring suffers from low civic oversight. Strengthening awareness and enhancing participatory channels—including digital outreach and capacity-building for communities and planners—has been recommended to improve legitimacy, transparency, and compliance in public construction EIAs.

7.0 Strategies for Improving EIA Compliance

7.1 Strengthening Regulatory Oversight and Monitoring

Strengthening regulatory oversight requires predictable resourcing, firmer sanctions, and institutionalizing regular environmental audits to close the enforcement-implementation gap. Integrated compliance programs that combine funding for agency operations, workforce training, systematic audits, and transparent reporting have been shown to consolidate standards and improve enforcement capacity in project sectors. Empirical analyses indicate that monitoring and enforcement together explain significant variance in

environmental and socio-economic impacts from road projects, underscoring the efficacy of well-resourced oversight and sanctioning regimes (Santos et al., 2025). Operational measures should therefore prioritize routine, independent environmental audits, capacity development for auditors, and statutory sanctions linked to audit findings, complemented by electronic reporting to improve accountability and traceability of compliance actions. Such measures convert EIA conditions from static documents into enforceable management instruments, reduce opportunities for non-compliance, and enhance long-term sustainability outcomes for public construction programmes (Santos et al., 2025).

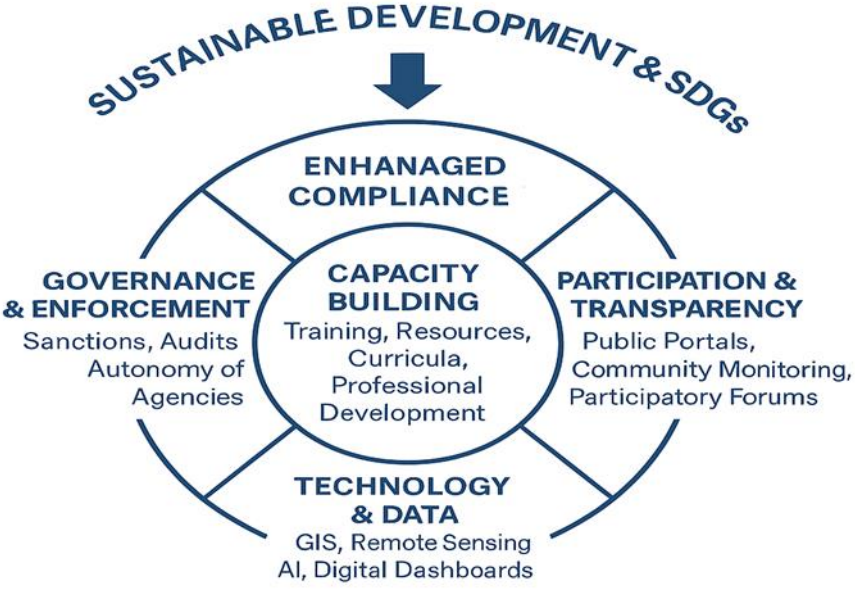

Figure 3: Integrated Strategy Framework for Improving EIA Compliance in Public Construction

Figure 3 illustrates an integrated, multi-layer strategy for improving EIA compliance in public construction. It highlights four mutually reinforcing pillars—governance and enforcement, capacity building, technology and data, and participation and transparency—working together to strengthen regulatory performance. Arrows show how these strategies collectively enhance compliance, which ultimately drives sustainable development outcomes and supports national progress toward achieving relevant Sustainable Development Goals (SDGs).

7.2 Capacity Building for EIA Practitioners and Stakeholders

Targeted capacity building—formal and in service training in environmental modelling, remote sensing/UAV surveys, sensor-based monitoring, GIS, digital twins, and Building Information Modelling (BIM)—improves Environmental Impact Assessment (EIA) rigour by enhancing baseline data quality, predictive analysis, and continuous monitoring for public construction projects (Kamarulzaman et al., 2023). Empirical and technical reviews indicate that training in modern monitoring technologies and data analytics increases transparency and evidence-based decision-making, thereby strengthening compliance verification and adaptive mitigation during construction (Kamarulzaman et al., 2023).

Effective capacity building programmes should integrate university curricula, professional certification, mentorship, short courses, scholarship schemes, and public–private partnerships to institutionalize skills transfer and lifelong learning for practitioners, regulators, and community stakeholders. Incorporating citizen science and participatory monitoring enhances community awareness and oversight, while digital training for regulators enables the use of RegTech and remote verification to address enforcement gaps.

7.3 Leveraging Technology and Digital Tools in EIA Monitoring

Geospatial and remote-sensing toolsets (GIS, multispectral and SAR satellites, LiDAR) provide robust spatial-temporal baselines and change detection critical to Environmental Impact Assessment (EIA) monitoring, enabling automated land-use/cover mapping, hydrological and erosion assessments, and post-clearance verification for construction footprints. Unmanned Aerial Vehicles (UAVs) and drone photogrammetry produce high-resolution Digital Elevation Models (DEMs) and Ortho mosaics for site-level compliance checks (e.g., erosion control, vegetation buffers) complementing satellite observations and improving object detection via AI methods.

Integrating these sensors with IoT, GeoAI, and digital dashboards yields near-real-time alerts, transparent reporting, and spatial dashboards that enhance regulatory oversight, public access, and adaptive management; case studies of real-time forest monitoring systems illustrate operational gains for enforcement and stakeholder transparency. Successful deployment requires interoperable geoinformation systems, analytics capacity, and training to avoid false positives and ensure the legal admissibility of digital evidence.

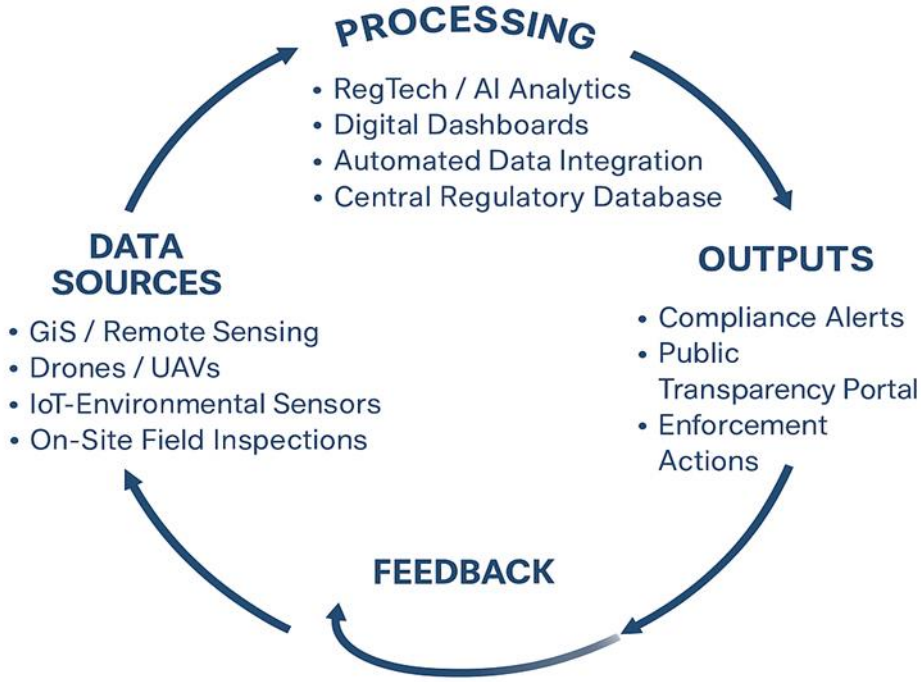

Figure 4: Technology-Enabled EIA Monitoring Architecture for Public Construction Projects

Figure 4 presents a circular architecture demonstrating continuous, technology-enabled EIA monitoring for public construction projects. Data from GIS, drones, IoT sensors, and field inspections flow into AI-powered analytics and regulatory dashboards. The system generates outputs such as compliance alerts, enforcement actions, and public transparency updates. A feedback loop reinforces adaptive monitoring, enabling regulators and project proponents to improve compliance over time.

7.4 Enhancing Public Participation and Transparency

Public disclosure platforms, community monitoring groups, and participatory forums demonstrably improve EIA accountability by widening information access, enabling co production of local knowledge, and creating continuous civic oversight that reinforces permit conditions and mitigation uptake (Butt et al., 2024; Nwamekwe & Chikwendu, 2025; Okeagu et al., 2024; Babatunde et al., 2020). Empirical and practice studies show that participatory approaches — from participatory rural appraisal to community-led biodiversity matrices — increase the legitimacy of decisions, surface context specific impacts, and reduce

opportunities for hurried or opaque approvals in public construction projects (Butt et al., 2024; Babatunde et al., 2020; Nilsson et al., 2018).

Scaling these mechanisms requires digital disclosure, capacity building, and institutional routines for sustained engagement: e governance and ICT portals expand reach and transparency, while collaborative auditing and multi actor partnerships institutionalize community monitoring and feedback into enforcement cycles (Datta et al., 2023; Olawumi & Chan, 2018; Emeka et al., 2025). Combining technology with training and formal participatory procedure therefore strengthens compliance, improves EIA follow up, and enhances project accountability and sustainability outcomes (Datta et al., 2023; Emeka et al., 2025).

8.0 Conclusion and Recommendations

8.1 Summary of Key Findings

The review demonstrates that while legal and institutional frameworks governing EIA are widely adopted, compliance in public construction projects is often inadequate. Several interrelated barriers—including weak enforcement, institutional fragmentation, limited technical expertise, political influence, and poor stakeholder participation—contribute to this shortfall. Empirical studies show recurring patterns of incomplete implementation of mitigation measures, inadequate monitoring, and poor-quality reporting.

As a result, public construction activities continue to generate significant environmental, social, and public health risks. Non-compliance compromises environmental sustainability, disrupts ecosystems, increases pollution levels, and exposes communities to hazards such as flooding and unsafe waste disposal. Ultimately, these gaps threaten long-term development objectives and slow national progress toward achieving key Sustainable Development Goals (SDGs).

8.2 Policy and Practice Recommendations

Strengthening EIA compliance requires integrated interventions across governance, technology, and community engagement. Key recommendations include:

1. Strengthening Regulatory Enforcement: Governments must reinforce compliance mechanisms through stricter sanctions, regular inspections, and

independent environmental audits. Environmental agencies require autonomy to resist political interference and enforce regulations consistently.

2. Enhancing Institutional and Technical Capacity: Adequate funding, improved staffing, and continuous professional training are essential for improving EIA quality. Capacity-building should emphasize environmental modelling, impact prediction tools, field monitoring techniques, and sustainable construction practices.

3. Leveraging Modern Monitoring Technologies: The adoption of Geographic Information Systems (GIS), drones, remote sensing, and digital monitoring dashboards can significantly improve data accuracy, transparency, and real-time tracking of project impacts. These tools help close reporting gaps and support evidence-based decision-making.

4. Promoting Transparency and Public Participation: Increased stakeholder engagement—through open-access EIA portals, participatory forums, and community monitoring groups—enhances accountability and reduces the risk of non-compliance. Effective public participation creates social pressure that encourages developers and institutions to adhere to environmental standards.

5. Ensuring Policy Coherence and Stable Funding: Clearer policy guidelines, harmonized institutional responsibilities, and sustained budgetary support are needed to strengthen overall EIA governance and long-term environmental stewardship.

8.3 Directions for Future Research

To advance the field and address identified gaps, future research should explore:

1. Quantitative Assessment of EIA Compliance Levels: There is a need for empirical metrics that objectively evaluate compliance performance across sectors and regions.

2. Sector-Specific Compliance Challenges: Studies should examine how compliance barriers vary across infrastructure types—such as roads, housing, water systems, and energy projects.

3. Community-Based Monitoring Approaches: Further work is needed on models that empower local communities to participate in EIA monitoring, increase transparency, and improve enforcement outcomes.

4. Role of Emerging Technologies in EIA Enforcement: Artificial intelligence, IoT-enabled sensors, automated environmental reporting systems, and blockchain-based transparency tools offer new possibilities for strengthening

compliance. Empirical research is needed to assess their effectiveness and feasibility in developing contexts.

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