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RESEARCH ARTICLE

Reframing Environmental Impact Assessment Through Building Thermal Performance: A Multidisciplinary Framework for Sustainable Development in Warm-Humid Tropical Nigeria

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ABSTRACT

Environmental Impact Assessment (EIA) is widely recognised as a key instrument for integrating environmental considerations into development planning. However, its effectiveness within the built environment is often constrained when implementation emphasises procedural compliance over multidisciplinary knowledge integration. Consequently, environmentally significant development-performance variables may receive insufficient attention despite their implications for sustainability outcomes. This paper develops a multidisciplinary framework for strengthening Environmental Impact Assessment within warm-humid climatic contexts. The study adopts a conceptual-review approach supported by an illustrative thermal-performance case study from Owerri, Nigeria. Literature was synthesised from Environmental Impact Assessment, environmental management, building physics, sustainable development, urban climatology and climate-responsive design. The Owerri case utilised 1,602 paired attic–indoor temperature observations to demonstrate how environmental conditions influence building performance and how performance outcomes may generate broader environmental consequences. The paper advances a bidirectional interpretation of EIA that recognises reciprocal interactions between environmental conditions, development performance and sustainability outcomes. Building thermal performance is employed as an illustrative environmental variable demonstrating the need for multidisciplinary expertise in environmental assessment. The findings show that environmentally significant relationships frequently emerge at the intersection of architecture, engineering, building physics, planning and environmental science, yet may remain underrepresented within fragmented assessment processes. The study contributes to EIA theory by reconceptualising environmental assessment as a multidisciplinary knowledge-integration platform and proposes a framework for strengthening collaboration, sustainability-oriented decision-making and climate-responsive development within the built environment.

Keywords: *EIA; Multidisciplinary assessment; Thermal performance; Sustainability; Climate-responsiveness; Systems theory*

1. INTRODUCTION

Environmental Impact Assessment (EIA) is widely recognised as one of the most important instruments for integrating environmental considerations into development planning and decision-making. Since it emerged as a formal environmental-management mechanism, EIA has evolved beyond its original role as a regulatory procedure to become an important component of sustainable-development governance. By providing a structured process for identifying, predicting and evaluating the likely consequences of development activities before implementation, EIA seeks to ensure that environmental considerations are incorporated into project planning alongside economic, technical and social objectives (IAIA, 1999; Glasson et al., 2019; Morgan, 2012).

The importance of EIA has increased as sustainability challenges have become more complex and interconnected. Contemporary development is shaped by climate change, rapid urbanisation, resource depletion, environmental degradation and growing demands for resilient infrastructure. These challenges extend beyond traditional environmental concerns and increasingly involve interactions among ecological, technological, social and economic systems. Consequently, environmental assessment is no longer concerned solely with mitigating direct environmental impacts but also with supporting broader sustainability objectives through informed and integrated decision-making (Bond et al., 2020; United Nations, 2023).

Within the built environment, the relevance of EIA is particularly significant because buildings and infrastructure influence environmental systems throughout their life cycle. Development activities alter land cover, modify hydrological processes, affect local microclimates, consume resources and generate emissions. At the same time, environmental conditions influence the operational performance of buildings and infrastructure. These reciprocal relationships suggest that environmental assessment should be capable of addressing both the environmental consequences of development and the implications of environmental conditions for development performance. However, this broader perspective remains only partially reflected within many Environmental Impact Assessment frameworks and implementation practices.

The environmental significance of buildings extends beyond their construction impacts. Operational building performance has emerged as a major sustainability concern because of its influence on energy demand, resource consumption, environmental quality and climate-related outcomes. Buildings account for a substantial proportion of global energy consumption and associated greenhouse-gas emissions, making their operational characteristics increasingly relevant to sustainable-development policy and environmental governance (IEA, 2024; UNEP, 2023).

One of the principal determinants of operational building performance is the interaction between environmental conditions and the building envelope. Climatic variables such as solar radiation, temperature, humidity and wind continuously influence the thermal behaviour of buildings through heat-transfer processes involving conduction, convection and radiation (Hens, 2017). The effectiveness with which building-envelope systems respond to these environmental conditions affects indoor environmental quality, occupant comfort and energy demand. These relationships are particularly important in warm-humid tropical climates where buildings are subjected to sustained thermal stress arising from high solar irradiance, elevated humidity and persistently high temperatures. In such environments, roof systems play a critical role because they represent one of the primary pathways through which solar heat enters buildings (Akbari & Levinson, 2008; Santamouris, 2020). The thermal characteristics of roofs, ceilings and attic spaces therefore influence not only indoor environmental conditions but also broader environmental outcomes through their effects on cooling demand and energy consumption.

Building thermal performance consequently occupies a position at the interface between environmental systems and development systems. Environmental conditions influence building behaviour, while building-performance outcomes contribute to wider sustainability consequences. Understanding these interactions requires knowledge originating from architecture, engineering, building physics, environmental science and climate studies. Building performance is therefore not merely a technical design concern but an issue with direct environmental relevance.

Despite growing recognition of the environmental significance of operational building performance, Environmental Impact Assessment practice continues to focus predominantly on the direct impacts of development activities on environmental systems. Conventional assessment frameworks commonly address issues such as land-use change, biodiversity impacts, pollution, waste management, infrastructure provision and environmental compliance. These considerations remain essential; however, they often provide limited insight into how environmental conditions influence development performance and how resulting performance outcomes may generate additional environmental consequences. This limitation reflects a broader conceptual issue within Environmental Impact Assessment. Much assessment practice continues to be guided by a predominantly linear understanding of environmental relationships in which development is viewed primarily as a source of environmental impact and the environment is regarded as the recipient of those impacts. Such an approach provides only a partial representation of environmental–development interactions because it overlooks the ways environmental conditions influence the long-term performance of development systems.

A second and related limitation concerns the extent of multidisciplinary integration within Environmental Impact Assessment implementation. Environmental problems are inherently multidimensional and frequently require expertise from multiple disciplines. International experience demonstrates that effective Environmental Impact Assessment commonly involves contributions from environmental scientists, planners, engineers, ecologists, economists and other specialists (Bond et al., 2020; Glasson et al., 2019). However, the degree to which different forms of expertise are integrated varies considerably across regulatory and institutional contexts. As a consequence, environmentally significant variables that emerge at the intersection of multiple disciplinary domains may receive insufficient attention within assessment processes.

Building thermal performance provides a useful example of this challenge. Understanding the environmental implications of thermal behaviour requires expertise in architecture, engineering, building physics, climate science and environmental management. Yet such considerations are seldom treated as integral components of Environmental Impact Assessment despite their relevance to energy demand, environmental performance and sustainable development. This observation suggests that the challenge confronting Environmental Impact Assessment extends beyond the omission of individual assessment variables and points instead to the broader issue of multidisciplinary knowledge integration.

Against this background, this paper argues that Environmental Impact Assessment should be reconceptualised as a multidisciplinary and bidirectional environmental-management framework capable of addressing reciprocal interactions between environmental conditions, development performance and sustainability outcomes. Building thermal performance is employed as an illustrative environmental variable through which this broader argument is examined. This paper aims to propose a multidisciplinary framework for strengthening Environmental Impact Assessment within the built environment and to demonstrate how multidisciplinary knowledge integration can enhance the capacity of environmental assessment to support sustainable development in warm-humid climates. To achieve this aim, the study pursues four objectives. First, it examines Environmental Impact Assessment as a process–product system and explores its role as an integrative environmental-management instrument. Second, it develops a bidirectional interpretation of Environmental Impact Assessment that recognises reciprocal interactions between environmental conditions and development performance. Third, it uses evidence from an illustrative thermal-performance case study in Owerri, Nigeria, to demonstrate how environmentally significant variables may emerge at the intersection of multiple disciplinary domains. Fourth, it proposes a multidisciplinary Environmental Impact Assessment framework designed to strengthen knowledge integration and sustainability-oriented decision-making. Existing EIA frameworks remain predominantly procedural and frequently provide limited mechanisms for integrating specialised knowledge from disciplines that influence environmental performance within the built environment. This paper addresses this gap by advancing a multidisciplinary interpretation of Environmental Impact Assessment and by proposing a framework for integrating building-performance considerations into environmental assessment processes. Specifically, the paper contributes to EIA theory by reconceptualising environmental assessment as a multidisciplinary and bidirectional environmental system. The proposed framework operationalises this theoretical reconceptualisation within the context of climate-responsive built-environment assessment.

2. MATERIALS AND METHODS

Conceptual-Review Research Design

This study adopts a conceptual-review research design supported by an illustrative empirical case study. Conceptual-review approaches are particularly appropriate when the objective is to synthesise knowledge from multiple disciplinary domains, identify conceptual limitations within existing scholarship, and develop new theoretical or practice-oriented frameworks (Jaakkola, 2020; Snyder, 2019). Unlike conventional empirical studies that seek statistical generalisation from observed data, conceptual studies focus on integrating existing knowledge, advancing theoretical understanding and generating new perspectives for research and practice.

The problem addressed in this paper spans several disciplinary domains, including Environmental Impact Assessment (EIA), environmental management, architecture, building physics, urban climatology and sustainable development. Although these fields share common concerns relating to environmental performance and sustainability, they have frequently evolved along separate intellectual trajectories. As a result, important relationships between environmental assessment, building performance and sustainable development remain insufficiently integrated within both scholarship and professional practice. The conceptual-review design was therefore adopted to facilitate interdisciplinary synthesis and to provide a basis for developing a multidisciplinary Environmental Impact Assessment framework. The study does not seek to replace existing EIA procedures. Rather, it seeks to identify conceptual limitations within prevailing approaches and propose a framework capable of strengthening knowledge integration within environmental decision-making.

Literature Synthesis Strategy

The study employed an integrative literature-synthesis strategy. Integrative reviews are particularly suited to complex and multidisciplinary research problems because they permit the inclusion of theoretical, empirical, and policy-oriented literature from diverse knowledge domains (Torraco, 2016; Snyder, 2019). This approach was considered appropriate because the study seeks to examine Environmental Impact Assessment not only as a regulatory procedure but also as a sustainability-oriented and multidisciplinary environmental-management process.

Literature was drawn from five principal areas: Environmental Impact Assessment and environmental management; building physics and thermal-performance research; sustainable-development scholarship; urban climatology and climate-responsive design; and systems-thinking approaches to environmental governance. The review focused on recurring themes relevant to the study objectives, including the evolution of Environmental Impact Assessment, multidisciplinary environmental decision-making, environmental influences on development performance, thermal behaviour of buildings, sustainability implications of operational performance and opportunities for strengthening knowledge integration within assessment practice. Rather than undertaking a quantitative meta-analysis, the study employed thematic and conceptual synthesis. This enabled the identification of relationships among concepts originating from different disciplines and provided the basis for developing the framework proposed in this paper.

Role of the Illustrative Owerri Case Study

Although the study is primarily conceptual in orientation, an illustrative empirical case study was incorporated to demonstrate the practical relevance of the conceptual arguments advanced. The purpose of the case study was not to establish statistical generalisation but to provide tangible evidence of the reciprocal relationship between environmental conditions and development performance. The illustrative case involved thermal monitoring of a residential building located in Owerri, southeastern Nigeria, a warm-humid tropical city characterised by high solar irradiance, elevated humidity and persistent thermal stress. Thermal data were obtained using paired Elitech RC-4 temperature loggers installed within the attic and indoor environments of the monitored building. Measurements were recorded at six-hour intervals, generating 1,602 paired attic–indoor temperature observations.

The monitored variables included attic temperature, indoor temperature, attic–indoor thermal gradient, and decrement factor. These indicators were selected because they provide insight into the transmission of environmental heat loads through building-envelope systems and the resulting influence on indoor environmental conditions. Within the context of this study, the Owerri case serves as an illustrative example of how environmentally significant performance variables may emerge at the intersection of architecture, engineering, building physics and environmental science.

Analytical Framework

The analytical framework guiding this study is informed by Systems Theory and multidisciplinary environmental-management principles. Systems Theory conceptualises environmental and development systems as interconnected components of larger socio-ecological systems characterised by interaction, feedback and adaptation (von Bertalanffy, 1968; Checkland, 1999). From this perspective, buildings are not isolated physical entities but dynamic systems that both influence and respond to environmental conditions. The study further recognises Environmental Impact Assessment as both a process and a product. As a process, EIA facilitates the systematic identification, prediction and evaluation of environmental consequences during project planning. As a product, it generates information that informs decision-making, design modification and sustainability outcomes. However, conventional assessment approaches frequently emphasise the impacts generated by development while giving comparatively limited attention to the ways environmental conditions influence development performance. Accordingly, this study adopts the analytical premise that Environmental Impact Assessment should be understood as a bidirectional and multidisciplinary environmental-management system. Environmental conditions influence development performance through physical, ecological and climatic processes, while development-performance outcomes generate environmental consequences through resource consumption, energy demand and environmental modification. This perspective provided the basis for examining existing Environmental Impact Assessment approaches, interpreting the Owerri case evidence and developing the multidisciplinary framework proposed in this paper.

3. RESULTS AND DISCUSSION

Environmental Impact Assessment as Process and Product

Environmental Impact Assessment (EIA) is commonly understood as a systematic process through which the likely environmental consequences of proposed developments are identified, predicted and evaluated before major decisions are taken (IAIA, 1999; Glasson et al., 2019). Since its institutionalisation within environmental governance frameworks, EIA has become one of the most widely adopted mechanisms for incorporating environmental considerations into development planning. Beyond its regulatory role, EIA provides a structured basis for balancing environmental protection, economic development and social objectives within decision-making processes.

The effectiveness of Environmental Impact Assessment derives partly from its dual character as both a process and a product. As a process, EIA involves a sequence of activities including screening, scoping, impact prediction, evaluation, mitigation and monitoring. These activities facilitate the systematic examination of environmental consequences and support informed decision-making. As a product, EIA generates reports, analyses and recommendations that guide project approval, design modification and environmental management (Morgan, 2012).

This dual character is important because it highlights that the value of EIA extends beyond regulatory compliance. The quality of environmental decisions depends not only on the existence of procedural requirements but also on the quality, breadth and integration of knowledge incorporated into assessment processes. Consequently, EIA can be understood as both a technical assessment procedure and a mechanism for generating sustainability-oriented knowledge.

Limitations of Compliance-Oriented Assessment Practice

Despite its recognised importance, EIA is frequently criticised for becoming overly procedural and compliance-oriented. In many contexts, assessment activities are undertaken primarily to satisfy regulatory requirements rather than to strengthen environmental decision-making or sustainability outcomes (Bond et al., 2020; Morgan, 2012). Under such circumstances, EIA risks becoming an administrative exercise focused on document production rather than a substantive mechanism for environmental learning and project improvement. A compliance-oriented approach may also encourage narrow interpretations of environmental impacts. Assessment efforts often concentrate on demonstrating adherence to regulatory standards relating to pollution control, waste management, ecological protection, and land-use compatibility. While these considerations remain essential, they may not adequately capture the broader environmental relationships associated with development systems and their long-term performance. Within the built environment, this limitation becomes particularly significant because environmental consequences frequently emerge throughout the operational life of developments rather than solely during construction. Building performance, energy demand, climate responsiveness, and resource efficiency all influence sustainability outcomes, yet these issues are not always examined comprehensively within conventional assessment frameworks. Consequently, environmentally significant relationships may remain underrepresented despite their relevance to long-term environmental performance. These observations suggest that strengthening Environmental Impact Assessment requires more than procedural refinement. It also requires a broader understanding of environmental relationships and a greater emphasis on integrating diverse forms of knowledge capable of informing sustainability-oriented decision-making.

Environmental Impact Assessment as an Integrative Knowledge Platform

The multidisciplinary nature of environmental problems suggests that EIA should be viewed not merely as a regulatory procedure but as a platform for integrating knowledge from multiple disciplines. Environmental issues rarely occur within isolated domains. Instead, they emerge through interactions among ecological systems, technological systems, social processes and economic activities. Effective assessment therefore depends upon the ability to synthesise different forms of expertise and evaluate their implications collectively. This integrative perspective is consistent with the original philosophy of EIA. EIA was conceived as a decision-support mechanism capable of bringing together diverse information relevant to environmental management (Glasson et al., 2019). In practice, environmental assessments often involve contributions from planners, environmental scientists, engineers, ecologists, economists and other specialists. The challenge lies not simply in assembling multiple experts but in integrating their knowledge in a manner that improves understanding of environmental relationships and sustainability implications. Viewing EIA as an integrative knowledge platform shifts attention away from compliance alone and towards the quality of environmental understanding generated during assessment. It emphasises interdisciplinary collaboration, systems thinking and the identification of interactions among environmental and development systems. Such an interpretation is particularly relevant to contemporary sustainability challenges, which increasingly require coordinated responses across disciplinary boundaries. This perspective also provides a basis for reconsidering the relationship between environmental conditions and development performance. If Environmental Impact Assessment is intended to support informed environmental decision-making, then assessment frameworks should be capable of examining not only the impacts of development on environmental systems but also the ways environmental conditions influence development outcomes.

Conventional One-Way Environmental Assessment Logic

Much EIA practice is implicitly founded on a linear understanding of environmental relationships. Under this conventional interpretation, development activities are regarded primarily as sources of environmental change, while environmental systems are viewed as recipients of those impacts. Consequently, assessment frameworks focus largely on identifying, predicting and mitigating the effects of development on environmental resources and ecological systems (Glasson et al., 2019; Morgan, 2012). This perspective has contributed significantly to environmental protection by drawing attention to issues such as habitat loss, pollution, land degradation and resource depletion. However, it also reflects a largely one-directional conception of environmental relationships. The dominant analytical question becomes: How will the proposed development affect the environment? While this question remains fundamental, it represents only one dimension of environmental interaction. Development systems do not operate independently of environmental conditions. Buildings, infrastructure and human activities are continuously influenced by climatic, ecological and environmental processes. Consequently, environmental relationships extend beyond impact generation and include the ways environmental conditions shape development performance and sustainability outcomes. The limitations of one-way assessment logic become increasingly apparent within climate-sensitive sectors such as the built environment. Environmental variables such as solar radiation, temperature, humidity, wind and precipitation directly influence building performance, energy demand and operational efficiency. Yet these relationships often receive less attention than conventional impact categories despite their environmental significance.

Bidirectional Environmental Relationships

Recognising the reciprocal nature of environmental relationships requires a broader conceptualisation of EIA. Development activities influence environmental conditions through resource consumption, emissions generation and environmental modification. Simultaneously, environmental conditions influence development performance through physical, ecological and climatic processes. Environmental systems and development systems therefore interact through continuous feedback relationships rather than through simple one-way causal pathways. Within the built environment, these interactions are readily observable. Climatic conditions influence thermal behaviour, energy demand, infrastructure performance and occupant well-being. Development responses to these environmental conditions subsequently affect resource consumption, emissions and environmental quality. Building thermal performance provides one example of this relationship because it represents a mechanism through which environmental forcing is translated into operational environmental outcomes.

A bidirectional interpretation of Environmental Impact Assessment therefore expands the scope of environmental analysis. Rather than focusing exclusively on how developments affect environmental systems, assessment also considers how environmental conditions influence the performance and sustainability implications of development systems. This perspective is particularly relevant in the context of climate change, where environmental variability increasingly affects the resilience, efficiency, and long-term viability of development projects. Importantly, a bidirectional approach does not replace conventional impact assessment. Rather, it complements existing assessment practices by providing a more comprehensive understanding of environmental–development interactions and their implications for sustainability.

Systems-Theory Interpretation

Systems Theory provides a useful conceptual foundation for understanding EIA as an integrative and bidirectional process. According to systems thinking, environmental phenomena emerge from interactions among interconnected components rather than from isolated causal relationships (von Bertalanffy, 1968; Checkland, 1999). Environmental systems, development systems and human activities therefore constitute elements of larger socio-ecological systems characterised by feedback, adaptation and interdependence. From a systems perspective, EIA is concerned with understanding relationships rather than merely identifying impacts. Development activities influence environmental systems, environmental conditions influence development performance, and both sets of interactions contribute to broader sustainability outcomes. Assessment therefore becomes a process of evaluating dynamic environmental relationships rather than simply documenting isolated effects. This interpretation aligns closely with contemporary sustainability thinking, which emphasises complexity, resilience and systems-based approaches to environmental governance (Folke et al., 2016). It also provides a conceptual basis for integrating development-performance variables into environmental assessment because such variables often occupy critical positions within environmental feedback systems. The foregoing discussion suggests that EIA should not be understood solely as a mechanism for predicting environmental impacts arising from development activities. Rather, environmental assessment may be conceptualised as a multidirectional system in which environmental conditions influence development performance while development outcomes simultaneously influence environmental sustainability. This perspective extends conventional interpretations of EIA by emphasising multidisciplinary knowledge integration and reciprocal environmental interactions. Accordingly, the present study advances EIA theory by reconceptualising environmental assessment as a multidisciplinary and bidirectional environmental system. The framework proposed in the subsequent section operationalises this theoretical position within the context of climate-responsive built-environment assessment.

Building Physics and Environmental Sustainability

The preceding section argued that EIA should be understood as an integrative and bidirectional environmental-management framework capable of examining reciprocal relationships between environmental conditions and development systems. Within the built environment, one of the most visible manifestations of these relationships is building thermal performance. Building thermal behaviour provides a useful illustration of how environmental conditions influence development performance and how development responses subsequently generate broader environmental consequences.

Building thermal performance is fundamentally governed by the principles of building physics, which examine the transfer of heat, air and moisture through building-envelope systems (Hens, 2017). Environmental conditions such as solar radiation, air temperature, humidity, and wind continuously interact with roofs, walls, windows, and ventilation systems, influencing indoor environmental conditions and operational performance. Consequently, buildings are not passive recipients of environmental influences but dynamic systems whose performance reflects ongoing interactions with their surrounding environment. The environmental significance of thermal performance extends beyond occupant comfort. Operational building performance influences energy demand, resource consumption, and emissions generation, thereby affecting broader sustainability outcomes. According to the International Energy Agency (IEA, 2024) and the United Nations Environment Programme (UNEP, 2023), operational energy use remains one of the most significant contributors to the environmental footprint of the built environment. Improving building responsiveness to environmental conditions therefore represents an important component of sustainable development strategies. These observations highlight an important conceptual point. Building thermal performance occupies a position between environmental conditions and environmental outcomes. Environmental variables influence thermal behaviour, while thermal-performance outcomes influence resource consumption and environmental sustainability. As such, thermal performance provides a useful example of the broader environmental–development interactions discussed in the preceding section.

Thermal Performance and Environmental Outcomes

The relationship between environmental conditions and building performance is particularly evident in warm-humid climates. High solar irradiance, elevated temperatures, and persistent atmospheric humidity create significant thermal stress that influences the operation of buildings throughout their life cycle (Santamouris, 2020). Under such conditions, the ability of buildings to moderate environmental heat gains becomes an important determinant of environmental performance.

Among building-envelope components, roof systems play a particularly significant role because they receive substantial direct solar exposure and often constitute a primary pathway for heat transfer into occupied spaces (Akbari & Levinson, 2008). The thermal characteristics of roof materials, attic spaces, ceiling systems, and ventilation arrangements therefore influence the magnitude of heat transfer and the resulting indoor thermal environment. Building responses to environmental forcing have implications that extend beyond individual structures. Excessive heat gains frequently increase cooling demand, resulting in higher energy consumption and associated environmental impacts. At larger scales, widespread thermal inefficiency may contribute to increased electricity demand, greater emissions intensity, and heightened urban thermal stress. Consequently, thermal performance should not be viewed solely as a building-design concern but also as an issue with broader environmental and sustainability implications. This relationship illustrates the bidirectional nature of environmental interactions. Environmental conditions affect development performance through physical heat-transfer processes, while development-performance outcomes influence environmental quality through energy consumption and associated impacts. Thermal performance therefore functions as an intermediary mechanism linking environmental forcing with environmental consequences. Importantly, understanding these relationships requires expertise from multiple disciplinary domains. Environmental scientists contribute knowledge regarding climatic conditions and environmental processes. Architects address climate-responsive design and building form. Engineers and building physicists evaluate heat-transfer mechanisms and operational performance. Consequently, thermal performance provides an example of how environmentally significant issues frequently transcend disciplinary boundaries and require integrated forms of analysis.

Implications for Environmental Assessment

The significance of building thermal performance within the context of this study lies not in its uniqueness but in its illustrative value. Thermal behaviour demonstrates how environmentally significant variables may emerge through interactions among environmental conditions, technological systems and human activities. It therefore provides a practical example of the types of relationships that may remain insufficiently represented within narrowly defined assessment frameworks. Conventional EIA has historically concentrated on evaluating the effects of development activities on environmental systems. While this focus remains essential, the discussion presented in this paper suggests that assessment processes should also recognise variables that influence the environmental performance of developments throughout their operational life cycle. Building thermal performance represents one such variable because it links environmental conditions, development behaviour and sustainability outcomes. The implication is not that thermal performance should become a dominant component of EIA. Rather, it demonstrates the importance of ensuring that assessment processes possess the capacity to incorporate relevant forms of expertise when environmentally significant issues arise. Similar considerations may apply to other development-performance variables, including energy efficiency, infrastructure resilience, climate-adaptation capacity and operational environmental performance. From this perspective, thermal performance serves as a broader illustration of the need for multidisciplinary EIA. Its environmental significance arises not only from the technical characteristics of buildings but also from the range of expertise required to understand its implications. The issue therefore extends beyond building physics and points towards the broader challenge of knowledge integration within environmental assessment. This observation is particularly important because it shifts attention away from individual assessment variables and towards the institutional and professional structures through which environmental knowledge is generated and applied. If environmentally significant relationships increasingly emerge at the intersection of multiple disciplines, then the effectiveness of EIA will depend upon its ability to facilitate meaningful integration of diverse forms of expertise.

Accordingly, the discussion of building thermal performance provides a bridge between the conceptual arguments developed in the preceding section and the examination of multidisciplinary EIA practice that follows. The example demonstrates why multidisciplinary collaboration matters and why strengthening knowledge integration should be considered a central objective of contemporary EIA systems.

The Multidisciplinary Nature of Environmental Problems

Environmental problems are inherently multidimensional. Issues such as climate change, urbanisation, biodiversity loss, environmental degradation, energy demand and infrastructure resilience emerge through interactions among ecological, technological, social and economic systems rather than from isolated causes. Consequently, understanding and managing environmental problems frequently requires expertise originating from multiple disciplinary domains.

This reality has important implications for EIA. Since EIA seeks to identify, predict and evaluate environmental consequences before development decisions are made, its effectiveness depends upon the breadth and quality of knowledge incorporated into assessment processes. Environmental conditions, development activities and sustainability outcomes are interconnected phenomena that cannot be fully understood through the perspective of a single discipline. Effective environmental assessment therefore requires the integration of expertise capable of addressing different dimensions of environmental change and development performance. Within the built environment, the multidisciplinary nature of environmental problems is particularly evident. Development decisions influence ecological systems, resource consumption, urban microclimates, infrastructure performance and human well-being simultaneously. Similarly, environmental conditions influence the performance of buildings, infrastructure and urban systems through complex physical and climatic processes. Understanding these relationships requires contributions from planning, environmental science, architecture, engineering, ecology, climate science and related fields.

The example of building thermal performance discussed in the preceding section illustrates this challenge. Evaluating the environmental significance of thermal behaviour requires knowledge of climate processes, building-envelope performance, energy systems and sustainability outcomes. No single discipline possesses all the expertise necessary to examine these relationships comprehensively. Consequently, the effectiveness of EIA depends not only on the participation of multiple specialists but also on the integration of their knowledge.

International Best Practices in EIA

International experience demonstrates that EIA is widely recognised as a multidisciplinary process. Across many regulatory systems, environmental assessment is implemented through collaboration among specialists responsible for addressing different dimensions of environmental and development performance (Glasson et al., 2019; Bond et al., 2020).

In the United States, the National Environmental Policy Act established the principle of interdisciplinary environmental assessment by encouraging the integration of scientific, technical and socio-economic expertise within Environmental Impact Statements. Similar approaches are evident within the United Kingdom, Canada, Australia, South Africa and the European Union, where EIA commonly involves coordinated input from environmental scientists, planners, engineers, ecologists and other specialists. These international experiences reflect a shared recognition that environmental assessment cannot be effectively undertaken through a single disciplinary perspective. Environmental consequences are diverse and often interconnected, requiring multiple forms of expertise to identify cumulative effects, evaluate sustainability implications and develop appropriate mitigation strategies. Consequently, multidisciplinary collaboration has become a defining characteristic of mature EIA systems. Importantly, international best practice extends beyond the inclusion of multiple experts. Effective assessment also requires mechanisms for integrating knowledge across disciplinary boundaries. The objective is not merely to produce separate technical reports but to develop a coherent understanding of environmental relationships capable of informing decision-making. This emphasis on integration is particularly relevant in the context of sustainability challenges, where environmental, social and technological issues are increasingly interdependent.

Professional Fragmentation and Knowledge Gaps

Despite widespread recognition of the multidisciplinary nature of EIA, the extent of knowledge integration achieved in practice often varies considerably. In many contexts, assessment activities remain organised around separate disciplinary contributions with limited opportunities for collaborative interpretation and synthesis. As a result, EIA may function as a collection of independent technical studies rather than as a genuinely integrated environmental-management process.

Professional fragmentation can create important knowledge gaps within assessment systems. Specialists frequently focus on variables associated with their respective disciplines, while relationships that span multiple domains may receive comparatively limited attention. Environmental issues that emerge through interactions among climatic conditions, technological systems, infrastructure performance and human behaviour may therefore remain insufficiently examined despite their relevance to sustainability outcomes. Within the built environment, this challenge is particularly significant because development performance is influenced by numerous interacting factors. Building behaviour, infrastructure resilience, energy demand and environmental quality are shaped by relationships among design decisions, engineering systems, climatic conditions and operational practices. Understanding these interactions often requires collaboration among professionals whose expertise extends beyond conventional environmental-impact categories.

The example of building thermal performance illustrates how environmentally significant variables may emerge within these interdisciplinary spaces. Thermal behaviour is influenced by environmental conditions, architectural decisions, engineering systems and building-physics principles, while its outcomes affect energy consumption and environmental sustainability. Where assessment processes operate within fragmented disciplinary structures, such relationships may receive less attention than their environmental significance warrants. The challenge therefore extends beyond the omission of specific variables. It concerns the institutional capacity of EIA to integrate different forms of expertise and to identify environmentally relevant relationships that do not fall neatly within traditional disciplinary boundaries.

Theoretical Implications for EIA

Conventional EIA theory is founded on the principle that development activities generate environmental consequences that must be identified, predicted, evaluated, and mitigated before project implementation to support environmentally informed decision-making (Glasson & Therivel, 2024; Sánchez, 2018). Accordingly, EIA evolved as a predictive and preventive environmental-management instrument concerned primarily with understanding how proposed developments may affect environmental systems and sustainability outcomes (Morgan, 2012; Bond et al., 2020).

While this orientation has significantly strengthened environmental governance worldwide, it has also encouraged a predominantly impact-centred interpretation of environmental assessment in which analytical attention is directed principally toward the effects of development on the environment rather than toward reciprocal interactions between environmental conditions and development performance. While this orientation has significantly strengthened environmental governance, it has traditionally emphasised the influence of development on environmental conditions, thereby providing limited consideration of how environmental conditions may simultaneously influence development performance and sustainability outcomes. The thermal-performance case study from Owerri provides an illustrative example of this reciprocal relationship. The observed thermal behaviour of the building was shaped by climatic variables, roof characteristics, attic configuration, material properties, and heat-transfer processes operating across multiple disciplinary domains. Understanding these relationships required the integration of knowledge from architecture, engineering, building physics, environmental science, and climate-responsive design. The case therefore demonstrates that environmentally relevant performance outcomes may not be adequately captured through fragmented or mono-disciplinary assessment approaches.

Accordingly, this study advances a bidirectional interpretation of EIA in which environmental conditions and development performance are understood as mutually interacting components of a broader environmental-management system. From this perspective, environmental assessment extends beyond the prediction of environmental impacts to include consideration of how environmental conditions influence the sustainability performance of development outcomes. Such a reconceptualisation broadens the analytical scope of EIA and reinforces the importance of multidisciplinary knowledge integration within assessment practice. The multidisciplinary framework proposed in this study operationalises this theoretical interpretation by providing a structured mechanism through which expertise from environmental science, architecture, engineering, planning, and related disciplines can be integrated within environmental assessment processes. In doing so, the framework shifts EIA from a predominantly compliance-oriented exercise toward a more holistic sustainability-oriented platform for knowledge integration and decision-making. The principal theoretical contribution of the study therefore lies in reconceptualising EIA as a multidisciplinary and bidirectional environmental-management system capable of addressing the complex interactions that characterise contemporary climate-responsive development.

Purpose and Context of the Case Study: Owerri, Nigeria

The purpose of the Owerri case study is to provide illustrative empirical evidence supporting the conceptual arguments advanced in this paper. The study is not intended to establish statistical generalisations concerning residential-building performance in warm-humid climates. Rather, it demonstrates how environmentally significant development-performance variables emerge through interactions between environmental conditions and built systems and why understanding such relationships requires multidisciplinary expertise. Owerri, located in southeastern Nigeria, experiences a warm-humid tropical climate characterised by high solar irradiance, elevated humidity and persistently high temperatures. These climatic conditions create substantial thermal stress for residential buildings and make building-envelope performance an important determinant of indoor environmental quality and operational energy demand. The city therefore provides an appropriate context for examining the relationship between environmental forcing and development performance. Within the broader argument of this paper, the case study serves as an example of the reciprocal interactions discussed in Sections 3 and 4. Specifically, it illustrates how environmental conditions influence building behaviour and how resulting performance outcomes possess wider environmental implications.

Thermal Monitoring Procedure

The illustrative case involved thermal monitoring of a two-storey residential building incorporating a lightweight metallic roof system, a common roofing typology within many tropical urban environments. Paired Elitech RC-4 temperature loggers were installed within the attic space and the occupied indoor environment to monitor thermal conditions within the building. Measurements were recorded at six-hour intervals, generating 1,602 paired attic–indoor temperature observations. The monitored variables included attic temperature, indoor temperature, attic–indoor thermal gradient, and decrement factor. These indicators were selected because they provide insight into the influence of environmental heat loads on building performance and the extent to which roof systems moderate external thermal forcing. The case was incorporated not as a comprehensive building-performance study but as a practical demonstration of the type of environmental-performance relationship that may be relevant to EIA and sustainability-oriented decision-making.

Key outcomes of the study

Analysis of the monitored dataset revealed consistent thermal differences between attic and indoor environments. The attic temperature averaged 29.98 °C, while the indoor temperature averaged 29.26 °C, producing a mean attic–indoor thermal gradient of 0.72 °C. These observations indicate that environmental heat gains transmitted through the roof system influenced indoor thermal conditions throughout the monitoring period. Analysis of thermal variability further showed an attic temperature range of 14.8 °C and an indoor temperature range of 11.7 °C. The corresponding decrement factor of approximately 0.79 indicates that a substantial proportion of attic thermal fluctuation was reflected within the indoor environment. This finding suggests relatively limited attenuation of environmental heat loads by the roof–ceiling assembly and highlights the influence of roof-mediated heat transfer on operational building performance. Although the monitored building represents only a single case, the results clearly demonstrate that environmental conditions exert measurable influence on development performance through physical heat-transfer processes. The findings therefore reinforce the argument that building behaviour constitutes an important interface between environmental conditions and sustainability outcomes.

Implications for Multidisciplinary Environmental Assessment

The significance of the Owerri case lies less in the magnitude of the observed temperature differences than in the range of expertise required to interpret them. Understanding the monitored thermal behaviour requires contributions from architecture, engineering, building physics, climatology and environmental science. Each discipline provides a different perspective on the relationship between environmental forcing and development performance.

From an architectural perspective, the findings draw attention to the influence of roof design, material selection and climate-responsive design strategies. Engineering and building-physics perspectives help explain heat-transfer mechanisms and the thermal responsiveness of the roof–ceiling assembly. Environmental science and climatology provide understanding of the climatic conditions responsible for thermal loading. Together, these disciplines reveal relationships that would be difficult to understand through a single professional lens. The case therefore supports the central proposition of this paper that environmentally significant variables often emerge at the intersection of multiple domains of expertise. Building thermal performance is employed here as an illustrative example, but similar interdisciplinary relationships may arise in connection with infrastructure resilience, climate adaptation, water efficiency, energy performance and other sustainability-related concerns. More broadly, the Owerri evidence highlights the limitations of environmental-assessment approaches that focus exclusively on direct impacts generated by development activities. The monitored thermal behaviour demonstrates that environmental conditions also influence development performance and that these performance outcomes may subsequently contribute to wider environmental consequences through energy demand and resource consumption. Consequently, effective EIA requires not only the identification of environmental impacts but also the integration of knowledge capable of explaining environmental–development interactions. The lessons derived from the case study provide empirical support for the multidisciplinary EIA framework proposed in the following section. They demonstrate why stronger knowledge integration is necessary and why EIA should increasingly function as a platform for multidisciplinary environmental understanding and sustainability-oriented decision-making.

Conceptual Basis of the Framework

The preceding sections have argued that EIA (EIA) is most effective when understood as an integrative and bidirectional environmental-management system. Contemporary sustainability challenges emerge through interactions among environmental, technological, social and economic systems and therefore require corresponding integration of knowledge during environmental decision-making. However, EIA practice often remains fragmented, with disciplinary inputs considered separately rather than as components of a coherent analytical process. The illustrative Owerri case study demonstrated how environmentally significant development-performance variables can emerge at the intersection of architecture, engineering, building physics, climatology and environmental science. Building thermal performance was employed as an example because it clearly illustrates how environmental conditions influence development performance and how resulting performance outcomes generate wider environmental consequences. More importantly, the case demonstrated that understanding such relationships requires knowledge extending beyond any single professional domain. The proposed framework responds to this challenge by reconceptualising EIA as a multidisciplinary knowledge-integration platform. Rather than viewing EIA primarily as a compliance procedure, the framework positions it as a mechanism for synthesising diverse forms of expertise in order to improve environmental understanding, sustainability evaluation and development decision-making. The framework is informed by three interrelated principles:

Systems Thinking – Environmental and development systems are interconnected and should be evaluated as components of larger socio-ecological systems.

Bidirectional Environmental Assessment – Assessment should examine both the impacts of development on environmental systems and the influence of environmental conditions on development performance.

Multidisciplinary Knowledge Integration – Effective environmental assessment requires collaboration among multiple professional disciplines and the synthesis of their respective forms of expertise.

Together, these principles provide the conceptual foundation for a more comprehensive and sustainability-oriented EIA process.

Multidisciplinary Knowledge Domains

The framework recognises EIA as a collaborative process involving multiple knowledge domains. Although specific disciplinary requirements vary according to project type and context, the framework identifies six principal domains that commonly contribute to sustainability-oriented assessment within the built environment.

Environmental Science: Environmental science provides expertise relating to ecological systems, environmental quality, biodiversity, pollution processes, and resource management. This domain remains central to conventional EIA because it addresses direct environmental consequences associated with development activities.

Planning and Urban Development: Planning contributes expertise regarding land-use organisation, spatial development, infrastructure provision, development control and urban sustainability. Planners provide understanding of how individual projects relate to broader urban and regional development objectives.

Architecture and Climate-Responsive Design: Architecture contributes expertise concerning building form, spatial organisation, material selection and climate-responsive design strategies. Architectural input is particularly important where environmental conditions influence operational building performance and occupant well-being.

Engineering and Infrastructure Systems: Engineering provides expertise relating to structural systems, mechanical systems, environmental control technologies, infrastructure performance and resource efficiency. Engineering knowledge assists in evaluating technical responses to environmental challenges.

Building Physics and Performance Analysis: Building physics contributes to understanding of heat transfer, moisture movement, energy performance and operational building behaviour. This domain is particularly relevant when environmental conditions influence development performance through physical processes.

Climate and Environmental Modelling: Climate science and environmental modelling provide knowledge regarding environmental forcing, climatic variability, adaptation requirements and future environmental risks. This expertise supports evaluation of long-term sustainability and resilience.

The framework does not suggest that all projects require equal emphasis on every discipline. Rather, it recognises that environmentally significant issues often emerge through interactions among these domains and therefore require integrated forms of assessment.

Integrative Assessment Dimensions

The proposed framework is organised around three interconnected assessment dimensions.

Environmental Conditions: The first dimension concerns environmental conditions that influence development systems. These include climatic variables, ecological processes, environmental quality indicators and resource constraints. Conventional EIA frequently treats such variables primarily as environmental receptors. The proposed framework extends this perspective by recognising them as active determinants of development performance.

Development Systems: The second dimension comprises the physical, technological and organisational characteristics of development projects. Buildings, infrastructure, engineering systems and operational activities are conceptualised as dynamic systems that interact continuously with environmental conditions.

Sustainability Outcomes: The third dimension concerns the environmental, social and economic consequences emerging from environmental–development interactions. These outcomes include energy demand, resource consumption, environmental quality, resilience, operational performance and broader sustainability implications.

The framework proposes that EIA should focus on understanding relationships among these three dimensions rather than examining each dimension independently. Such an approach encourages assessment of environmental interactions, feedback mechanisms, and long-term sustainability consequences.

Framework Structure and Operational Logic

The operational logic of the framework is based on a structured process of multidisciplinary knowledge integration. The process begins with the identification of environmental conditions relevant to the proposed development. These conditions may include climatic characteristics, ecological constraints, environmental risks, and sustainability challenges. Rather than treating these variables solely as environmental receptors, the framework recognises them as factors capable of influencing development performance. The second stage involves multidisciplinary assessment of development systems. Specialists from relevant disciplines evaluate how environmental conditions interact with design decisions, technological systems, infrastructure performance and operational characteristics. This stage represents the primary point of interdisciplinary collaboration within the framework. The third stage involves synthesis of disciplinary findings. Rather than presenting specialist studies as isolated outputs, the framework requires integration of knowledge to identify interactions, dependencies, and cumulative implications. This stage transforms EIA from a collection of technical reports into a coherent environmental-understanding process. The fourth stage evaluates sustainability outcomes arising from environmental–development interactions. Particular attention is given to operational performance, resource efficiency, resilience and long-term environmental consequences. The final stage involves decision support and adaptive management. Assessment findings inform project design, mitigation measures, sustainability strategies and environmental-management plans. Monitoring and feedback mechanisms allow assessment outcomes to inform future decision-making and project adaptation.

This operational sequence establishes EIA as a continuous process of environmental learning rather than a one-time compliance exercise.

Application of the Framework

The proposed framework can be applied across a wide range of development contexts but is particularly relevant within climate-sensitive environments where environmental conditions exert strong influence on development performance. Within warm-humid climates, for example, assessment may require integration of environmental science, climate analysis, architecture, engineering and building-physics expertise to evaluate relationships between environmental forcing and operational performance. Existing development-control and environmental-review procedures often emphasise regulatory compliance and planning approval functions but may provide limited opportunities for systematic integration of building-physics, architectural, engineering, and environmental-performance expertise. The Owerri case illustrates how environmentally significant building-performance outcomes can emerge from interactions that extend beyond the scope of any single discipline. Beyond building thermal performance, the framework is equally applicable to issues such as infrastructure resilience, climate adaptation, energy efficiency, water management and urban sustainability. In each case, environmentally significant relationships emerge through interactions among environmental conditions, development systems and sustainability outcomes. The principal contribution of the framework therefore lies not in promoting the assessment of any single variable but in providing a structure through which multidisciplinary knowledge can be integrated to support more comprehensive environmental decision-making. By repositioning EIA as a knowledge-integration platform, the framework strengthens its capacity to address contemporary sustainability challenges and contributes to the development of more climate-responsive and sustainable built environments.

Policy Implications

The framework proposed in this study has important implications for environmental policy and EIA practice. The analysis has shown that contemporary sustainability challenges increasingly emerge through interactions among environmental conditions, technological systems and development processes. Consequently, EIA must evolve beyond narrowly defined compliance functions towards more integrative approaches capable of supporting sustainability-oriented decision-making.

A key policy implication concerns the need to strengthen multidisciplinary participation within EIA processes. While many regulatory frameworks acknowledge the importance of specialist input, implementation frequently focuses on procedural compliance rather than meaningful knowledge integration. The framework proposed in this paper suggests that the effectiveness of EIA depends not only on the inclusion of multiple disciplines but also on the capacity to synthesise their respective contributions into coherent environmental understanding.

The framework also highlights the importance of recognising development-performance variables within environmental decision-making. The illustrative thermal-performance case demonstrated that environmental conditions can exert significant influence on development outcomes and that these outcomes may subsequently generate broader environmental consequences. Environmental policy should therefore encourage assessment approaches capable of identifying and evaluating such environmental–development interactions throughout the life cycle of projects. More broadly, the framework supports a shift towards systems-oriented environmental governance. Rather than treating environmental impacts as isolated events, assessment systems should increasingly recognise interdependencies, feedback mechanisms and long-term sustainability implications. Such a transition would strengthen the capacity of EIA to contribute to climate-responsive and sustainable development.

Professional Implications

The study also carries important implications for professional practice within the built-environment sector. Environmental problems are rarely confined to a single disciplinary domain, yet professional responsibilities often remain organised around disciplinary boundaries. As a result, environmentally significant relationships that span multiple domains may receive insufficient attention during project planning and assessment. The framework proposed in this paper emphasises that effective EIA should be viewed as a collaborative process rather than the responsibility of a single profession. Environmental scientists, planners, architects, engineers, building physicists and climate specialists each contribute distinct forms of expertise necessary for understanding environmental–development interactions. Consequently, the quality of environmental assessment depends upon the extent to which these perspectives are integrated rather than considered independently.

The Owerri case study illustrates this point clearly. Understanding the observed thermal behaviour required knowledge of climatic conditions, building-envelope performance, architectural design and engineering systems. No single discipline could adequately explain the relationship between environmental forcing and operational performance. The case therefore demonstrates why multidisciplinary collaboration should be regarded as a prerequisite for comprehensive environmental assessment rather than an optional enhancement. The framework further suggests that professional education and capacity-building initiatives should place greater emphasis on interdisciplinary understanding and systems thinking. Strengthening EIA requires not only technical competence within individual disciplines but also the ability to collaborate across disciplinary boundaries and interpret complex environmental relationships.

Contributions to Theory and Practice

This study contributes to EIA scholarship by advancing a conceptual reinterpretation of assessment as an integrative and bidirectional environmental-management framework. Traditional approaches have primarily focused on evaluating the impacts of development activities on environmental systems. While this remains an essential function of EIA, the present study argues that assessment should also examine how environmental conditions influence development performance and how resulting performance outcomes contribute to broader sustainability consequences.

The study therefore extends existing EIA theory by introducing a bidirectional perspective grounded in Systems Theory. From this perspective, environmental systems and development systems are understood as interconnected components of larger socio-ecological systems characterised by interaction, feedback and adaptation. Environmental assessment consequently becomes a process of understanding environmental–development relationships rather than merely documenting environmental impacts.

A second contribution lies in the reconceptualisation of EIA as a multidisciplinary knowledge-integration platform. The framework shifts attention from procedural compliance towards the integration of expertise required to understand complex sustainability challenges. In doing so, it provides a conceptual basis for strengthening collaboration among professional disciplines and improving the analytical capacity of environmental-assessment systems. Practically, the framework offers a structured approach for incorporating multidisciplinary knowledge into EIA processes. Although building thermal performance served as the illustrative example employed in this paper, the framework is equally applicable to a wide range of sustainability issues involving interactions among environmental conditions, development systems, and operational performance.

Future Research Directions

The framework proposed in this study provides a conceptual foundation for future research concerning multidisciplinary EIA and sustainability-oriented environmental governance. Additional studies are needed to examine how the framework performs within different climatic regions, development sectors, and regulatory contexts. Such investigations would help evaluate its adaptability and practical effectiveness across diverse environmental and institutional settings. Future research may also explore other development-performance variables that possess environmental significance but remain underrepresented within conventional EIA practice. Building thermal performance was selected because it provides a clear illustration of environmental–development interactions within warm-humid climates. However, similar relationships may exist in relation to infrastructure resilience, energy systems, water efficiency, climate adaptation and operational sustainability. Further work is also required to investigate institutional mechanisms capable of supporting multidisciplinary collaboration within EIA. Understanding how knowledge integration occurs in practice, and how barriers to interdisciplinary cooperation can be overcome, represents an important area for future scholarship. Ultimately, the future development of EIA will depend upon its ability to respond to increasingly complex sustainability challenges. Research that strengthens multidisciplinary understanding, systems thinking and environmental knowledge integration will therefore play an important role in shaping the next generation of environmental-assessment practice.

4. CONCLUSION

Environmental Impact Assessment remains one of the most important mechanisms for integrating environmental considerations into development planning and decision-making. However, the increasing complexity of contemporary sustainability challenges has exposed limitations in assessment approaches that emphasise procedural compliance while giving comparatively less attention to multidisciplinary knowledge integration. Environmental issues associated with climate change, urbanisation, resource efficiency, infrastructure performance and environmental quality are characterised by interactions among environmental, technological and social systems that cannot be adequately understood through isolated disciplinary perspectives.

This paper has argued that Environmental Impact Assessment should be reconceptualised as an integrative and bidirectional environmental-management framework capable of addressing these complex interactions. Building thermal performance was employed as an illustrative environmental variable through which this broader argument was examined. The discussion demonstrated that environmental conditions influence development performance and that resulting performance outcomes may generate wider environmental consequences through their effects on energy demand, operational efficiency, and sustainability. More importantly, the analysis showed that understanding such relationships requires the integration of expertise from multiple disciplinary domains.

The illustrative Owerri case study provided empirical support for this argument by demonstrating how environmental forcing influenced building thermal behaviour and how interpretation of the observed performance required contributions from architecture, engineering, building physics, climatology and environmental science. Although the case focused on thermal performance, its broader significance lies in highlighting the type of environmentally significant relationships that may emerge at the intersection of multiple fields of knowledge and therefore require corresponding multidisciplinary assessment. On the basis of these observations, the paper proposed a multidisciplinary Environmental Impact Assessment framework designed to strengthen knowledge integration within environmental decision-making. The framework positions Environmental Impact Assessment as a collaborative platform through which environmental conditions, development systems and sustainability outcomes can be evaluated within a coherent analytical structure. By incorporating systems thinking, bidirectional environmental relationships and multidisciplinary collaboration, the framework extends conventional interpretations of Environmental Impact Assessment and provides a basis for more comprehensive sustainability-oriented assessment.

The principal theoretical contribution of this study lies in reconceptualising EIA as a multidisciplinary and bidirectional environmental system rather than a predominantly procedural impact-prediction exercise. By operationalising this perspective through a multidisciplinary assessment framework, the study provides a pathway for integrating climate-responsive building-performance considerations into sustainability-oriented environmental assessment practice.

5. COMPETING INTERESTS

None to declare.

REFERENCES

Akbari, H., & Levinson, R. (2008). Evolution of cool-roof standards in the United States. *Advances in Building Energy Research, 2*(1), 1–32. https://doi.org/10.3763/aber.2008.0201

Bond, A., Morrison-Saunders, A., Pope, J., & Retief, F. (2020). *Environmental impact assessment: Practice and participation* (4th ed.). Oxford University Press.

Checkland, P. (1999). *Systems thinking, systems practice: Includes a 30-year retrospective*. John Wiley & Sons.

Folke, C., Biggs, R., Norström, A. V., Reyers, B., & Rockström, J. (2016). Social-ecological resilience and biosphere-based sustainability science. *Ecology and Society, 21*(3), Article 41. https://doi.org/10.5751/ES-08748-210341

Glasson, J., Therivel, R., & Chadwick, A. (2019). *Introduction to environmental impact assessment* (5th ed.). Routledge.

Hens, H. (2017). *Building physics—Heat, air and moisture: Fundamentals and engineering methods with examples and exercises* (3rd ed.). Ernst & Sohn.

International Association for Impact Assessment. (1999). *Principles of environmental impact assessment best practice*. International Association for Impact Assessment.

International Energy Agency. (2024). *Energy efficiency 2024*. International Energy Agency.

Jaakkola, E. (2020). Designing conceptual articles: Four approaches. *AMS Review, 10*(1–2), 18–26. https://doi.org/10.1007/s13162-020-00161-0

Morgan, R. K. (2012). Environmental impact assessment: The state of the art. *Impact Assessment and Project Appraisal, 30*(1), 5–14. https://doi.org/10.1080/14615517.2012.661557

Oke, T. R., Mills, G., Christen, A., & Voogt, J. A. (2017). *Urban climates*. Cambridge University Press.

Pisello, A. L. (2022). *Building energy and environmental performance: Towards sustainable and smart buildings*. Springer.

Sánchez, L. E. (2018). *Environmental Impact Assessment and Environmental Management in Developing Countries*. Edward Elgar.

Santamouris, M. (2020). *Minimizing energy consumption, energy poverty and global and local climate change in the built environment: Innovating to zero*. Elsevier.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research, 104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Torraco, R. J. (2016). Writing integrative literature reviews: Using the past and present to explore the future. *Human Resource Development Review, 15*(4), 404–428. https://doi.org/10.1177/1534484316671606

United Nations. (2023). *The Sustainable Development Goals Report 2023*. United Nations.

United Nations Environment Programme. (2023). *2023 global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector*. United Nations Environment Programme.

von Bertalanffy, L. (1968). *General system theory: Foundations, development, applications*. George Braziller.