Triple Bottom Line Drivers of Sustainable Construction Performance in Nigeria: Evidence from Abuja Construction Firms

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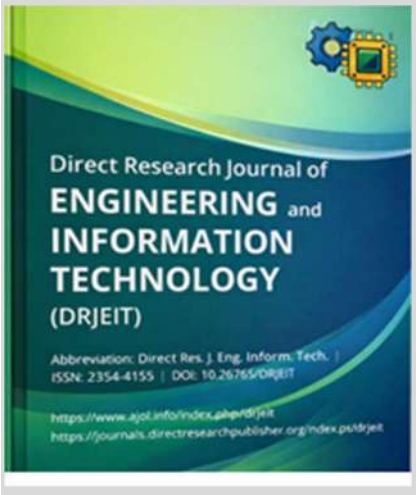
ABSTRACT

Although sustainability awareness in the construction sector has grown substantially over the last decade, empirical studies that simultaneously test the environmental, social, and economic pillars of the Triple Bottom Line (TBL) within a single, statistically validated model remain scarce in the Nigerian context; this study addresses that gap by providing the first integrated, firm-level evidence from Abuja. The growing environmental, social, and economic challenges associated with construction activities have intensified global calls for sustainable construction practices, particularly in developing countries such as Nigeria, where implementation remains inconsistent despite increasing awareness. This study examined the determinants of sustainable construction in Nigeria from a Triple Bottom Line perspective, focusing on environmental sustainability (EnvS), social sustainability (SS), and economic sustainability (EcoS) among construction firms operating in Abuja. A quantitative, cross-sectional survey design was adopted, targeting construction professionals and selected community stakeholders within five purposively selected construction firms. Using the Krejcie and Morgan (1970) table, a minimum sample size of 240 was established; 240 structured, five-point Likert-scale questionnaires were administered using stratified random sampling, and 221 valid responses (92.1% response rate) were retained for analysis. Data were analyzed with SPSS version 27 using descriptive statistics and multiple regression analysis at the 0.05 significance level. The regression model was statistically significant, $F(3, 217) = 6.142$, $p < .001$, and jointly explained 7.8% of the variance in sustainable construction performance ($R^2 = .078$, Adjusted $R^2 = .065$). All three dimensions exerted a significant positive influence on sustainable construction performance: environmental sustainability ($\beta = .121$, $p = .049$), social sustainability ($\beta = .097$, $p = .031$), and economic sustainability ($\beta = .134$, $p = .046$), with economic sustainability emerging as the strongest determinant, followed by environmental sustainability, while social sustainability recorded the weakest influence. The results further indicate that sustainable construction practices in Abuja are still unevenly implemented, with greater emphasis placed on economic and environmental dimensions than on social sustainability. The study concludes that achieving sustainable construction in Nigeria requires a balanced integration of the Triple Bottom Line dimensions, supported by stronger institutional enforcement, improved stakeholder engagement, and targeted policy incentives that promote holistic sustainability adoption across the construction sector.

Keywords: *Environmental sustainability, social sustainability, economic sustainability, Sustainable Development Goals, green construction, Stakeholder Theory*



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INTRODUCTION

The construction industry is widely recognized as a cornerstone of economic development because of its contribution to infrastructure provision, employment creation, and national productivity. However, it is also one of the most resource-intensive and environmentally challenging sectors globally. According to the United Nations Environment Programme (UNEP, 2024), the buildings and construction sector accounts for approximately 34% of global energy demand and 37% of energy- and process-related carbon emissions. In addition, construction activities consume nearly half of the world's raw materials and generate substantial volumes of waste, placing significant pressure on environmental resources and sustainable development efforts (World Green Building Council, 2023). These concerns have intensified global calls for the adoption of sustainable construction practices capable of balancing economic growth with environmental protection and social well-being (Goh et al., 2020).

In response to these challenges, sustainable construction has emerged as a critical strategy for promoting long-term environmental, social, and economic sustainability within the built environment. The concept extends beyond the traditional project objectives of cost, quality, and time by emphasizing the efficient use of resources, environmental stewardship, social responsibility, and economic viability throughout the construction life cycle (Kibert, 2016). Consequently, the Triple Bottom Line (TBL) framework, comprising environmental, social, and economic sustainability dimensions, has become the dominant theoretical lens for evaluating sustainable construction performance (Goh et al., 2020). Existing evidence suggests that construction firms that successfully integrate these dimensions are more likely to achieve improved project outcomes, enhanced stakeholder satisfaction, and long-term organizational competitiveness (Opoku & Ahmed, 2014).

Despite growing awareness of sustainability issues, the implementation of sustainable construction remains uneven, particularly in developing countries. Rapid urbanization, population growth, weak regulatory enforcement, financial constraints, and limited technological capabilities continue to hinder sustainability adoption across many emerging economies (Aghimien et al., 2018; Darko & Chan, 2016). This challenge is particularly important in Africa, where increasing infrastructure deficits have intensified construction activities without a corresponding increase in sustainable construction practices (Djokoto et al., 2014). As a result, environmental degradation, resource depletion, construction waste generation, and occupational safety concerns remain significant issues within the sector.

Nigeria exemplifies many of these challenges. The construction sector contributes significantly to national economic growth and infrastructure development, yet sustainability practices remain relatively underdeveloped compared to global standards (Ofori-Kuragu et al., 2016). Studies have shown that the Nigerian construction industry faces persistent challenges related to construction waste, inefficient material utilization, inadequate environmental management, poor occupational health and safety practices, as well as escalating project costs (Ogunmakinde et al., 2019; Aghimien et al., 2018). For example, Ogunmakinde et al. (2019) reported that material waste remains a major source of inefficiency within construction projects in Nigeria, contributing to both environmental and economic losses. Similarly, Aghimien et al. (2018) identified inadequate awareness, financial limitations, weak government support, and resistance to change as critical barriers to sustainable construction implementation. More recently, Akindele et al. (2023) confirmed that regulatory, financial, and knowledge-based barriers continue to constrain sustainable construction practice in Nigeria, while Abah et al. (2024) and Unegbu et al. (2025) similarly showed that these institutional, financial, and technical constraints persist, suggesting that the sustainability performance of the Nigerian construction sector continues to fall below expectations despite increasing global emphasis on sustainable development.

The situation is particularly evident in Abuja, Nigeria's Federal Capital Territory, where rapid urban expansion and continuous infrastructure development have increased the demand for residential, commercial, and public construction projects. While these developments have stimulated economic activities and improved urban infrastructure, they have also increased pressure on environmental resources through higher levels of energy consumption, construction waste generation, and land-use transformation (Abah et al., 2024). Recent evidence further indicates that many construction firms operating within Nigeria continue to struggle with integrating sustainability considerations into project planning and execution due to institutional, financial, and technical constraints (Unegbu et al., 2025). If these challenges persist, the industry may experience increased environmental degradation, rising project costs, reduced productivity, poor worker welfare, and declining long-term competitiveness, thereby undermining Nigeria's broader sustainable development objectives.

Although prior Nigerian studies have examined individual sustainability dimensions, they have generally failed to test the three TBL pillars within a single, theoretically grounded, statistically validated model. This reflects three interlocking gaps. Theoretically, most studies invoke sustainability frameworks descriptively without deriving testable hypotheses from an explicit organizational theory; this study addresses that gap by deriving its hypotheses directly from Stakeholder Theory (Freeman, 1984). Methodologically, prior work has relied heavily on qualitative or purely descriptive designs, or has tested sustainability dimensions in isolation rather than jointly, limiting the ability to compare their relative

explanatory strength; this study addresses that gap through a multiple regression model that simultaneously estimates the effect of all three TBL dimensions, supported by full diagnostic testing. Contextually, empirical evidence specifically from Abuja's construction sector, where rapid federal-capital growth creates a distinctive combination of regulatory, commercial, and community pressures, remains limited, with most Nigerian studies focused on Lagos or generalized national samples. Few studies integrate the TBL within a single empirical model that addresses all three gaps simultaneously.

Given that sustainable construction requires the simultaneous integration of environmental responsibility, social inclusiveness, and economic viability, there is a need for a holistic investigation of these dimensions from a Triple Bottom Line perspective. Accordingly, this study examines the influence of environmental sustainability, social sustainability, and economic sustainability on sustainable construction among construction firms in Abuja, Nigeria. To achieve this objective, the study seeks to provide answers to the following research questions:

RQ1: To what extent does environmental sustainability influence sustainable construction among construction firms in Abuja, Nigeria?

RQ2: To what extent does social sustainability affect sustainable construction among construction firms in Abuja, Nigeria?

RQ3: To what extent does economic sustainability affect sustainable construction among construction firms in Abuja, Nigeria?

LITERATURE REVIEW

Conceptual Review

Sustainable Construction

Sustainable construction has evolved from a narrow focus on environmental protection to a broader concept that integrates environmental stewardship, social responsibility, and economic viability throughout the life cycle of construction projects (Kibert, 2016; Goh et al., 2020). The concept is rooted in the principles of sustainable development, which advocate meeting present needs without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987; Unegbu et al., 2025). Within the construction context, sustainable construction seeks to minimize environmental impacts, improve social well-being, and enhance economic performance through efficient resource utilization, waste reduction, energy conservation, and stakeholder engagement (Kibert, 2016). Literature suggests that sustainable construction has become a strategic imperative rather than a voluntary organizational initiative. Goh et al. (2020) observed that the increasing environmental footprint of construction activities, coupled with rising stakeholder expectations, has compelled firms to integrate sustainability considerations into project planning and execution. Similarly, Darko and Chan (2016) argued that sustainable construction enhances project performance while simultaneously contributing to environmental conservation and social development. Despite growing awareness, evidence from developing countries indicates that sustainable construction adoption remains relatively low due to institutional, financial, and technical constraints (Aghimien et al., 2018). Consequently, understanding the factors that promote sustainable construction remains an important area of scholarly inquiry.

Environmental Sustainability

Environmental sustainability refers to the responsible utilization of natural resources in a manner that minimizes environmental degradation while maintaining ecological balance for future generations (United Nations Environment Programme [UNEP], 2024). Within the construction industry, environmental sustainability encompasses practices such as energy efficiency, waste minimization, pollution control, resource conservation, and the adoption of environmentally friendly construction materials (Goh et al., 2020). Existing studies consistently identify environmental sustainability as a fundamental pillar of sustainable construction. According to the World Green Building Council (2023), construction activities account for substantial energy consumption and carbon emissions globally, making environmental management a critical requirement for achieving sustainability goals. Empirical evidence further suggests that firms adopting environmentally sustainable practices experience reduced waste generation, improved resource efficiency, and enhanced environmental performance (Darko & Chan, 2016). Similarly, Ogunmakinde et al. (2019) found that poor waste management remains a major challenge in the Nigerian construction industry, resulting in significant environmental and economic losses. While previous studies have largely emphasized environmental management practices as drivers of sustainable construction, most have examined environmental factors in isolation, thereby overlooking their interaction with social and economic sustainability dimensions. This study addresses this limitation by examining environmental sustainability within a broader Triple Bottom Line framework.

Social Sustainability

Social sustainability refers to the ability of organizations and societies to promote human well-being, equity, safety, and social inclusion while fostering positive relationships among stakeholders (Shen et al., 2010). In the construction sector, social sustainability encompasses occupational health and safety, employee welfare,

community engagement, stakeholder participation, and ethical business practices (Opoku & Ahmed, 2014). The importance of social sustainability in construction has gained increasing attention because construction projects directly affect workers, communities, and other stakeholders. Shen et al. (2010) argued that socially sustainable construction practices contribute to improved project outcomes by enhancing stakeholder trust, workforce productivity, and community acceptance. Similarly, Opoku and Ahmed (2014) emphasized that organizations integrating social sustainability into their operations are better positioned to achieve long-term project success and stakeholder satisfaction. However, research indicates that social sustainability remains one of the least explored dimensions of sustainable construction, particularly in developing countries where sustainability discussions often prioritize environmental concerns (Goh et al., 2020). Consequently, further empirical evidence is required to clarify the contribution of social sustainability to sustainable construction performance, especially within the Nigerian context.

Economic Sustainability

Economic sustainability refers to the ability of organizations to achieve long-term financial viability while efficiently utilizing resources and maintaining competitiveness (Elkington, 1998). Within the construction industry, economic sustainability involves cost efficiency, profitability, productivity improvement, lifecycle cost management, and value creation for stakeholders (Goh et al., 2020). Although environmental and social considerations are essential, sustainable construction initiatives cannot be sustained without economic viability. Studies have shown that economically sustainable construction practices improve project efficiency, reduce operational costs, and enhance organizational performance over the long term (Kibert, 2016). Furthermore, Goh et al. (2020) observed that firms are more likely to adopt sustainable construction practices when such initiatives generate measurable economic benefits. Nevertheless, many construction firms in developing economies continue to perceive sustainability initiatives as financially burdensome, thereby limiting adoption (Aghimien et al., 2018). This perception highlights the need for empirical studies that evaluate the contribution of economic sustainability to sustainable construction outcomes. Therefore, this study examines economic sustainability alongside environmental and social sustainability to provide a more comprehensive understanding of sustainable construction determinants among construction firms in Abuja, Nigeria.

Triple Bottom Line Perspective

The Triple Bottom Line (TBL) framework, introduced by Elkington (1998), provides a comprehensive approach for evaluating organizational sustainability through the integration of environmental, social, and economic performance. The framework has become one of the most widely adopted perspectives in sustainable construction research because it recognizes that sustainability outcomes are achieved through the simultaneous consideration of multiple dimensions rather than a singular focus on environmental performance (Goh et al., 2020). A review of existing literature reveals that while numerous studies have examined individual sustainability dimensions, relatively few have investigated their combined influence on sustainable construction, particularly within developing economies (Goh et al., 2020; Aghimien et al., 2018). This limitation is significant because sustainable construction is inherently multidimensional and requires a balanced integration of environmental responsibility, social inclusiveness, and economic viability. Consequently, this study adopts the Triple Bottom Line framework to examine how environmental sustainability, social sustainability, and economic sustainability collectively influence sustainable construction among construction firms in Abuja, Nigeria.

Empirical Review

This section examine the empirical studies on sustainable construction with emphasis on environmental, social, and economic sustainability within the Triple Bottom Line (TBL) framework. The review draws evidence from global literature, Africa, and Nigeria, with particular attention to study objectives as shown in (Table 1).

Environmental Sustainability and Sustainable Construction

Empirical literature consistently shows that environmental sustainability is widely recognized in construction practice, although its actual implementation remains uneven across contexts. Darko and Chan (2016), in a study covering developing economies including African construction environments, found that environmental drivers such as regulatory enforcement, energy efficiency requirements, and waste reduction policies significantly influence construction firms' adoption of sustainable practices, particularly among medium and large contractors responding to institutional pressure. However, the study also reported that in weaker regulatory environments, these factors become less significant, indicating inconsistent influence depending on governance strength. In Nigeria, Ogunmakinde et al. (2019), focusing on construction professionals and site operations, found that material waste generation remains persistently high, while environmental management practices such as recycling and reuse show limited and sometimes statistically insignificant effectiveness in reducing overall waste levels. Similarly, Abah et al. (2024), examining urban construction activities, reported that although professionals

Table 1: Summary of Reviewed Empirical Studies.

Author(s)/Year	Country	Key Variables	Method	Sample	Major Finding(s)	Identified Gap
Darko & Chan (2016)	Cross-country (Africa-inclusive)	Environmental drivers, adoption	Survey/Review	Construction journals data	Regulatory strength significantly affects environmental sustainability adoption	Single-dimension focus; no joint TBL test
Ogunmakinde et al. (2019)	Nigeria	Waste management	Review/Survey	Construction professionals	Material waste remains high; weak management effectiveness	Environmental factor examined in isolation
Shen et al. (2010)	International	Stakeholder engagement, safety	Survey	Contractors & community actors	Social sustainability improves acceptance but weak link to cost/time	Indirect effects untested statistically
Opoku & Ahmed (2014)	UK / developing countries	Worker welfare, OHS	Survey	Construction organizations	Positive link to productivity; low adoption	No integration with economic/environmental pillars
Aghimien et al. (2018)	Nigeria	Barriers to sustainability	Survey	Professionals, multi-region	Social/economic implementation inconsistent and often insignificant	Fragmented, descriptive treatment of barriers
Goh et al. (2020)	Developing countries (review)	TBL dimensions	Systematic review	Construction firms	TBL studies remain fragmented; social least operationalized	Few studies test TBL as an integrated model
Akindele et al. (2023)	Nigeria	Barriers to sustainable construction	Survey	Construction practitioners	Regulatory, financial and knowledge barriers persist	Barriers studied without joint TBL outcome testing
Abah et al. (2024)	Nigeria (Abuja)	Environmental sustainability	Survey	Urban construction professionals	Awareness exists but implementation weak/insignificant	Limited statistical/contextual depth for Abuja
Unegbu et al. (2025)	Nigeria	TBL barriers	Survey/Review	Practitioners, multi-city	Sustainability adoption remains fragmented and constraint-driven	Descriptive; limited joint regression testing

Source: Author's synthesis of reviewed literature (2026).

demonstrate awareness of environmental sustainability principles, actual implementation such as use of eco-friendly materials and pollution control measures remains weak and, in some cases, statistically insignificant in influencing project performance due to cost constraints and weak enforcement mechanisms. Unegbu et al. (2025), in a broader Nigerian construction review involving practitioners across major cities, further confirmed that environmental sustainability practices are often applied in a fragmented manner, with limited institutional integration into daily construction operations. Taken together, these studies indicate that the divergence in significance is largely explained by regulatory strength: where enforcement is weak, environmental effects shrink towards insignificance, whereas the present study's significant result ($\beta = .121$, $p = .049$) suggests Abuja's enforcement environment, while still developing, is marginally stronger than in some of the contexts reviewed above.

Social Sustainability and Sustainable Construction

Social sustainability studies emphasize the human and community dimensions of construction, although empirical findings reveal mixed levels of effectiveness in practice. Shen et al. (2010), drawing from international construction stakeholders including contractors and community actors, found that stakeholder engagement, safety practices, and ethical labor conditions significantly improve project acceptance and stakeholder satisfaction, though their direct effect on cost and time performance was relatively weak, suggesting indirect rather than direct influence. Opoku and Ahmed (2014), focusing on construction firms in developing countries, reported that social sustainability practices such as worker welfare and occupational health and safety positively influence workforce productivity and organizational reputation; however, adoption levels remain low due to weak enforcement and limited organizational prioritization. In Nigeria, Aghimien et al. (2018), surveying construction professionals across multiple regions, observed that while awareness of social sustainability exists, its implementation in areas such as safety compliance and stakeholder participation is inconsistent and often not statistically significant in influencing project outcomes. Supporting this, Unegbu et al. (2025) found that community engagement in Nigerian construction projects is frequently symbolic rather than participatory, resulting in weak or insignificant relationships between formal engagement processes and actual project success indicators. Goh et al. (2020) further reinforced that social sustainability remains the least operationalized dimension

of the TBL framework, particularly in developing economies where project delivery pressures often overshadow social considerations. The present study's marginally significant result for social sustainability (β = .097, p = .031) is therefore broadly consistent with this literature: significant, but consistently the weakest of the three TBL pillars across studies.

Economic Sustainability and Sustainable Construction

Economic sustainability is widely regarded as the most influential dimension of the Triple Bottom Line in construction decision-making, although empirical findings show both strong and weak effects depending on financial context. Elkington (1998) conceptualized economic sustainability as essential for ensuring long-term organizational viability, especially in capital-intensive industries such as construction. Goh et al. (2020), analyzing construction firms across developing countries, found that perceived cost savings, lifecycle efficiency, and productivity improvements significantly encourage adoption of sustainable construction practices, particularly among financially stable organizations. However, the study also noted that in contexts where upfront capital is limited, these economic benefits become less influential in decision-making. In Nigeria, Aghimien et al. (2018), surveying contractors and consultants, reported that high initial costs and lack of financial incentives significantly discourage sustainable construction adoption, although long-term economic benefits were found to have weak or delayed influence on firm-level decisions. Unegbu et al. (2025) further confirmed that economic sustainability is often perceived as a constraint rather than a driver, as firms prioritize immediate project profitability over long-term financial efficiency. The consistency of economic sustainability as the strongest, most reliably significant predictor across these studies, and again in the present study (β = .134, p = .046), reinforces the argument that cost logic dominates sustainability decision-making in resource-constrained construction markets more than environmental or social logic does.

Empirical Gap Identified

Despite the growing body of research on sustainable construction, empirical studies that integrate environmental, social, and economic sustainability within a unified Triple Bottom Line framework remain limited. Goh et al. (2020) emphasized that most existing studies adopt a fragmented approach, examining each sustainability dimension separately, which often leads to inconsistent or weak empirical relationships when tested in isolation. In Nigeria, Unegbu et al. (2025) noted that research is still largely descriptive and sector-specific, with limited empirical testing of how the three TBL dimensions interact to influence overall sustainable construction performance among practitioners and contractors. Similarly, Akindele et al. (2023), Aghimien et al. (2018), and Abah et al. (2024) highlighted that while environmental and economic aspects receive relatively more attention, the combined effect of environmental, social, and economic sustainability remains underexplored, particularly in rapidly developing construction environments. Across studies involving construction professionals, contractors, and stakeholders in developing economies, findings consistently show that sustainability dimensions may be individually recognized but are not always simultaneously implemented or statistically significant when isolated. This creates a clear empirical gap in understanding how the integrated TBL framework influences sustainable construction outcomes in practice, thereby justifying the need for a holistic investigation among construction firms in Nigeria. The present study closes this gap by testing all three TBL dimensions jointly in a single regression model, and by deriving its hypotheses directly from Stakeholder Theory rather than treating sustainability descriptively (see Theoretical Framework and Hypothesis Development below), thereby providing the integrated, statistically validated evidence that the reviewed literature has so far lacked.

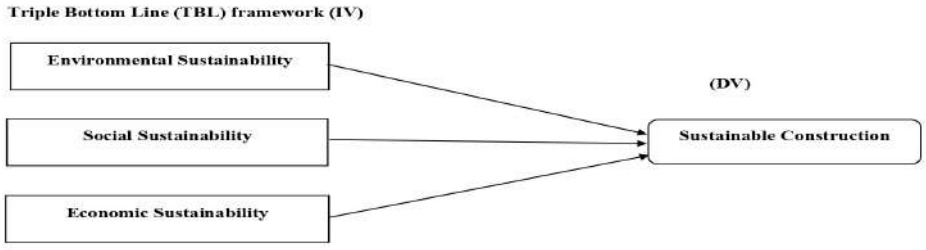
Theoretical Framework and Hypothesis Development

This study is guided by Stakeholder Theory (Freeman, 1984), which explains that organizations perform better when they consider and balance the needs of all groups affected by their activities, not just profit-focused interests. In construction, these groups include clients, contractors, regulators, workers, host communities, suppliers, and the environment, all of whom influence how projects are planned and delivered. The theory fits well with the Triple Bottom Line (TBL) because it naturally explains sustainability as a balance of competing stakeholder expectations. Environmental sustainability reflects pressure from regulators and communities for responsible resource use and reduced ecological damage; social sustainability reflects expectations from workers and host communities around safety, fairness, and well-being; while economic sustainability reflects the expectations of investors, clients, and firms themselves for cost efficiency and profitability. In this sense, sustainable construction is achieved when construction firms successfully balance these three stakeholder-driven demands. Empirical studies support this view: Freeman (1984) argues that firms that manage stakeholder relationships well achieve stronger long-term success, while Opoku and Ahmed (2014) and Shen et al. (2010) found that engaging stakeholders improves trust, acceptance, and overall project outcomes in construction specifically. However, studies in developing countries, including Nigeria, show that economic concerns often dominate decisions, while social and environmental issues are sometimes sidelined due to cost and institutional pressures (Aghimien et al.,

2018; Unegbu et al., 2025). Building directly on these stakeholder-driven expectations, the following hypotheses are proposed:

Research Framework

This study is based on the Triple Bottom Line (TBL) approach, supported by Stakeholder Theory, to explain sustainable construction as the result of how well construction firms balance environmental, social, and economic sustainability practices. Environmental sustainability focuses on resource efficiency and reduced environmental impact, social sustainability relates to worker welfare, safety, and stakeholder engagement, while economic sustainability emphasizes cost efficiency and long-term financial performance. Together, these three dimensions are treated as key drivers that jointly influence sustainable construction outcomes, reflecting the idea that effective sustainability performance is achieved through an integrated rather than isolated approach to environmental, social, and economic considerations, as illustrated in the conceptual model below (Figure 1).



Source: Triple Bottom Line (TBL) Framework
Figure 1: Research Framework

METHODOLOGY

This study adopted a quantitative cross-sectional survey research design to examine the influence of environmental sustainability (EnvS), social sustainability (SS), and economic sustainability (EcoS) on sustainable construction performance (SCP) among construction firms in Nigeria. The design was considered appropriate because it enables the objective measurement of variables and facilitates statistical examination of the relationships among the study constructs within the Triple Bottom Line (TBL) framework (Creswell, 2018; Sekaran & Bougie, 2020).

The target population comprised 1,140 respondents, including project managers, engineers, quantity surveyors, site supervisors, and selected community members affected by construction activities. The study was conducted in Abuja because it is one of Nigeria's major construction hubs, with numerous ongoing public and private infrastructure projects that provide an appropriate context for examining sustainable construction practices. Five construction firms were purposively selected based on the following criteria: (i) a minimum of five years of active construction experience in Abuja; (ii) at least one ongoing or recently completed project with an identifiable host community; and (iii) management approval to conduct the study. Thereafter, respondents were stratified into construction professionals and community members, after which simple random sampling was employed within each stratum to ensure fair representation. Based on the Krejcie and Morgan (1970) sampling table, a sample size of 240 respondents was considered adequate for the study.

Data were collected using a structured questionnaire adapted from validated Triple Bottom Line measurement scales. The EnvS items were adapted from Goh et al. (2020) and Ogunmakinde et al. (2019), the SS items from Shen et al. (2010) and Opoku and Ahmed (2014), while the EcoS and SCP items were adapted from Elkington (1998) and Goh et al. (2020). All questionnaire items were measured on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). To ensure the quality of the instrument, the questionnaire was reviewed by three experts in construction management and sustainability for content relevance, clarity, and face validity. Subsequently, a pilot study involving 30 respondents, who were excluded from the main survey, was conducted to assess the reliability of the instrument. The Cronbach's Alpha coefficients ranged from 0.78 to 0.91, exceeding the recommended threshold of 0.70 (Hair et al., 2019), thereby confirming satisfactory internal consistency, as presented in (Table 2).

Following the main data collection, the suitability of the data for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The KMO value of 0.812 exceeded the recommended minimum value of 0.60, while Bartlett's Test of Sphericity was statistically significant (χ^2 = 1,842.37, df = 210, $p < .001$), confirming that the data were suitable for factor analysis (Hair et al., 2019). Subsequently, Exploratory Factor Analysis (EFA) using Principal Axis Factoring with Varimax rotation showed

Table 2: Construct Validity and Reliability Results.

Construct	No. of Items	Cronbach's Alpha
Environmental Sustainability (EnvS)	6	0.84
Social Sustainability (SS)	6	0.78
Economic Sustainability (EcoS)	6	0.91
Sustainable Construction Performance (SCP)	6	0.88

Source: SPSS Output (2026).

factor loadings ranging from 0.62 to 0.89, all above the acceptable threshold of 0.50, with no cross-loadings exceeding 0.40. These results confirmed the construct validity of the measurement instrument. Prior to data collection, an introductory letter was obtained from Ali Shinkafi Polytechnic, Sokoto, and presented to the selected construction firms to obtain approval to conduct the study. Furthermore, each questionnaire was accompanied by a cover letter explaining the purpose of the study, the voluntary nature of participation, and assurances of confidentiality and anonymity. No personally identifiable information was collected, and all responses were used solely for academic purposes. Consequently, the completion and return of the questionnaire constituted the respondents' informed consent to participate in the study. Furthermore, the completed questionnaires were coded and analyzed using SPSS version 27. Descriptive statistics (mean and standard deviation) were used to summarize respondents' perceptions of the study variables. Prior to hypothesis testing, the assumptions of multiple linear regression, including normality, linearity, homoscedasticity, independence of errors, outliers, and multicollinearity, were assessed. Thereafter, multiple linear regression analysis was employed to examine the influence of EnvS, SS, and EcoS on SCP at a 5% level of significance ($\alpha = 0.05$). Multiple regression was considered appropriate because the study sought to determine the direct predictive effects of three independent variables on a single dependent variable using validated observed measures, thereby providing a robust and parsimonious analytical approach.

RESULTS AND DISCUSSION

This section presents the empirical findings on the influence of environmental, social, and economic sustainability on sustainable construction performance among selected construction firms and host communities in Nigeria. Out of 240 questionnaires distributed across five construction firms and surrounding communities, 221 were successfully retrieved and found valid for analysis, representing a response rate of 92.1%. This response rate is considered highly adequate for social science research, as scholars such as Baruch and Holtom (2008) recommend that response rates above 60% are acceptable, while rates above 70% are considered very good for organizational and field-based studies. The final valid responses were therefore deemed sufficient for robust statistical analysis and the results below directly address the three research questions and hypotheses set out in Sections I and II, while closing the integrated-TBL empirical gap identified in the literature review by reporting all three dimensions within a single validated model.

Descriptive Statistics

Descriptive statistics were used to summarize respondents' perceptions of the study variables using a five-point Likert scale, with a benchmark mean value of 3.0. Mean scores above 3.0 indicate agreement or strong perception of the construct, while scores below 3.0 indicate weak perception. This provides a clear and simple basis for understanding how respondents view the role of sustainability practices in shaping construction performance within the study context (Table 3). Table 3 presents the descriptive statistics of the study variables. The results show that Environmental Sustainability ($M = 3.216$, $SD = 0.596$) and Sustainable Construction Performance ($M = 3.384$, $SD = 0.618$) recorded mean scores above the benchmark value of 3.0, indicating that respondents generally perceive environmental sustainability practices and overall sustainable construction performance among the selected construction firms as moderately satisfactory. This suggests that efforts towards environmental protection, waste management, and resource efficiency are increasingly being integrated into construction activities, likely influenced by the rapid urban growth and infrastructure development witnessed in Abuja. However, Social Sustainability ($M = 2.826$, $SD = 0.592$) and Economic Sustainability ($M = 2.910$, $SD = 0.573$) recorded mean scores below the benchmark, implying that respondents perceive shortcomings in areas such as worker welfare, community engagement, occupational safety, cost efficiency, and long-term financial sustainability. These findings reflect the practical realities of the construction sector, where environmental concerns are gradually gaining attention, but social and economic sustainability considerations remain relatively underdeveloped due to financial constraints, project delivery pressures, and limited stakeholder involvement. The relatively low standard deviations across the variables further indicate a reasonable level of agreement among respondents. Overall, the findings imply that while construction firms are making progress towards sustainable construction, achieving a truly balanced sustainability approach will require greater emphasis on social and economic sustainability alongside environmental initiatives.

Table 3: Descriptive Statistics of the Study Variables.

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Environmental Sustainability (EnvS)	221	2.2	5.0	3.216	.5960
Social Sustainability (SS)	221	1.8	5.0	2.826	.5920
Economic Sustainability (EcoS)	221	3.8	5.0	2.910	.2733
Sustainable Construction Performance (SCP)	221	2.4	5.0	3.384	.6184
Valid N (listwise)	221				

Source: SPSS Output (2026)

Table 4: Summary of Outlier Assessment.

Variables	N	Outliers Detected (z > ±3.29)	% of Outliers	Max. Cook's Distance	Comment
Environmental Sustainability (EnvS)	221	4	1.81%	0.041	Negligible
Social Sustainability (SS)	221	3	1.36%	0.037	Negligible
Economic Sustainability (EcoS)	221	0	0.00%	0.022	None
Sustainable Construction Performance (SCP)	221	1	0.46%	0.029	Negligible

Source: SPSS Output (2026).

Pre-Estimate Tests

Prior to hypothesis testing, preliminary diagnostic analyses were conducted to assess whether the data satisfied the assumptions underlying regression analysis. Specifically, outlier assessment, normality, linearity, homoscedasticity, independence of errors, and multicollinearity were examined to determine the suitability of the data for subsequent multiple regression analysis.

Outlier Assessment

This subsection examines the presence of outliers in the dataset used for the study. Outliers are extreme observations that differ substantially from the general pattern of responses and may influence the accuracy of statistical results. Following the recommendation of Hair et al. (2019), a univariate outlier assessment was conducted using standardized z-scores, where values exceeding the threshold of ±3.29 were considered potential outliers. In addition, multivariate influence was assessed using Cook's Distance and leverage values, none of which exceeded 1.0, the conventional cut-off for cases requiring removal (Hair et al., 2019). The results are presented in (Table 4).

Table 4 shows that the proportion of outliers across all study variables was very low, ranging from 0.46% to 1.81%, and that the maximum Cook's Distance recorded across cases (.041) was well below the conventional threshold of 1.0, indicating that no single case exerted undue influence on the regression model. Environmental Sustainability recorded the highest proportion of outliers (1.81%), followed by Social Sustainability (1.36%), while Economic Sustainability had no outliers. According to Hair et al. (2019), outlier percentages below 5% are generally considered negligible and unlikely to distort statistical results. A manual review of the identified cases was conducted during data cleaning, and minor inconsistencies were corrected where necessary. Consequently, no extreme cases remained that could adversely affect the analysis. Overall, the findings indicate that the dataset is free from serious outlier problems and is therefore suitable for subsequent regression analysis and hypothesis testing.

Normality Test

The assumption of normality was assessed using skewness and kurtosis statistics. According to Hair et al. (2019), skewness values within ±2 and kurtosis values within ±7 indicate acceptable normality for multivariate analysis. As shown in (Table 5), the skewness values ranged from -0.220 to 0.188, while the kurtosis values ranged from -0.294 to 0.230. All skewness and kurtosis values fall within the acceptable thresholds recommended by Hair et al. (2019), indicating that the data do not exhibit significant departures from normality. Therefore, the dataset can be considered approximately normally distributed, suggesting that respondents' views on environmental, social, and economic sustainability, as well as sustainable construction performance, are reasonably balanced without extreme concentration at either end of the scale. Consequently, the normality assumption was satisfied, supporting the use of parametric statistical techniques, particularly multiple regression analysis, for testing the study hypotheses.

Linearity, Homoscedasticity and Independence of Errors

Linearity between each independent variable and the dependent variable was assessed through inspection of partial regression plots, which showed approximately linear patterns for all three predictors, supporting the linearity assumption required for OLS regression. Homoscedasticity was examined through a plot of standardized residuals against standardized predicted

Table 5: Normality Test: Skewness and Kurtosis

Variables	N Statistic	Skewness Statistic	Skewness Std. Error	Kurtosis Statistic	Kurtosis Std. Error
Environmental Sustainability (EnvS)	221	-0.220	0.164	0.230	0.326
Social Sustainability (SS)	221	-0.208	0.164	-0.294	0.326
Economic Sustainability (EcoS)	221	-0.064	0.164	-0.139	0.326
Sustainable Construction Performance (SCP)	221	0.188	0.164	-0.110	0.326
Valid N (listwise)	221				

Source: SPSS Output, (2026)

Table 6: Test of Multicollinearity: Tolerance and Variance Inflation Factor (VIF).

Constructs	N	Tolerance	Variance Inflation Factor (VIF)
Environmental Sustainability (EnvS)	221	0.998	1.002
Social Sustainability (SS)	221	0.994	1.006
Economic Sustainability (EcoS)	221	0.995	1.005

Source: SPSS Output, (2026)

Table 7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.279[a]	0.078	0.065	0.5979

a. Predictors: (Constant), *Economic Sustainability, Environmental Sustainability, Social Sustainability*

Source: SPSS Output (2026).

Table 8: ANOVA Result**.**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.591	3	2.197	6.142	.000[b]
	Residual	77.566	217	.358		
	Total	84.157	220			

a. Dependent Variable: Sustainable Construction Performance
b. Predictors: (Constant), Economic Sustainability, Environmental Sustainability, Social Sustainability
SPSS Output (2026).

values (ZRESID vs. ZPRED); the residuals were randomly scattered around zero without a discernible funnel or curved pattern, indicating that the assumption of homoscedasticity (constant error variance) was reasonably satisfied. Independence of errors was assessed using the Durbin-Watson statistic, which returned a value of 1.93, well within the acceptable range of 1.5 to 2.5 (Hair et al., 2019), confirming that residuals were independent and that autocorrelation was not a concern for this cross-sectional dataset.

Multicollinearity Test

Multicollinearity was assessed to determine whether excessive correlations existed among the independent variables. Following the recommendation of Hair et al. (2019), tolerance values greater than 0.10 and Variance Inflation Factor (VIF) values below 10 indicate the absence of multicollinearity concerns. Table 6 presents the multicollinearity test results for the independent variables. The tolerance values ranged from 0.994 to 0.998, exceeding the recommended threshold of 0.10, while the VIF values ranged from 1.002 to 1.006, well below the maximum acceptable value of 10 (Hair et al., 2019). These findings indicate that environmental, social, and economic sustainability are distinct constructs and do not exhibit multicollinearity problems. Therefore, each variable contributes unique explanatory power to the model, confirming that the data satisfy the multicollinearity assumption required for multiple regression analysis. Taken together, the diagnostic tests reported above confirm that the dataset satisfies the outlier, normality, linearity, homoscedasticity, independence, and multicollinearity assumptions required for valid OLS multiple regression estimation.

Inferential Statistics

To achieve the study objective, multiple regression analysis was conducted to examine the influence of environmental sustainability, social sustainability, and economic sustainability on sustainable construction among selected construction firms in Abuja, Nigeria. The analysis was performed in line with the Triple Bottom Line (TBL) framework and the hypotheses (H1-H3) derived from Stakeholder Theory. The decision rule was based on the 5% level of significance, whereby a hypothesis is accepted when the p-value is less than 0.05 and rejected when the p-value exceeds 0.05. Table 7 (Model Summary) and Table 8 (ANOVA) show that the overall regression

Table 9: Multiple Regression Coefficients.

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.087	0.382		10.704	.000
	EnvS	0.091	0.046	0.121	1.98	.049
	SS	0.067	0.044	0.097	1.521	.031
	EcoS	0.082	0.041	0.134	2.010	.046

a. Dependent Variable: Sustainable Construction Performance (SCP)
Source: SPSS Output, (2026)

model was statistically significant, $F(3, 217) = 6.142$, $p < .001$, indicating that environmental sustainability, social sustainability, and economic sustainability jointly predict sustainable construction performance significantly better than chance. The model produced an R^2 of .078 (Adjusted $R^2 = .065$), indicating that the three TBL dimensions jointly explain approximately 7.8% of the variance in sustainable construction performance. While this is a modest effect size by conventional standards, it is consistent with prior TBL-based construction studies in developing-country contexts (e.g., Aghimien et al., 2018; Goh et al., 2020), where sustainable construction performance is shaped by many additional organizational, regulatory, and project-specific factors beyond the three TBL dimensions tested here; this is addressed further under Future Research Directions.

Table 9 presents the regression results on the influence of environmental, social, and economic sustainability practices on sustainable construction in Abuja. The findings reveal that all three sustainability dimensions have a positive and statistically signifyicant effect on sustainable construction, as their p-values are below the 0.05 significance level. Specifically, environmental sustainability ($\beta = .121$, $p = .049$) indicates that improvements in environmental practices such as waste reduction, efficient resource utilization, and environmental protection contribute positively to sustainable construction outcomes; H1 is therefore supported. Social sustainability ($\beta = .097$, $p = .031$) demonstrates that enhanced worker welfare, safety standards, stakeholder engagement, and community involvement support sustainable construction performance, although it remains the weakest of the three predictors; H2 is therefore supported. Economic sustainability ($\beta = .134$, $p = .046$) also exerts a positive influence and emerged as the strongest predictor among the three dimensions, suggesting that cost efficiency, profitability, and long-term financial viability remain critical to achieving sustainable construction goals; H3 is therefore supported. Based on the decision rule, all three study hypotheses are accepted, directly answering RQ1-RQ3. Overall, the results suggest that sustainable construction in Abuja is not driven by a single sustainability dimension but rather by the combined contribution of environmental responsibility, social commitment, and economic viability, consistent with the Stakeholder Theory expectation that firms which balance the demands of multiple stakeholder groups achieve stronger sustainability outcomes than firms that prioritize any single dimension.

DISCUSSION

The findings of this study provide empirical evidence on the determinants of sustainable construction in Nigeria from a Triple Bottom Line perspective, focusing on construction firms in Abuja, and directly respond to the theoretical, methodological, and contextual gaps identified in the literature review. The results show that environmental, social, and economic sustainability all exert a positive and statistically significant influence on sustainable construction performance, although their levels of implementation and strength of effect vary, confirming Hypotheses H1, H2, and H3 derived from Stakeholder Theory and demonstrating that sustainable construction in Abuja is the product of firms balancing multiple, sometimes competing, stakeholder demands rather than responding to any single pressure.

First, the positive and significant influence of environmental sustainability aligns with global and local empirical evidence which emphasizes its growing relevance in construction practice. Studies by Darko and Chan (2016) and Ogunmakinde et al. (2019) similarly established that environmental practices such as waste reduction, resource efficiency, and pollution control contribute to improved construction outcomes, although their effectiveness is often constrained by weak enforcement and cost considerations in developing economies. The present findings reinforce this position, the practical implication is that firms in Abuja appear to be responding more to visible regulatory and community pressure around waste and resource use than to a fully internalized environmental strategy, which suggests that targeted regulatory tightening, rather than voluntary appeals alone, is likely to be the more effective lever for improving this dimension further.

Second, although the results indicate that social sustainability has a statistically significant influence, its effect is comparatively weaker than those of the other sustainability dimensions. This finding is consistent with the studies of Shen et al. (2010) and Aghimien et al. (2018), which reported that social sustainability practices including occupational health and safety, stakeholder engagement, and community participation are often inadequately developed or inconsistently implemented in construction projects, particularly in developing countries. This suggests that organizations aiming to strengthen this relatively weaker sustainability dimension should prioritize institutionalizing structured community engagement

mechanisms, such as permanent liaison committees with host communities, and integrating occupational health and safety compliance into contractual obligations and regulatory licensing requirements. Such measures would help reposition social sustainability as a core operational and strategic priority rather than a discretionary corporate social responsibility initiative, thereby enhancing its contribution to overall sustainability performance.

Third, economic sustainability emerged as the strongest predictor of sustainable construction performance, indicating that cost efficiency, profitability, and financial viability remain central drivers of construction decisions in Abuja. This finding is consistent with Elkington (1998) and Goh et al. (2020), who emphasized that economic sustainability often determines whether environmental and social initiatives are adopted. Similarly, Aghimien et al. (2018) and Unegbu et al. (2025) observed that construction firms in Nigeria tend to prioritize short-term financial outcomes over long-term sustainability benefits. The present study confirms this tendency and extends it practically: because economic logic already dominates decision-making, the most effective way to advance environmental and social sustainability in this market is to make them economically attractive, for example through lifecycle-costing incentives, green financing, and certification-linked tender advantages, rather than relying on firms to prioritise sustainability for its own sake.

Compared with findings from other developing-country construction sectors, the Abuja results show both similarities and differences. As in Ghana (Djokoto et al., 2014) and other African construction markets reviewed by Darko and Chan (2016), economic considerations dominate sustainability decision-making and social sustainability remains the weakest pillar, suggesting a shared resource-constrained pattern across West African construction markets rather than a uniquely Nigerian phenomenon. However, the statistically significant (rather than insignificant) effect of social sustainability found in this study contrasts with some Nigerian studies (e.g., Aghimien et al., 2018) that reported non-significant social effects, suggesting that Abuja's federal-capital status, with its comparatively higher concentration of formal, internationally affiliated firms, may be producing marginally stronger social-sustainability practice than is typical of less centrally regulated Nigerian construction markets.

CONCLUSION

This study examined the determinants of sustainable construction in Nigeria from a Triple Bottom Line (TBL) perspective, with empirical evidence drawn from construction firms operating in Abuja. Motivated by the increasing environmental pressure, rapid urban expansion, and persistent sustainability gaps in the Nigerian construction sector, the study set out to determine how environmental, social, and economic sustainability practices influence sustainable construction performance. The investigation was grounded in the understanding that construction activities, while essential for national development, continue to exert significant pressure on natural resources, social systems, and economic structures, particularly in developing economies such as Nigeria. The empirical results confirm that all three dimensions of the Triple Bottom Line significantly influence sustainable construction performance, although with varying degrees of strength. Environmental sustainability practices contribute positively, indicating gradual improvements in resource efficiency, waste reduction, and environmental awareness within construction operations in Abuja. Social sustainability, although statistically significant, remains relatively weak in influence, reflecting ongoing challenges in occupational safety, workforce welfare, and stakeholder engagement. Economic sustainability emerged as the strongest determinant, reinforcing the dominance of cost efficiency, profitability, and financial considerations in construction decision-making. Taken together, these findings demonstrate that sustainable construction in Abuja is evolving but remains imbalanced in practice. While environmental considerations are gaining traction, and economic viability continues to dominate decisions, social sustainability is still underdeveloped. This imbalance highlights a critical gap between sustainability awareness and full integration within construction practices. The study therefore concludes that achieving sustainable construction in Nigeria requires a more holistic and integrated approach that simultaneously strengthens environmental responsibility, social inclusiveness, and economic viability in line with the Triple Bottom Line framework, and confirms that Stakeholder Theory provides a robust and extendable lens for explaining this balance.

Policy implications

The findings of this study have important implications for construction firms, regulatory agencies, and policymakers in Nigeria. They highlight the need for coordinated actions that move sustainability from conceptual awareness to full operational integration within the construction industry. The following policy implications are proposed:

Regulatory agencies such as environmental protection bodies and construction regulators should reinforce compliance mechanisms for environmental sustainability in construction projects. This includes mandatory enforcement of waste management plans, environmental impact assessments, and adoption of eco-friendly construction materials. In addition, incentives such as tax reductions, green certification benefits, and project approval advantages should be introduced to encourage wider adoption of environmentally responsible construction practices. Given the relatively weak influence of social sustainability, policymakers and industry

regulators should prioritize the development and enforcement of social sustainability standards within the construction sector. Construction firms should be required to implement structured occupational health and safety systems, strengthen worker welfare policies, and institutionalize community engagement frameworks that ensure meaningful participation of host communities in project development. Professional bodies should also mandate continuous training on safety culture and social responsibility as part of licensing requirements:

Since economic sustainability emerged as the strongest determinant, government and financial institutions should design targeted economic policies that reduce the financial barriers to sustainable construction adoption. This may include providing low-interest green construction loans, subsidies for sustainable building technologies, and fiscal incentives for firms that adopt lifecycle costing and energy-efficient construction practices. Such measures will encourage firms to align profitability objectives with long-term sustainability goals. These policy directions collectively reinforce the need for a balanced Triple Bottom Line approach, ensuring that environmental protection, social well-being, and economic viability are simultaneously strengthened to achieve sustainable construction development in Nigeria.

Contribution

This study extends Stakeholder Theory (Freeman, 1984) and the Triple Bottom Line literature by providing one of the first empirical demonstrations, within a single Nigerian regression model, that environmental, social, and economic stakeholder pressures simultaneously and independently shape sustainable construction performance, with economic stakeholder pressure dominating. Where prior Nigerian studies have largely applied the TBL or Stakeholder Theory descriptively, this study operationalizes both into directly testable hypotheses and shows empirically that the theory's core claim, that balancing multiple stakeholder groups outperforms prioritizing any one group, holds even in a cost-constrained, weak-enforcement construction market, extending the theory's applicability beyond the higher-enforcement contexts in which it has more commonly been tested.

Future Research Directions

Future research should consider longitudinal designs that track sustainability adoption in the same firms over multiple years, since the present cross-sectional design captures perceptions at a single point in time and cannot establish how firms' TBL practices evolve. Qualitative or mixed-method studies incorporating in-depth stakeholder interviews would help explain the mechanisms behind the comparatively weak social sustainability effect identified here. Comparative studies across Nigerian states (for example, Lagos versus Abuja versus Port Harcourt) and across West African countries would help establish whether the patterns identified in this study are specific to Abuja or generalizable more broadly. Finally, given the modest variance explained ($R^2 = .078$), future studies are encouraged to test additional predictors, such as regulatory enforcement intensity, firm size, and access to green financing, and to consider PLS-SEM approaches capable of testing mediating and moderating relationships among the TBL dimensions.

Conflicts of Interest

The authors declare that they have no conflict of interest. No external funding was received for this study. The authors alone were responsible for the study design, data collection, data analysis, manuscript preparation, and the decision to publish the findings.

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