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Navigating the Nexus: Overcoming Challenges in Public-Private Partnerships for Sustainable Building Initiatives in Developing Countries

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ABSTRACT

This research examines the challenges and barriers that Public-Private Partnerships (PPPs) face in implementing sustainable building initiatives in developing countries. The study addresses financial, regulatory, technical, risk management, and social-environmental factors that influence the success of PPPs in the construction of sustainable buildings. Drawing from a comprehensive review of existing literature and case studies, the study highlights key issues such as high upfront costs, uncertain returns, limited access to financing, technological risks, and weak regulatory frameworks. By integrating theoretical frameworks like the Resource-Based View (RBV) and Transaction Cost Economics (TCE), the research explores the interplay between these challenges and the factors that hinder the effectiveness of PPPs in sustainable building projects. The findings underscore the need for improved capacity building, enhanced regulatory enforcement, and better risk management strategies. Policy recommendations are provided to address the gaps and improve the overall effectiveness of PPPs in promoting sustainable development in the built environment. Finally, the study outlines directions for future research to further explore the evolving dynamics of PPPs in sustainable construction and their potential role in achieving sustainable development goals.

KEYWORDS: Financial constraints, regulatory issues, technical expertise, risk management, social impact, and environmental sustainability.

JEL CODES: K32; L33; L74; O13; O18; Q56; R52

INTRODUCTION

Public-Private Partnerships (PPPs) have become essential for mobilizing private sector resources and expertise to address infrastructure needs, particularly in developing countries where public funds are often limited (Delmon, 2017; Leigland, 2018; Chileshe et al., 2023). In sustainable building initiatives, PPPs facilitate the adoption of environmentally friendly construction practices, energy efficiency measures, and renewable energy technologies, supporting progress toward sustainable development goals (Yescombe & Farquharson, 2018; Mugarura, 2019; Almeile et al.,

2024). By harnessing private-sector innovation and investment with public-sector oversight, PPPs can enhance the sustainability and effectiveness of infrastructure projects (Vassileva, 2018; Berrone et al., 2019; Cohen et al., 2021).

Integrating theoretical frameworks provides deeper insight into the factors affecting PPP effectiveness in sustainable building initiatives. Resource Dependency Theory (RDT) by Pfeffer and Salancik, (2003), suggests that public entities rely on private sector resources, such as capital, technology, and expertise, to bridge resource gaps in developing countries. This dependency drives partnerships but also requires careful negotiation to align public and private interests (Pfeffer & Salancik, 1978; Chileshe et al., 2023). RDT helps explain why public entities seek private involvement in sustainable projects, particularly in regions where public resources are constrained. Institutional Theory by Selznick (1948) further informs PPP analysis by highlighting how regulatory and cultural frameworks shape PPP operations. In developing countries, institutional stability can significantly affect project implementation. Variability in regulatory frameworks, coupled with bureaucratic delays, often hinders timelines and increases costs (DiMaggio & Powell, 1983; Scott, 2008; Cui et al., 2018; Akram et al., 2023). Applying Institutional Theory clarifies how regulatory inconsistencies impact PPP projects, underscoring the need for more stable and supportive policy environments for sustainable infrastructure development.

Transaction Cost Economics (TCE) by Tadelis and Williamson, (2012) also offers critical insights into PPP challenges, particularly the financial and administrative costs associated with complex multi-stakeholder partnerships. In sustainable construction projects, transaction costs-including those associated with negotiating, monitoring, and enforcing contracts-can be substantial, given the specialized requirements of sustainable practices (Williamson, 1981; Dewulf & Garvin, 2020; Sherratt et al., 2020). TCE helps explain how the high transaction costs typical of sustainable construction projects are further exacerbated by limited technical expertise and insufficient support infrastructure in developing regions (Chan et al., 2018; Tamošaitienė et al., 2020; Iqbal et al., 2021).

By drawing on these theoretical frameworks, this study aims to investigate the primary barriers to effective PPP implementation in sustainable building within developing countries. Analyzing issues such as financial constraints, regulatory and policy barriers, technical capacity limitations, and risk management challenges through these theoretical lenses provides a nuanced understanding of how these barriers operate and interact. This framework-based analysis offers valuable insights for policymakers, practitioners, and stakeholders, suggesting actionable strategies to foster more resilient, effective, and sustainable PPPs in the infrastructure sector.

PROBLEM STATEMENT

Despite the growing interest and investment in Public-Private Partnerships (PPPs) for sustainable building, there remains a significant gap in understanding the unique challenges and barriers these partnerships face in developing countries. Existing literature frequently lacks a comprehensive synthesis of these obstacles, particularly within the sustainable building context, and is often

limited in addressing the interconnected theoretical underpinnings that shape PPP effectiveness. Resource Dependency Theory (RDT), Institutional Theory, and Transaction Cost Economics (TCE) provide valuable frameworks for understanding these challenges, yet they are underutilized in this context. RDT highlights the reliance of the public sector on private capital, technology, and expertise to overcome resource limitations, especially in infrastructure-poor regions. However, this dependency introduces complexities in aligning the goals and incentives of both sectors, particularly in areas with limited public resources and high demand for sustainable solutions. Institutional Theory suggests that developing countries' regulatory and cultural contexts, which often include inconsistent or complex policies, can significantly hinder PPP success. Likewise, TCE underscores the impact of high transaction costs in managing multi-stakeholder partnerships and the specialized requirements of sustainable building projects.

To bridge these theoretical and practical gaps, this study systematically examines the primary barriers affecting PPPs in sustainable building initiatives within developing countries, focusing on the interplay between financial limitations, regulatory challenges, technical expertise shortages, risk management complexities, and social-environmental factors. A deeper understanding of these barriers, grounded in relevant theoretical frameworks, will equip policymakers, practitioners, and stakeholders to develop more informed strategies.

Addressing these issues is essential for refining regulatory frameworks, strengthening financial mechanisms, building technical capacity, and enhancing social and environmental safeguards, ultimately maximising the potential of PPPs to contribute to sustainable development goals. This systematic review synthesizes existing literature and case studies to analyze these barriers through a theoretical lens, providing insights into effective strategies and recommendations for enhancing PPP success and sustainability in the built environment of developing countries.

OBJECTIVE AND RESEARCH QUESTION

The study objective is to systematically analyse and synthesise the challenges faced by Public-Private Partnerships (PPPs) in leveraging resources and expertise to support sustainable building initiatives in developing countries and to provide actionable insights and recommendations for enhancing the effectiveness and sustainability of these partnerships.

The study research question is, what are the primary challenges faced by Public-Private Partnerships (PPPs) in leveraging resources and expertise to support sustainable building initiatives in developing countries, and what strategies can be recommended to enhance their effectiveness and sustainability?

SCOPE AND LIMITATIONS

This systematic review focuses on analysing the challenges faced by Public-Private Partnerships (PPPs) in leveraging resources and expertise specifically for sustainable building initiatives in developing countries. The review will encompass a comprehensive examination of literature and

case studies addressing financial constraints, regulatory issues, technical expertise gaps, risk management complexities, and social-environmental considerations within this context. It aims to provide actionable insights and recommendations to enhance the effectiveness and sustainability of PPPs in promoting sustainable development in the built environment of developing nations.

The study acknowledges certain limitations, which have been duly considered and addressed. The limitations are as follows: **Geographical Focus:** The review primarily focuses on developing countries, which may limit the generalizability of findings to developed economies with different regulatory and economic landscapes.

Data Availability: Access to comprehensive and up-to-date literature and case studies on PPPs in sustainable building initiatives in developing countries may pose limitations, particularly in regions with limited academic and research infrastructure.

Methodological Constraints: The review's scope is constrained by the methodologies and data available in the literature, which may vary in quality and depth across different studies and sources.

Temporal Scope: The review focuses on contemporary challenges and strategies related to PPPs in sustainable building, which may not fully capture historical perspectives or future trends in sustainable development practices.

METHODOLOGY

The methodology for this systematic review involves several key steps to comprehensively analyse the challenges faced by Public-Private Partnerships (PPPs) in leveraging resources and expertise for sustainable building initiatives in developing countries. The methodology follows that of previous research works (Khorsan & Crawford, 2014; Linares-Espinós et al., 2018; Munn et al., 2018). Firstly, comprehensive searches are conducted across academic databases such as PubMed, Scopus, and Web of Science using relevant keywords including "public-private partnerships," "sustainable building," and "developing countries." Grey literature sources, reports, and case studies from reputable organisations and government agencies are also included to ensure a broad coverage of the literature.

Inclusion criteria dictate that studies published in English within the last 10-15 years are considered to maintain relevance and currency. The review focuses on primary research articles, systematic reviews, meta-analyses, and case studies specifically addressing challenges and strategies related to PPPs in sustainable building initiatives in developing countries. Studies that do not directly address the research question or lack empirical evidence are excluded to maintain the review's focus and rigour.

During screening and selection, titles and abstracts of retrieved articles are screened based on predefined inclusion criteria. Full texts of potentially relevant articles are then retrieved and assessed for eligibility. Reasons for exclusion are documented during the full-text review phase to ensure transparency and reproducibility of the selection process.

Data extraction involves the development of a structured form to systematically extract relevant information from included studies. This includes extracting data on study characteristics (e.g., author, year, location), the methodology employed, key findings, and recommendations pertaining to PPP challenges and strategies in sustainable building initiatives.

Quality assessment of included studies is conducted using appropriate tools to evaluate the risk of bias and methodological rigour. Tools such as the Joanna Briggs Institute Critical Appraisal tools or the Cochrane Risk of Bias tool for randomised trials are utilised to assess the quality of evidence and ensure robustness in the review process.

Synthesis and analysis of findings entail a narrative synthesis approach, categorising and thematically analysing challenges and strategies identified in the literature. Patterns, inconsistencies, and relationships between studies are explored to generate overarching conclusions. Gaps in current knowledge are identified, and recommendations are proposed to enhance PPP effectiveness in promoting sustainable development in the built environment of developing countries.

The review adheres to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparent reporting of the review process and findings. Findings are presented through descriptive summaries, tables, and figures to enhance clarity and accessibility, providing valuable insights for stakeholders and policymakers aiming to improve sustainable development practices in developing countries.

FINDINGS ON CHALLENGES IN PUBLIC-PRIVATE PARTNERSHIPS (PPPS) FOR SUSTAINABLE BUILDING INITIATIVES IN DEVELOPING COUNTRIES

FINANCIAL VIABILITY

Higher Upfront Costs

Sustainable building practices often entail significantly higher upfront costs compared to traditional construction methods. These increased costs are primarily due to the need for eco-friendly materials, which are often more expensive than conventional options (Zuo & Zhao, 2014; Smit, 2015; Kibert, 2016; Chen et al., 2024). Additionally, integrating energy-efficient technologies such as solar panels, advanced HVAC systems, and high-performance insulation adds to the initial financial outlay (D'Oca, 2018; Mukhtar et al., 2021). Sustainable design considerations, including site orientation for optimal natural lighting, green roofs, and water recycling systems, further contribute to the elevated costs (Pradhan et al., 2019; Shafique et al.,

2020; Zhang & He, 2021). These investments, while beneficial in the long term, require substantial capital at the outset, which can be a barrier for many projects, especially in developing countries.

Uncertain Returns

While sustainable building practices promise long-term benefits such as energy savings, reduced operational costs, and enhanced building durability, these returns are not always immediate or guaranteed (Kibert, 2016; Zhang et al., 2018; Satchwell et al., 2021). Energy savings from efficient systems and lower utility bills may accrue gradually, sometimes taking several years to offset the higher initial investment (Vaidyanathan et al., 2013 Allcott & Greenstone, 2017). Additionally, the durability and reduced maintenance costs of sustainable buildings contribute to long-term financial viability, but these benefits can be difficult to quantify upfront. The uncertainty of returns can make it challenging to secure investment, as stakeholders may be wary of the delayed payoff and the potential for unforeseen operational challenges that could impact financial performance (Kauffman et al., 2015).

Limited Capital

Access to financing in developing countries is often constrained by underdeveloped capital markets and limited availability of green finance mechanisms (Taghizadeh-Hesary & Yoshino, 2019; LE & PHAM, 2021; Yu et al., 2021; Jain et al., 2022) Many financial institutions in these regions may lack the expertise or willingness to invest in sustainable projects, viewing them as higher risk compared to conventional construction (Smith et al., 2014; Akadiri, 2015; Gatti, 2023). The perceived higher risks associated with sustainable projects can include technological uncertainties, regulatory changes, and market acceptance issues (Darko et al., 2017; Chan et al., 2018; Lieu et al., 2019; Shaktawat & Vadhera, 2021). This can result in higher interest rates or more stringent loan conditions, further complicating efforts to secure necessary capital. Additionally, the lack of robust green finance frameworks and incentives can hinder the availability of funds specifically earmarked for sustainable building initiatives, limiting the ability of developers to pursue such projects (Agyekum et al., 2022; Owusu-Manu et al., 2023).

RISK ALLOCATION

Technological Risks

Adopting new technologies in sustainable construction introduces a range of technological risks that can affect project outcomes and investor confidence (Hwang & Tan, 2012; Kibert, 2016; Darko, 2019). Performance reliability is a significant concern; new technologies, such as advanced energy-efficient systems or innovative construction materials, may not yet have a proven track record (Ruparathna et al., 2016; Benavente-Peces, 2019; Li et al., 2019; Liu et al., 2023). This

uncertainty can lead to higher maintenance costs if the technologies fail to perform as expected or require more frequent repairs and replacements. Furthermore, market acceptance of these technologies can be unpredictable. If new sustainable technologies are not well-received by the market or fail to meet user expectations, this can result in lower occupancy rates or diminished market value for the properties (Cherry et al., 2018; Dessouky, 2021; Zarinkamar, 2021). Private investors may hesitate to bear these technological risks without clear assurances, such as warranties, performance guarantees, or risk-sharing arrangements with the public sector (Faisal, 2016; Rose, 2021; Batjargal & Zhang, 2022). These arrangements can include provisions for cost-sharing in case of technological failures or financial incentives to adopt innovative solutions (Urzúa et al., 2016; Cherkos & Jha, 2021; Herath & Herath, 2023).

Market Risks

Market risks in sustainable construction projects encompass various factors that can impact profitability and investor confidence. Market fluctuations, such as changes in economic conditions or interest rates, can affect the demand for sustainable buildings (Busch et al., 2016; Akomea-Frimpong et al., 2022; Li & Wang, 2023). During economic downturns, for instance, the higher initial costs of sustainable buildings might make them less attractive to potential buyers or tenants compared to conventional buildings (Chegut et al., 2014; Robinson et al., 2016; Adabre & Chan, 2019). Regulatory changes also pose a significant risk; new environmental regulations or changes in building codes can increase compliance costs or alter project feasibility (Gan et al., 2015; Kibert, 2015; Conejos et al., 2019; Murtagh et al., 2020). Additionally, shifts in consumer demand can impact project success. While there is a growing trend towards sustainability, consumer preferences can be influenced by economic factors, cultural attitudes, and awareness levels (Akadiri et al., 2012; Wang et al., 2014; Liu et al., 2017; Darko et al., 2017). Mitigating these market risks requires robust market analysis and strategic risk management. This includes conducting thorough feasibility studies, engaging with stakeholders to understand market needs, and developing flexible business models that can adapt to changing conditions (Rohrbeck et al., 2013; Mont et al., 2014; França et al., 2017; Velter et al., 2020). Risk management strategies may also involve securing long-term contracts, such as power purchase agreements (PPAs) for renewable energy projects, to ensure stable revenue streams (Elwakil & Hegab, 2018; Wallace, 2019; Acharya, 2022; Stanitsas & Kirytopoulos, 2023).

REGULATORY AND LEGAL FRAMEWORKS

Uncertainty and Delays

In developing countries, inconsistent regulatory frameworks, bureaucratic red tape, and lengthy approval processes can create significant uncertainty and delays for sustainable building projects (I. Goodier & Chmutina, 2014; McDonnell, 2017; Ekpo, 2019; Zhao et al., 2020; Webster, 2023). Regulatory environments in these regions may lack standardisation, with frequent changes in

policies or unclear guidelines, making it challenging for developers to plan and execute projects efficiently (Mourgues & Kingombe, 2017; Kavishe et al., 2018; De Roo & Miller, 2019; Zuniga-Teran et al., 2020; Vassileva, 2022; Almeile et al., 2024). Bureaucratic red tape, including excessive paperwork, numerous approvals from different government departments, and complex compliance requirements, can slow down project timelines (Okwilagwe, 2017; Nalo, 2018; Khoza, 2021; Khoza & Rabie, 2021). These delays not only increase project costs due to prolonged construction periods and extended financing needs but also deter private-sector participation. Investors and developers may be reluctant to engage in projects with uncertain timelines and outcomes, fearing financial losses and operational inefficiencies. Streamlining regulatory processes and establishing clear, consistent guidelines are crucial to improving the investment climate for sustainable building initiatives.

Lack of Enforcement

Weak enforcement of environmental standards, building codes, and contractual obligations poses a significant challenge to the sustainability and success of PPP arrangements in developing countries (Trebilcock & Rosenstock, 2015; Opawole et al., 2019; Rezouki & Hassan, 2019; Akomea-Frimpong et al., 2023). Even when robust regulations are in place, a lack of effective enforcement mechanisms can lead to non-compliance, compromising project sustainability goals (Khoza, et al., 2021; Pequenino, 2023). For instance, inadequate monitoring and inspection can result in substandard construction practices, the use of non-compliant materials, or failure to implement required sustainability measures. Additionally, weak enforcement of contractual obligations can undermine investor confidence, as private partners may face difficulties in holding public sector entities accountable for their commitments (Shaoul et al., 2012; Yang et al., 2013; Leigland, 2018; Sartor & Beamish, 2020). This can lead to disputes, project delays, and financial losses. Strengthening enforcement mechanisms, ensuring regular monitoring and compliance checks, and establishing clear accountability frameworks are essential to maintaining the integrity of sustainable building projects and fostering a trustworthy PPP environment.

CAPACITY BUILDING

Technical Expertise

Developing countries often face a shortage of skilled professionals with expertise in sustainable construction practices, project management, and monitoring (Loganathan et al., 2017; Moon et al., 2018; Hauashdh et al., 2022; Oyebode et al., 2022; Omopariola et al., 2024). The adoption of sustainable building technologies and practices requires specialised knowledge in areas such as energy-efficient design, renewable energy integration, green materials selection, and sustainable urban planning (Chan et al., 2017; Yeatts et al., 2017; Chel & Kaushik, 2018; Fokaides et al., 2020; Hafez et al., 2023). However, limited access to training programs and educational resources impedes the development of local capacity in these critical areas (Wahid et al., 2017; Chan et al.,

2018; Scheihing et al., 2022). Training initiatives aimed at building technical expertise among engineers, architects, and construction professionals are essential to bridge this gap. These programs should emphasise practical skills development, hands-on training with sustainable technologies, and knowledge exchange with international experts to ensure that local practitioners are equipped to implement and manage sustainable construction projects effectively (McCoy et al., 2011; Annan-Diab & Molinari, 2017; Zhang et al., 2019; Olawumi & Chan, 2020; Hauashdh et al., 2022).

Administrative Capacity

Government agencies in developing countries may also lack the administrative capacity to effectively negotiate, implement, and manage complex Public-Private Partnership (PPP) agreements (Babatunde et al., 2015; Trebilcock & Rosenstock, 2015; Almarri & Abuhijleh, 2017; Osei-Kyei & Chan, 2017; Ahenkan et al., 2019; Kang et al., 2019). PPP projects involve intricate legal, financial, and technical considerations that require robust administrative capabilities (Cui et al., 2017; Delmon, 2017; Kang et al., 2019). However, bureaucratic inefficiencies, insufficient expertise in contract management, and limited experience in dealing with private sector partners can hinder the successful execution of PPPs (Kang et al., 2019; Rezouki & Hassan, 2019; Cherkos & Jha, 2021). This can lead to delays in project approvals, inadequate oversight during implementation, and challenges in ensuring compliance with contractual obligations and regulatory requirements. Strengthening administrative capacity through training programs, institutional reforms, and partnerships with experienced consulting firms or international organisations can enhance government agencies' ability to navigate PPP processes effectively (Plummer, 2013; Boyer & Newcomer, 2015; Chou et al., 2015; Kang et al., 2019; Chileshe et al., 2023). Developing clear guidelines, standardised procedures, and transparent decision-making frameworks are also essential to streamline administrative processes and improve overall project governance (Lappi et al., 2017; El Khatib et al., 2020; Kujala et al., 2021).

SOCIAL AND ENVIRONMENTAL IMPACT

Stakeholder Engagement

Effective stakeholder engagement is crucial for sustainable building projects to gain local support, address community concerns, and foster long-term project sustainability (Sherman & Ford, 2014; Shiel et al., 2016; Lalam, 2018; Di Maddaloni & Sabini, 2022; Baba et al., 2021). Engaging diverse stakeholders, including local communities, non-governmental organisations (NGOs), environmental groups, and other relevant stakeholders, ensure that their perspectives are considered in project planning and implementation (Boiral & Heras-Saizarbitoria, 2017; Hasan et al., 2018; Novoa et al., 2028). This involvement helps build trust, mitigate conflicts, and enhance social acceptance of the project. Community consultations, public hearings, and participatory

decision-making processes are essential tools for soliciting feedback, addressing grievances, and incorporating local knowledge and priorities into project design (Fromherz, 2013; Kvam, 2019; Modise, 2023). By fostering meaningful engagement, stakeholders become active participants in shaping project outcomes, promoting transparency, and contributing to positive social impacts such as improved community well-being and enhanced local capacity building (Boothroyd et al., 2017; Salvioni & Almici, 2020; When et al., 2020; Mussehl et al., 2022).

Environmental Sustainability

Environmental sustainability in sustainable building projects requires rigorous planning, monitoring, and compliance with sustainability criteria throughout the project lifecycle (Jalaei & Jrade, 2014; Wang et al., 2014; Wong & Zhou, 2015; Srivastava et al., 2021). This includes ensuring adherence to environmental standards, promoting resource efficiency, and minimising carbon footprints. Sustainable construction practices encompass a range of strategies, including energy-efficient building designs, the use of renewable energy sources, water conservation measures, and sustainable waste management practices (GhaffarianHoseini et al., 2013; Lipu et al., 2013; Akande et al., 2015; Chenari et al., 2016; Ribeiro et al., 2018; Owusu-Manu et al., 2023; Chen et al., 2024). Integrating these strategies into project planning and implementation helps mitigate environmental impacts, reduce resource consumption, and enhance ecosystem resilience. Monitoring environmental performance through regular assessments and audits ensures that sustainability goals are achieved and maintained (Adams et al., 2014; Puig et al., 2014; Bhattacharyya & Cummings, 2015; Bennett et al., 2017; Dragomir, 2018; Wessels, 2024). Compliance with sustainability criteria not only protects natural habitats and biodiversity but also contributes to long-term environmental stewardship and resilience against climate change impacts (Rannow et al., 2014; Chapin III et al., 2015; Barendse et al., 2016; Mathevet et al., 2018; Cantonati et al., 2020). By prioritising environmental sustainability, sustainable building projects can achieve significant ecological benefits and contribute to global efforts towards sustainable development (Ike et al., 2019; Leal Filho et al., 2019; Omer & Noguchi, 2020; Horry et al., 2022).

LONG-TERM COMMITMENT AND MAINTENANCE

Financial Sustainability

Securing sustainable funding sources for ongoing maintenance, upgrades, and operational costs is essential for the long-term viability and performance of sustainable buildings (Akadiri et al., 2012; Ahn et al., 2013; Urge-Vorsatz et al., 2013; Ruparathna et al., 2016). Unlike traditional construction, sustainable buildings often require specialised maintenance procedures and periodic upgrades to maintain their energy efficiency and environmental performance (Edwards & Naboni, 2013; Ruparathna et al., 2016; Petri et al., 2017; Bungau et al., 2022; Hauashdh et al., 2022). These ongoing costs may include servicing renewable energy systems, replacing sustainable materials, and implementing technological advancements to meet evolving sustainability standards (Ellabban

et al., 2014; Liu et al., 2015; Huenteler et al., 2016; Grubler et al., 2018; Gielen et al., 2019). Securing dedicated funding streams, such as through long-term maintenance funds, reserve funds, or income from energy savings, ensures that sufficient resources are available to cover these expenses over the building's lifecycle (Kats, 2013; Bielenberg et al., 2016; Bertone et al., 2016; Clark et al., 2018; Alam et al., 2019). Additionally, exploring innovative financing mechanisms, such as green bonds or public-private partnerships (PPPs), can provide additional financial support for sustainable building maintenance and operational needs (González-Ruiz et al., 2018; Bolton et al., 2020; Mirzaee & Sardroud, 2022; Vassileva, 2022; Ning et al., 2023; Akomea-Frimpong et al., 2024). By prioritising financial sustainability, stakeholders can safeguard investments in sustainable infrastructure and maximise long-term environmental and economic benefits.

Partnership Dynamics

Maintaining effective collaboration, transparency, and communication between public and private partners is crucial for resolving conflicts, adapting to evolving project needs, and ensuring continuous improvement in sustainability outcomes (Jomo et al., 2026; Klievink et al., 2016; Gray & Purdy, 2018; Van Tulder & Keen, 2018; Graci, 2020). Public-Private Partnerships (PPPs) rely on shared goals, mutual trust, and clear roles and responsibilities to achieve successful project outcomes (Benítez-Ávila et al., 2018; Kang et al., 2019; Warsen et al., 2028; Solheim-Kile et al., 2019). Establishing governance structures that promote open dialogue, regular stakeholder meetings, and collaborative decision-making processes helps build strong partnerships and foster a culture of accountability (Brown & Dillard, 2015; Payne & Calton, 2017; Smith & Benavot, 2019; MacDonald et al., 2022). Transparent reporting mechanisms and performance metrics allow stakeholders to track progress, identify potential challenges, and implement corrective actions promptly (Al-Khouri et al., 2015; Dumay et al., 2015; Kahn et al., 2015; Krasodomska et al., 2021; Kerzner, 2022). Effective communication channels ensure that all parties are informed of project developments, changes in requirements, and emerging sustainability trends (Alreshidi et al., 2017; Fewings & Henjewe, 2019; Servaes, 2022). By nurturing partnership dynamics based on mutual respect and shared objectives, stakeholders can overcome obstacles, leverage collective expertise, and drive continuous innovation towards achieving sustainable building goals (Watson et al., 2018; Ahn et al., 2019; Kuenkel & Kuenkel, 2019; Raiden & King, 2021; Jayashree et al., 2022; Khan et al., 2022).

SYNTHESIS OF CHALLENGES AND STRATEGIES IN PUBLIC-PRIVATE PARTNERSHIPS FOR SUSTAINABLE BUILDING INITIATIVES IN DEVELOPING COUNTRIES

Financial Viability: Sustainable building practices entail higher upfront costs due to eco-friendly materials, energy-efficient technologies, and sustainable design considerations. Uncertain returns pose challenges as benefits like energy savings accrue gradually, impacting investor confidence.

Limited capital availability further restricts funding options, exacerbated by perceived higher risks associated with sustainable projects.

Risk Allocation: Technological risks involve uncertainties in performance reliability and market acceptance of new sustainable technologies. Market risks include economic fluctuations, regulatory changes, and shifts in consumer demand, necessitating robust risk management strategies like warranties and performance guarantees.

Regulatory and Legal Frameworks: Challenges include inconsistent regulations, bureaucratic delays, and weak enforcement undermining project timelines and investor confidence. Strengthening regulatory clarity and enforcement mechanisms is crucial for fostering a conducive environment for sustainable building projects.

Capacity Building: Developing countries face shortages in technical expertise and administrative capacity, hindering effective project implementation. Training programs and institutional reforms are essential to build local capabilities and enhance government agencies' proficiency in managing PPPs.

Social and Environmental Impact: Stakeholder engagement is critical for gaining local support and addressing community concerns, ensuring projects align with local needs. Environmental sustainability requires stringent adherence to green practices and monitoring to mitigate ecological impacts.

Long-term Commitment and Maintenance: Ensuring financial sustainability through dedicated funding mechanisms and effective partnership dynamics is crucial for maintaining sustainable building infrastructure over its lifecycle. Transparent governance structures and continuous communication are vital for resolving conflicts and adapting to evolving project needs.

DISCUSSION OF FINDINGS ON CHALLENGES IN PUBLIC-PRIVATE PARTNERSHIPS (PPPS) FOR SUSTAINABLE BUILDING INITIATIVES IN DEVELOPING COUNTRIES

This discussion examines the challenges faced by PPPs in sustainable building within developing countries through the lens of theoretical frameworks, such as Transaction Cost Theory, Institutional Theory, Resource Dependency Theory, and Stakeholder Theory. These frameworks highlight the complexities in financial viability, risk allocation, regulatory frameworks, capacity building, and environmental and social sustainability. By interconnecting these factors, the discussion provides a nuanced understanding of the challenges and offers insight into effective strategies for improving PPP effectiveness.

Financial Viability

- i. Theoretical Context: Transaction Cost Theory helps frame the financial challenges in PPPs by highlighting how upfront costs and uncertain returns increase transaction costs, impacting project feasibility. Resource Dependency Theory further explains the limited

- capital, as developing countries often rely on external funding sources, which heightens financial risks and dependencies on global finance.
- ii. **Challenge Interplay:** Higher initial costs for eco-friendly materials, energy-efficient technologies, and sustainable design features demand significant capital, which is often scarce in developing countries. The uncertain returns also discourage private sector investments, as sustainable buildings may not yield immediate financial benefits. This lack of immediate profitability is exacerbated by weak capital markets and limited green finance options, creating a cycle of financial constraint that discourages participation.
 - iii. **Implications and Strategies:** To address these financial viability issues, Transaction Cost Theory suggests structuring PPPs to mitigate upfront costs and share financial risks through mechanisms like co-financing, green bonds, or tax incentives. Resource Dependency Theory further implies that developing countries need to foster stronger domestic capital markets or seek partnerships with international green finance institutions to diversify financial resources and lessen dependency on external funding.

Risk Allocation

- i. **Theoretical Context:** Transaction Cost Theory underscores the need for clear risk allocation to minimize potential disputes and costs. Stakeholder Theory also plays a role here, as effective risk management requires aligning interests and expectations across public and private stakeholders.
- ii. **Challenge Interplay:** Technological and market risks present significant obstacles. For instance, sustainable construction technologies may lack a proven performance record, leading to private-sector hesitancy to shoulder these risks alone. Additionally, market risks, such as fluctuating economic conditions and regulatory changes, create a high level of uncertainty that affects the willingness of investors to engage in PPPs.
- iii. **Implications and Strategies:** Applying Transaction Cost Theory, effective risk-sharing mechanisms—such as performance guarantees or government-backed insurance—can reduce private sector exposure and facilitate investment. Stakeholder Theory emphasizes the importance of early and continuous engagement with stakeholders, including securing risk-sharing agreements that clearly define roles, responsibilities, and protections for both parties.

Regulatory and Legal Frameworks

- i. **Theoretical Context:** Institutional Theory offers insights into the regulatory challenges by emphasizing the influence of institutional structures, norms, and governance quality on PPP success. Developing countries often face regulatory inconsistencies, bureaucratic hurdles, and weak enforcement, which hinder PPP efficiency and efficacy.
- ii. **Challenge Interplay:** Inconsistent regulations, frequent policy changes, and extensive bureaucratic procedures increase project costs and cause delays. Weak enforcement further exacerbates these issues, as non-compliance can lead to substandard sustainable practices that undermine environmental goals and reduce private sector confidence.

- iii. Implications and Strategies: Institutional Theory suggests that developing countries should strive to create stable regulatory environments by implementing standardised guidelines, improving transparency, and streamlining bureaucratic processes. Strengthening enforcement mechanisms through capacity building, regular monitoring, and stakeholder accountability can also foster a regulatory environment that encourages private sector investment.

Capacity Building

- i. Theoretical Context: Resource Dependency Theory and Institutional Theory both apply here. Resource Dependency Theory explains how PPPs depend on skilled personnel and administrative resources to manage sustainable building initiatives effectively. Institutional Theory highlights the importance of institutional capacity and administrative competence in supporting complex PPP arrangements.
- ii. Challenge Interplay: Many developing countries lack the technical and administrative capacity required to implement sustainable construction projects, including skills in sustainable design, project management, and regulatory compliance. This skills gap hinders the government's ability to manage complex PPP arrangements effectively, often leading to project delays, compliance challenges, and insufficient stakeholder engagement.
- iii. Implications and Strategies: Resource Dependency Theory suggests investing in local workforce training to build technical and managerial skills relevant to sustainable construction. Institutional Theory supports enhancing administrative capacity within government agencies by standardizing procedures, creating knowledge-sharing networks, and fostering partnerships with international institutions to transfer knowledge and expertise.

Social and Environmental Impact

- i. Theoretical Context: Stakeholder Theory is instrumental in addressing the social and environmental dimensions of PPPs. This theory posits that effective engagement with all stakeholders, including local communities and environmental advocates, is essential for sustainable outcomes. Additionally, Institutional Theory is relevant in ensuring environmental and social safeguards.
- ii. Challenge Interplay: Sustainable building projects need strong stakeholder engagement to address community concerns and secure local support. However, inadequate engagement can lead to community resistance and delays. Similarly, ensuring environmental sustainability requires adherence to stringent standards, which can be challenging in regions with weak regulatory enforcement.
- iii. Implications and Strategies: Stakeholder Theory underscores the need for inclusive, participatory approaches that involve all relevant stakeholders throughout the project lifecycle. Creating platforms for public dialogue, conducting community consultations, and addressing environmental concerns openly can foster community support and social

acceptance. Institutional Theory emphasizes establishing robust frameworks for monitoring environmental impact and enforcing compliance with sustainability standards.

Long-Term Commitment and Maintenance

- i. **Theoretical Context:** Resource Dependency Theory and Stakeholder Theory converge in the challenge of ensuring long-term commitment to maintenance and operational efficiency in sustainable building projects. Effective partnership dynamics and stable funding are crucial for maintaining sustainable outcomes.
- ii. **Challenge Interplay:** Sustainable buildings often require specialised maintenance to retain their energy efficiency and environmental benefits. The public sector's capacity to secure funding for long-term maintenance and the private sector's commitment to partnership dynamics directly impact the sustainability of these projects.
- iii. **Implications and Strategies:** Resource Dependency Theory suggests the establishment of maintenance funds or dedicated revenue streams to ensure the financial sustainability of these projects. Stakeholder Theory reinforces the need for continuous communication, transparency, and shared accountability to foster strong partnerships that can adapt to changing conditions and ensure the longevity of sustainable building initiatives.

The theoretical frameworks applied here reveal the interconnectedness of the challenges facing PPPs in sustainable building projects in developing countries. Transaction Cost Theory, Institutional Theory, Resource Dependency Theory, and Stakeholder Theory collectively highlight the importance of clear risk allocation, capacity building, stakeholder engagement, and financial mechanisms in addressing these challenges. By applying these theories to the findings, this discussion underscores the need for multi-faceted strategies and adaptive approaches to overcome the complexities of sustainable building PPPs in developing countries. The insights provided can inform policymakers, practitioners, and stakeholders, guiding the development of robust frameworks and initiatives that maximize the potential of PPPs in achieving sustainable development goals.

CONCLUSIONS

Based on the findings regarding Public-Private Partnerships (PPPs) for sustainable building initiatives in developing countries, several broad conclusions emerge that underscore the critical factors influencing their success and sustainability.

Financial Constraints as a Primary Barrier

Sustainable building practices present considerable financial challenges, primarily due to higher upfront costs and uncertainties in achieving returns on investment. Limited access to capital, compounded by the perceived riskiness of sustainable projects, significantly impedes private-sector involvement. Solutions like green finance mechanisms, subsidies, and dedicated

maintenance funds are essential to address these barriers. Developing robust financial frameworks that reduce initial investment pressures and assure long-term financial sustainability will be pivotal to encouraging more widespread adoption of sustainable practices in PPPs.

Risk Allocation Requires Greater Flexibility and Strategic Support

Sustainable building projects often involve complex risks, including technological reliability, market fluctuations, and regulatory shifts. These risks necessitate clear risk-sharing arrangements between the public and private sectors, including performance guarantees, long-term contracts, and market studies. Addressing technological risks through warranties, promoting market acceptance with strategic outreach, and stabilizing regulatory frameworks can build investor confidence and improve project outcomes.

Regulatory and Institutional Strengthening is Essential

Weak regulatory environments, lengthy approval processes, and inconsistent enforcement are major hurdles for PPPs in developing countries. Streamlining regulatory processes and enhancing enforcement mechanisms is vital to create a more attractive and reliable investment climate. Transparent regulatory practices, consistent guidelines, and stronger enforcement would not only reduce project delays and uncertainties but also instill confidence in investors and partners, making PPPs more viable.

Capacity Building as a Key Driver of Project Success

The lack of technical and administrative expertise in sustainable construction hinders effective project implementation and oversight. This gap underscores the importance of capacity-building initiatives that offer practical, hands-on training in sustainable construction techniques, contract management, and PPP frameworks. By strengthening local capacity, countries can increase the likelihood of successful project execution, enhance compliance with sustainability standards, and promote knowledge transfer and innovation in the construction sector.

The Need for Long-Term Commitment and Effective Maintenance Plans

The long-term viability of sustainable building projects depends on securing funds for ongoing maintenance, upgrades, and operational needs. Sustainable buildings require periodic updates to maintain their energy efficiency, environmental performance, and relevance amid evolving standards. Financial mechanisms such as green bonds, dedicated maintenance funds, and income from energy savings are crucial to supporting these long-term needs, ensuring that sustainability goals are maintained throughout the building lifecycle.

Stakeholder Engagement and Strong Partnerships Foster Success

Effective collaboration between public and private entities, as well as with the communities involved, is vital for PPP success. Transparent communication, regular stakeholder meetings, and participatory decision-making help build trust, foster mutual accountability, and promote positive social impacts. Establishing frameworks for open dialogue and community involvement enhances local support and ensures that projects align with community needs, contributing to project sustainability and long-term social benefits.

Environmental and Social Impacts as Central Goals

Prioritising environmental sustainability through adherence to strict standards and regular performance monitoring contributes to resource conservation, reduced carbon footprints, and climate resilience. Additionally, involving local communities and addressing their needs and concerns through active engagement can amplify social benefits, contributing to better social acceptance, community well-being, and support for sustainable infrastructure.

CONCLUDING NOTE

In conclusion, the success of PPPs in sustainable building initiatives in developing countries hinges on creating a supportive ecosystem that addresses financial, regulatory, capacity-building, and partnership challenges. A holistic approach emphasising flexible financial mechanisms, regulatory consistency, capacity development, and effective stakeholder engagement can provide a strong foundation for these projects. By addressing these critical areas, PPPs can become effective vehicles for advancing sustainable construction goals, fostering economic resilience, and contributing to global sustainable development objectives.

POLICY RECOMMENDATIONS

Building on the general conclusions, the following policy recommendations are suggested to enhance the effectiveness and sustainability of Public-Private Partnerships (PPPs) for sustainable building in developing countries:

1. Establish Financial Incentives and Support Mechanisms

- i. **Green Finance Incentives:** Governments should implement or expand green finance mechanisms such as green bonds, tax credits, and low-interest loans dedicated to sustainable construction projects. These financial tools can help mitigate the high upfront costs and encourage private-sector investment in sustainable buildings.

- ii. **Subsidy and Grant Programs:** Provide targeted subsidies or grants for sustainable construction materials, energy-efficient technologies, and renewable energy systems within PPPs. These funds could be directed towards both private partners and public agencies to reduce overall project costs.
- iii. **Risk Mitigation Instruments:** Introduce insurance schemes or guarantee funds to protect investors from risks associated with sustainable projects. By offering financial safety nets, governments can increase investor confidence and attract private capital into high-risk markets.

2. Develop Clear Regulatory Frameworks and Streamlined Approval Processes

- i. **Standardize Sustainability Guidelines:** Establish clear, consistent sustainability standards that PPPs must follow, covering energy efficiency, waste management, and emissions reduction. This can include guidelines aligned with international standards to ensure quality and consistency.
- ii. **Streamline Regulatory Approvals:** Simplify and expedite approval processes for sustainable PPP projects. Introducing a "one-stop-shop" for regulatory clearances and reducing bureaucratic bottlenecks can accelerate project timelines and reduce administrative burdens for private-sector participants.
- iii. **Strengthen Contract Enforcement:** Ensure that project agreements, especially regarding risk allocation, are legally enforceable and upheld by an independent oversight body. Strong contract enforcement mechanisms can reduce uncertainties and improve trust among partners.

3. Promote Capacity-Building Initiatives for Local Stakeholders

- i. **Training Programs for Technical Skills:** Invest in training programs that build local expertise in sustainable construction, maintenance practices, and PPP management. This can involve partnerships with international organizations, universities, and the private sector to deliver specialized training modules.
- ii. **Enhance Public-Sector Project Management Capacity:** Establish dedicated PPP units within government agencies that are trained to handle the complexities of sustainable building projects. These units should focus on project design, risk assessment, and contract negotiation to ensure effective oversight.
- iii. **Encourage Knowledge Exchange and Best Practices Sharing:** Create platforms for local governments and private partners to share best practices, case studies, and lessons learned from successful sustainable PPP projects. Knowledge sharing can help standardize practices and avoid common pitfalls in project implementation.

4. Implement Long-Term Maintenance and Operational Funding Plans

- i. **Dedicated Maintenance Funds:** Set aside dedicated funds within the project budget to cover long-term maintenance and operational costs. This can ensure that sustainability standards are maintained throughout the project lifecycle without financial strain.
- ii. **Encourage Energy Savings Reinvestment:** Create policies that allow a portion of the savings from energy efficiency to be reinvested into project maintenance or improvement efforts. This self-sustaining financial approach helps keep projects in line with evolving sustainability standards.
- iii. **Introduce Performance-Based Contracts:** Develop contract models that link financial rewards to long-term performance, encouraging private partners to maintain the sustainability and efficiency of buildings over time. Such contracts can ensure high-quality operation and maintenance services.

5. Foster Effective Public-Private-Community Partnerships

- i. **Engage Local Communities from the Start:** Implement community consultation processes during the planning and design phases of PPP projects. Incorporating community input helps ensure the project aligns with local needs and builds social support for the initiative.
- ii. **Transparency and Accountability Mechanisms:** Establish mechanisms for transparent communication and accountability to the public. Regular updates on project milestones, sustainability performance, and community impacts can enhance public trust and support.
- iii. **Social Impact Commitments:** Encourage PPPs to include provisions for social benefits, such as job creation, skill development, and local sourcing of materials. These commitments can enhance the social value of the project and foster positive community relations.

6. Encourage Monitoring and Evaluation for Continuous Improvement

- i. **Regular Performance Audits:** Implement periodic sustainability audits that measure project performance against established environmental and social benchmarks. These audits help ensure that projects are meeting sustainability goals and provide data for adjustments if needed.
- ii. **Public Reporting Requirements:** Require regular public reporting on project outcomes, including environmental impacts, energy savings, and social benefits. Transparency in reporting can motivate private partners to adhere to sustainability commitments and foster public accountability.
- iii. **Adaptive Management Approaches:** Develop adaptive management frameworks that allow for iterative improvements based on project performance data. Adaptive management enables continuous learning and improvements, enhancing project resilience and alignment with changing sustainability standards.

7. Adopt a Multi-Stakeholder Coordination Approach

- i. **Create PPP Coordination Bodies:** Form multi-stakeholder coordination bodies at the national and local levels to oversee sustainable PPP projects. These bodies can help align goals across sectors, facilitate resource sharing, and resolve conflicts between stakeholders.
- ii. **Leverage International Partnerships and Support:** Engage with international organizations, development banks, and NGOs for technical assistance, funding, and policy guidance. Access to global expertise and resources can significantly enhance project quality and sustainability.

These policy recommendations outline a comprehensive approach to addressing the financial, regulatory, capacity-building, and partnership challenges in implementing sustainable PPPs. By focusing on financial incentives, streamlined regulations, capacity development, community engagement, and rigorous performance monitoring, governments can create a supportive environment for sustainable building initiatives. When effectively implemented, these policies can catalyse sustainable development, foster resilience, and provide long-term social and environmental

DIRECTIONS FOR FUTURE RESEARCH

To advance the effectiveness and scalability of Public-Private Partnerships (PPPs) in sustainable building projects within developing countries, future research should focus on the following areas:

1. Evaluation of Financial Instruments for Sustainable PPPs

- i. **Cost-Benefit Analysis of Green Finance Tools:** Further research should investigate the effectiveness of green finance instruments such as green bonds, tax credits, and sustainability-linked loans. Studies could assess the financial impact on project costs, the extent of private-sector participation, and the overall success in achieving sustainable outcomes.
- ii. **Private Sector Risk Perception and Mitigation Strategies:** Research should explore how financial instruments can mitigate perceived risks in sustainable construction. Understanding the barriers to private-sector investment, especially in high-risk or underdeveloped markets, will help tailor more effective financial models for sustainable PPPs.

2. Governance and Institutional Frameworks

- i. **Impact of Regulatory Frameworks on PPP Success:** Future studies could analyze the relationship between regulatory clarity, transparency, and the success of sustainable PPP projects. Research should identify the key regulatory factors that either facilitate or hinder the implementation of green building projects in developing countries.
- ii. **Governance Models for PPPs:** Exploring various governance models for PPPs, particularly those that integrate sustainability goals, could offer insights into how effective governance can enhance project outcomes. This includes studying the role of contract enforcement, risk-sharing, and the involvement of local stakeholders.

3. Technological Innovation and Sustainability

- i. **Innovative Construction Technologies:** Research on emerging sustainable construction technologies (e.g., modular construction, 3D printing, and energy-efficient building materials) within PPPs is crucial. Studies should focus on the feasibility of these technologies in developing countries, cost-effectiveness, and scalability.
- ii. **Smart Buildings and Energy Management:** Future research could examine the integration of smart technologies and energy management systems in sustainable PPP buildings. Investigating how these technologies contribute to long-term operational efficiency and energy savings in low-resource settings would provide valuable insights.

4. Social and Environmental Impacts of Sustainable PPPs

- i. **Social Impact Assessments:** Further research should investigate the social impacts of sustainable PPP projects, such as the creation of jobs, improvement in local living conditions, and community empowerment. Research could assess whether PPPs contribute to social development goals and how these benefits are distributed among local populations.
- ii. **Environmental Performance Metrics:** In-depth studies on the environmental outcomes of sustainable building projects in PPPs are necessary. Research should focus on assessing the carbon footprint, energy consumption, waste reduction, and water conservation of these projects over time.

5. Capacity Building and Local Expertise Development

- i. **Training Needs in PPPs for Sustainability:** Studies could explore the specific training needs of local governments, contractors, and stakeholders involved in sustainable PPPs. Identifying gaps in knowledge and skills related to sustainable construction practices,

project management, and PPP frameworks will help design more effective capacity-building programs.

- ii. Long-Term Capacity Building Models: Research should explore the development of sustainable training programs that are adaptable to local contexts and can continue to evolve alongside changing technologies and sustainability practices.

6. Public Perception and Stakeholder Engagement

- i. Community Acceptance and Involvement: Future research could focus on the role of community involvement in the design and implementation of sustainable PPPs. Understanding how public perceptions influence the success of such projects will help improve stakeholder engagement strategies.
- ii. Public-Private Partnerships in Informal Urban Areas: Since many developing countries have rapidly expanding informal settlements, research into how PPPs can be designed to meet the unique challenges of these areas is crucial. Studies could examine the potential for sustainable building in informal urban settings, where infrastructure and financing gaps are most severe.

7. Long-Term Sustainability and Lifecycle Analysis

- i. Lifecycle Cost and Performance Assessments: Research should focus on the long-term performance and cost of sustainable PPP buildings, including operational costs and energy performance over their entire lifecycle. Studies that assess the durability of materials, systems, and technologies will provide insights into the true sustainability of PPP projects.
- ii. Impact of Maintenance and Upkeep on Sustainability Goals: Future studies could examine how maintenance practices affect the sustainability of PPP buildings, particularly energy efficiency and environmental impact. Research into best practices for long-term maintenance planning in sustainable PPP projects would be valuable.

8. Global Comparisons and Case Studies

- i. Comparative Analysis of PPP Models: Conducting cross-country comparative studies of sustainable PPPs could help identify successful models that can be replicated or adapted to different contexts. Research should look at both developed and developing countries to see how PPPs with a sustainability focus are structured and their outcomes.
- ii. Case Studies of Successful Projects: More in-depth case studies of successful PPP projects focused on sustainable building, particularly in developing countries, could offer valuable insights. Research could identify key success factors, common challenges, and solutions applied in diverse settings.

9. Impact of Climate Change on PPP Design

- i. Resilience and Adaptation in PPP Projects: Research could focus on how sustainable building practices within PPPs are adapting to the challenges posed by climate change, such as extreme weather events or shifting energy demands. This includes exploring climate-resilient design strategies and the role of PPPs in disaster preparedness.
- ii. Climate-Smart Technologies in Developing Countries: Investigate how climate-smart building technologies can be integrated into PPPs in developing countries, especially in regions vulnerable to climate change impacts. Research could examine the viability of such technologies in local contexts and their cost-benefit balance.

10. Sustainability Reporting and Performance Metrics

- i. Frameworks for Sustainability Reporting in PPPs: Research could focus on developing standardized frameworks for sustainability reporting in PPPs. This would help stakeholders evaluate and compare the environmental, social, and financial performance of projects.
- ii. Developing Key Performance Indicators (KPIs): Future studies should focus on creating universally applicable KPIs for assessing the sustainability of PPPs. These indicators should cover a range of sustainability dimensions, including resource efficiency, social equity, and economic viability.

By addressing these research areas, future studies will help improve the design, implementation, and impact of sustainable PPPs, making them more effective in addressing the challenges of sustainable building in developing countries. This research agenda will support the transition toward greener, more equitable, and resilient infrastructure in line with global sustainability goals.

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