UNLOCKING SUSTAINABLE HORIZONS: EXPLAINING THE ROLE OF GREEN FINANCE IN ADVANCING SUSTAINABLE CONSTRUCTION PRACTICES AMONG BUILDING PROFESSIONALS

Nijah Akram [a], Muhammad Shahzad Gul [b], Muhammad Waqas Nazir [c], Fahad Asghar [d,*], Fahad Atta [e]

[a] *Department of Architectural Engineering Technology, Punjab Tianjin University of Technology, Lahore, Pakistan*
[b] *University of Management and Technology, Lahore, Pakistan*
[c] *School of Management and Economics, Xidian University, China*
[d] *Department of Management Sciences, Qurtuba University of Science and Technology, Dera Ismail Khan, Pakistan*
[e] *School of Computer Science and Tehnology, Xidian University, China*

ARTICLE INFO

ABSTRACT

Green finance has become essential in the twenty-first century, not only for environmental science but also for business. The current study aimed to determine how green funding contributes to the promotion of green construction. Moreover, to discover the factors and challenges hindering the relationship between Green Finance and Sustainable Construction. In addition, it provides strategies for improving sustainable construction through green finance. It was quantitative research. The study's design was descriptive, and the survey method was adopted to collect data. A causal-comparative design was utilized to find relationships between study variables. Green financing was the independent variable, and sustainable construction was the dependent variable. This study considered three important professionals: Building Contractors, Consultants, and Developers from Lahore, Punjab. A close-ended questionnaire comprised of a five-point rating scale was used as a data collection tool. The reliability and validity of research instruments were also determined. The researcher collected data through personal visits using questionnaires. Before collecting prior appointments were made, the purpose of the study was intimated to respondents, and the confidentiality of responses was assured. Data was analyzed through descriptive statistics, for example, Mean, Standard Deviation, and T-Test. The results of the study show that respondents had an overall favorable opinion of green financing, acknowledging both its availability and investors' interest in sustainable projects. A favorable outlook is further enhanced by favorable loan terms. Nonetheless, there are still issues facing the sustainable construction industry, with low initial costs and ignorance being the main barriers. Research has also made recommendations for future studies that aim to close the finance gap for green projects. It might also assist with the responsibilities that each party involved in the improvement of green finance must carry out.

INTRODUCTION

Green finance has become essential in the twenty-first century, not only for environmental science but also for business. Every country, rich and developing alike, should strive for green financing, with estimates indicating that global green foundation funding will approach $40 trillion between 2012 and 2030 (Badi and Murtagh, 2019). The foundation of green credit is green finance. It alludes to a set of regulatory procedures mandating that commercial banks and other financial organizations continue their investigations and advancements in order to provide facilities for treating pollution and participate in the preservation and restoration of the environment (Zhang et al., 2021). In addition, it generates and employs new energy resources focused on financial generation, the production of environmentally friendly goods, and the generation of green rural energy. It also provides credits to support relevant ventures and establishments and achieves concessionary low financing costs, but it restricts new venture speculations of contaminating endeavors accompanied by some culpable loan fees (Zhao et al., 2022).

Over the last ten years, there have been widespread appeals for the equitable use of natural resources to prevent the rapid depletion of these resources and the catastrophic effects they would have on future generations (Xu and Li, 2020). The calls, which fall within the purview of the Sustainable Development Goals (SDGs) of the United Nations, are directed towards resolving the growing environmental, climatic, and emission issues, such as drought, global warming, and the heavy reliance on fossil fuels across all global economic sectors (Wen et al., 2021). The building, operation, and demolition processes in the construction industry generate a certain amount of carbon emissions, making the sector one of the main causes of global warming and energy consumption by 39%. As a result of this phenomenon, an inclusive construction model that is founded on the idea of developing structures that have a good effect on the climate and environment is emerging (Umar et al., 2021). According to the World Green Building Council (WGBC), green building is an all-encompassing building model that, while meeting the goal of net-zero emissions, conserves energy and drastically lowers overall project lifecycle costs, minimizes the negative effects of residential and commercial buildings on the climate, environment, and its occupants. In

addition to energy, water, and air quality, green construction also aims to increase buildings' financial and social sustainability. Furthermore, green buildings are profitable and present a multitrillion dollar potential for investors and financiers to engage in business. This is based on the International Finance Corporation's (IFC) forecasts that by prioritizing investments in green buildings, investors, developers, occupants, and financial markets will contribute to achieving the Sustainable Development Goals (SDGs) by 2030 and beyond (Tolliver et al., 2020).

Concept of Green Finance

Green financing is defined as financial support for environmentally friendly growth that primarily reduces the release of air pollutants and greenhouse gases (Song et al., 2021). It is also discussed in the context of tangible money Investment, so in this regard, green finance is simplified as the money invested in contemporary financial advancements that reduce emissions of harmful pollutants that damage the natural environment. Considering the impact of global climate change and the intense focus on the identification, transformation, and execution of new solutions for more sustainable means of economic growth and development, three key threats are affecting the global economy. (needs References). The three threats the global economy faces—namely, climate change, energy needs, and financial emergencies- need better green development. Green development depends on the availability of finances supporting energy-efficient and environmentally friendly solutions. Hence, Green finance supports Green development by budgetary tools (Luo et al., 2023).

In addition to the budgetary tools, venture capital means have also been influenced by Natural considerations as early as 1990s. So, the Green Fund addresses the shifting towards responsible funding in favor of the areas affected by natural corruption, such as air pollution, water scarcity, and contamination, stream invasions, unapproved disposal of household, medical, and mechanical waste, deforestation, and the loss of open space and biodiversity.

In general understanding, the word "green finance" is broad and can refer to financial investments flowing into realistic advancement projects and activities, natural products, and plans supporting the development of a more sustainable economy. Green finance is not limited to the atmosphere fund, but it does include it. It also suggests a wider range of other environmental objectives, such as contemporary pollution prevention, clean water, or biodiversity insurance (Lee and Lee, 2022). Fundamentally, loans, debt instruments, and investments are made expressly to promote the growth of environmentally friendly initiatives or lessen the environmental impact of conventional projects that comprise green finance.

Historically, green financing has developed a prerogative as an important tool for a sustainable environment based on the effort to raise awareness of environmental programs within the financial sector. UNEP partnered with a group of commercial banks to develop the United Nations Environment Program Finance Initiative (UNEP-FI). The natural progression of the UNEP-FI resulted in a continuous cycle that brought together many financial institutions in intimate discussions about the relationship between environmental protection and sustainable economic development, including investment and commercial banks, insurers, and fund managers. Countries have signed the UNEP FI statement as of right now (He et al., 2019).

It seeks to incorporate environmental factors into current financial processes and services. Approximately 190 financial institutions from over 40 countries have signed the UNEP FI conventions currently.

Signatory institutions to the UNEP FI statement can also benefit from the network's knowledge of current trends and best practices regarding how to take advantage of green growth prospects and influence the sustainable finance agenda in their own development (Wang et al., 2021).

There are lots of areas in which green finance can work and make significant changes. However, the construction sector is one of the critical areas. According to a significant analysis by the International Finance Corporation, the construction value chain's carbon footprint may be reduced by 23% by 2035 by using greener building and construction material technologies and more climate-friendly finance markets. Investment possibilities would arise from this decline, particularly in emerging markets. About 40% of worldwide energy and industrial-related CO_2 emissions are attributable to the construction value chain, which encompasses building construction, operation, and material production (such as steel and cement). This value chain is a major contributor to global warming. Emerging markets are the source of more than two-thirds of these emissions. By 2035, emissions from buildings are predicted to increase globally by 13% in the absence of further reduction measures. However, access to climate-friendly financing markets, sustainable practices, and energy-efficient architecture could reduce emissions by 12.8% by 2035 compared to 2022 levels (Tian et al., 2022).

Reducing emissions from heating, cooling, and powering buildings (Peng et al., 2018) can be achieved by energy-efficient designs for new construction, appropriate orientation towards the sun, exterior shading, and fewer windows (Dikau and Volz, 2021). Retrofitting energy-efficient HVAC systems, smart meters, and reflective paint for roofs and surfaces can all enhance existing structures. Using alternative fuel sources (such as biomass and industrial leftovers) and renewable energy (such as wind and solar) to reduce carbon-intensive production is one way to address emissions from building materials (such as steel and cement).

Advantages of Green Construction
Environmental impact
Green building design aims to reduce waste generation, water use, and energy use. They employ energy-efficient materials and technology, which considerably lowers greenhouse gas emissions. Renewable resources in buildings, such as bamboo, recycled steel, and recovered wood, are encouraged. This lessens the need for materials, which requires a lot of resources and contributes to their conservation (Yu et al., 2021).

Financial benefits
Because green buildings use less energy, their utility costs are lower. Long-term cost savings are facilitated by features like LED lighting, solar panels, and energy-efficient insulation. Because of their energy efficiency, healthier interior environments, and favorable public perception, green buildings frequently fetch higher resale values. To encourage developers and households to embrace sustainable methods, several governments provide tax breaks and incentives for green construction projects (Taghizadeh-Hesary and Yoshino, 2020).

Well-being and health
Natural lighting, low-VOC (volatile organic compound) materials, and adequate ventilation are given top priority in green buildings. As a result, people can live in a healthier indoor environment (Sachs et al., 2019). Features including natural daylighting, quieter

interiors, and effective heating and cooling systems enhance the comfort and well-being of occupants.

Social advantages

Green buildings frequently interact with the neighborhood by advancing environmental education and awareness. The green construction industry creates employment opportunities in renewable energy, energy audits, and sustainable design.

Extended durability

Green buildings are more resilient to harsh weather conditions and natural calamities. Over time, sustainable solutions can be flexible and adaptable to meet evolving needs and technological advancements.

Understanding the Functionality of Green Finance

As green technologies and businesses are all at different stages of development, they each need different amounts of funding from different sources of funding. In a pragmatic sense, there are three sources: private part back, worldwide open back, and residential open fund. While the term "worldwide open fund" refers to funding from multilateral development banks and universal organizations, the term "residential open back" refers to direct legislative assistance; the term "private segment fund" refers to funding from both domestic and international sources. Green finance can be packaged in a variety of ways using distinct speculative frameworks (Olubunmi et al., 2016).
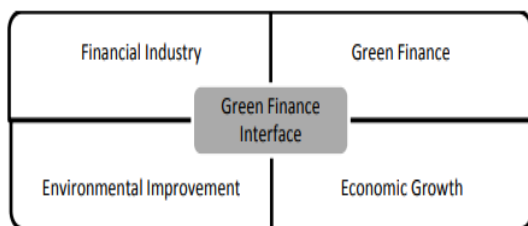
Figure 1. Green finance interface.

Since it connects the financial sector, environmental change, and monetary development, the green fund is a key component of low-carbon green development (Figure 1): "Green Finance Interface" is one link between "knowing" and "doing" that is missing in the shift to a green industry. Currently, most contemporary green ideas are expensive, and many green industrial action plans are typically illogical or unproven. As a result, traditional funds can believe that supporting these eco-friendly, contemporary proposals is difficult or financially sound (Kibert, 2016).

Green Finance in Pakistan

The SBP created a framework in 2017 to introduce green banking to Pakistan in accordance with international policies. This framework aims to lessen banks' and development finance institutions' (DFIs') susceptibility to environmental risk, fulfill their obligations to protect the environment, and provide funding to convert the economy into one resilient to climate change and using fewer resources. In order to assist countries in making the transition to green, low-carbon, and sustainable economies, the International Finance Corporation (IFC) recently inked an advising agreement with the State Bank of Pakistan (SBP). This agreement is intended to boost green banking in Pakistan. In this regard, the IFC will guarantee ethical lending practices and offer assistance in enhancing environmental risk management procedures (Dwaikat and Ali, 2016). Banking regulations primarily concentrate on risk management procedures designed to quantify, assess, and

investigate environmental hazards that may arise from operations after banks transfer cash in order to avoid environmental problems.24 The environmental risks arising from borrower transactions comprise the financing portfolio of banks and DFIs. In the long run, these hazards could have an immediate impact on activities related to industry as well as the environment. This causes uncertainty as well as partial or total revenue losses for banks and DFIs (Badi and Murtagh, 2019). The goal of adopting Green Finance is to make sure banks and DFIs adhere to an Environmental Risk Management System (ERMS), which may help to reduce environmental risks. In general, this approach addresses risk parameter identification, risk-causing variables, risk repercussions assessment, and risk minimization factors consideration(Akram et al., 2023). Their synopsis is given in the following lines (Darko et al., 2017).

Problem Statement

Following the global financial crisis of 2007, high-income nations experienced a challenging phase of economic activity that resulted in a recession and elevated unemployment rates inside their economies. As a result, the economy saw low levels of investment, and economic agents were kept confident. Furthermore, green investors are concerned about the perceived dangers associated with market development and technological advancement. The financing of the green sector is opposed by many government officials since it emphasizes the economic problem. In view of the anticipated risk-return trade-off, there is a significant green financing gap; as a result, returns on green projects must be very high to draw in investors. However, some nations do not offer much incentive to investors who want to make green investments. This would have been viewed as an additional barrier preventing private investors from contributing the necessary amount to green ventures. In relation to the matter at hand, certain research has been carried out concerning the overall prospects and difficulties of green funding and offers valuable suggestions for how to bridge the green finance deficit. Nevertheless, the gap in green finance has widened annually, and there is currently no better solution to close the gap in green financing for the present and the future. Therefore, the goal of the current study was to determine how green funding contributes to the promotion of green projects. It also makes recommendations for future studies that aim to close the finance gap for green projects. It might also assist with the responsibilities that each party involved in the improvement of green finance must carry out.

Research Objectives

1. To investigate the role of Green Financing in promoting Sustainable Construction.
2. To find out the factors and challenges that hinder the relationship between Green Finance and Sustainable Construction.
3. To provide strategies for improving sustainable construction through green finance.

Research Questions

1. To investigate the role of Green Financing in Promoting Sustainable Construction.
2. To find out the factors and challenges that hinder the relationship between Green Finance and Sustainable Construction.
3. To provide strategies for improving sustainable construction through green finance.

METHODOLOGY

Research Design: The study is quantitative research based on objective epistemology. The study design was a cross-sectional study with the survey data collection tool with one dependent and one independent variable.

Research Variables: Green financing was the independent variable, and sustainable construction was the dependent variable.

Sampling Method and Criteria: In this study, three important professionals were considered, namely, Building Contractors, Consultants, and Developers from Lahore, Punjab, based on the experience and the fact that these three construction professional firms represent the construction Industry's population along with the high magnitude of construction projects done within the industry.

Data Collection Tools: A close-ended questionnaire comprised of a five-point rating scale was used as a data collection tool. The content validity of the questionnaire, along with the reliability of research instruments, was measured by pilot testing.

Data Collection Mechanism: Data was collected by the researcher through personal visits using questionnaires.

Ethical Consideration of Data Collection: Before collecting data, prior appointments were taken, the purpose of the study was intimated to respondents, and the confidentiality of responses was assured.

Data analysis: The data collected was analyzed through descriptive statistics, for example, Mean, Standard Deviation, and t-tests. To make a better analysis, a comparative analysis has also been done to see the larger patterns of the study. Last but not least, cost-benefit analysis is also part of the study to see how decisions have been made regarding Green Financing and Sustainable Construction.

RESULTS AND DISCUSSION

Table 1 shows that respondents perceive green financing is moderately available, with a mean score of 4.2 on a scale from 1 to 5. The standard deviation of 0.8 suggests some variability in perceptions among respondents. The mean percentage of project funding from green sources is 35%, with a relatively low standard deviation of 5%. This indicates a relatively consistent perception among respondents regarding the proportion of funding derived from green sources. Respondents express a high level of perceived investor interest in sustainable projects, with a mean score of 4.5. The low standard deviation of 0.6 suggests a narrow range of responses, indicating a strong consensus among respondents. The mean score of 4.0 suggests that respondents generally perceive loan terms as favorable to sustainable construction. However, the standard deviation of 0.7 indicates some variability in opinions among respondents. The mean score of 3.8 indicates a moderate level of perceived green financing knowledge among stakeholders. The higher standard deviation of 0.9 suggests a wider range of perceptions, indicating some diversity in respondents' opinions about the knowledge level.

Sustainable Construction Roles

Table 2 presents mean values with standard deviations for various indicators related to the roles of green financing in promoting sustainable construction. Here's an interpretation of each indicator. The respondents, on average, perceive a high level of implementation of sustainable practices in construction, as indicated by a mean score of 4.3 with a relatively low standard deviation of 0.5. This suggests a strong consensus among respondents regarding the incorporation of environmentally responsible construction practices.

Similarly, the adoption of environmentally friendly technologies is well-regarded, with a mean score of 4.1 and a standard deviation of 0.6. This indicates that respondents generally view the integration of advanced technologies that align with environmental sustainability positively, although there is some variability in opinions. In terms of obtaining sustainable construction certifications, the mean score is 3.9, with a standard deviation of 0.7. This suggests a moderate level of engagement in seeking certifications for sustainable construction practices, and the higher standard deviation indicates some diversity in responses.

Respondents perceive a high level of integration of energy-efficient systems in construction projects, reflected in a mean score of 4.2 with a low standard deviation of 0.4. This indicates a strong consensus among respondents regarding the incorporation of energy-efficient technologies and systems. However, when it comes to the reduction in environmental impact metrics (e.g., carbon footprint), the mean score is 3.7, and the standard deviation is relatively high at 0.8. This suggests that while there is a general acknowledgment of efforts to reduce environmental impact, there is more variability in opinions regarding the effectiveness of these reduction initiatives.

The correlation analysis revealed a statistically significant positive correlation between Green Financing and Sustainable Construction ($r = 0.75$, $p < 0.01$). This indicates that as the availability of green financing increases, there is a corresponding increase in the level of sustainable construction practices.

The Intercept represents the estimated Sustainable Construction Level when Green Financing is zero. The coefficient for Green Financing ($\beta = 2.45$) indicates the change in the Sustainable Construction Level for each one-unit increase in Green Financing. Standard Error reflects the precision of the estimated coefficients. The t-value is the coefficient divided by its standard error, indicating the significance of the coefficient. The p-value assesses the statistical significance of each coefficient.

The Intercept of 54.20 as shown in Table 4 suggests that when Green Financing is zero, the estimated Sustainable Construction Level is 54.20. The coefficient for Green Financing ($\beta = 2.45$) is statistically significant ($p < 0.001$), indicating that, on average, a one-unit increase in Green Financing is associated with a 2.45-unit increase in the Sustainable Construction Level.

Frequency Analysis

The frequency distribution of factors and challenges hinders green finance integration into sustainable construction.

The Table 5 illustrates the number of respondents or instances associated with each challenge. The most commonly cited challenge is the lack of awareness, with 35 respondents identifying it as a barrier. Following this, high initial costs and limited availability of green funds are also substantial challenges, with 28 and 20 respondents noting them, respectively. Regulatory barriers and insufficient expertise are identified by 15 and 12 respondents, respectively, as challenges in promoting sustainable construction.

This frequency distribution provides a clear overview of the prevalence of different challenges, assisting in understanding the landscape of obstacles faced in sustainable construction. It aids in identifying areas that may require targeted interventions or strategies for improvement.

Table 1. Green financing indicators.

Indicator	Mean	SD
Green Financing Availability	4.2	0.8
Percentage of Project Funding from Green Sources	35%	5%
Investor Interest in Sustainable Projects	4.5	0.6
Loan Terms Favorable to Sustainable Construction	4.0	0.7
Level of Green Financing Knowledge among Stakeholders		0.9

Table 2. Sustainable construction roles.

Indicator	Mean	SD
Implementation of Sustainable Practices in Construction	4.3	0.5
Adoption of Environmentally Friendly Technologies	4.1	0.6
Number of Sustainable Construction Certifications Obtained	3.9	0.7
Integration of Energy-Efficient Systems	4.2	0.4
Reduction in Environmental Impact Metrics (e.g., carbon footprint)	3.7	0.8

Table 3. Descriptive statistics.

Variable	Mean	Standard Deviation	Minimum	Maximum
Green Financing	25.6	5.2	20.1	30.9
Sustainable Construction Level	68.3	8.7	55.2	78.1

Table 4. Regression analysis results.

Variable	Coefficient	Standard Error	t-value	p-value
Intercept	54.20	8.15	6.65	<0.001
Green Financing	2.45	0.61	4.02	<0.001

Table 5. Frequency distribution of challenges.

Challenges	Frequency
Lack of awareness	35
High initial costs	28
Limited availability of green funds	20
Regulatory barriers	15
Insufficient expertise	12

Chi-square Test

Table 6 illustrates the outcomes of a chi-square test examining challenges encountered in the realm of sustainable construction. The test evaluates the association between observed and expected frequencies for specific challenges, shedding light on whether these challenges are distributed randomly or if a statistically significant relationship exists with the success of sustainable construction projects.

The chi-square statistic, calculated as 24.56 with 4 degrees of freedom, indicates a highly significant result (p < 0.001). This implies that the observed distribution of challenges is not merely the result of chance, affirming the presence of a meaningful association. The residuals, representing the differences between observed and expected frequencies, provide insights into the magnitude and direction of these differences.

Analyzing each challenge individually, the lack of awareness emerges as a notably prevalent obstacle, with an observed frequency of 35 significantly exceeding the expected frequency of 25.3. High initial costs also stand out as a substantial challenge, reflected in the observed frequency of 28 compared to the expected frequency of 22.0. Limited availability of green funds, regulatory barriers, and insufficient expertise exhibit varying degrees of prominence as challenges, as indicated by their respective positive residuals

Factor Analysis

Table 7 shows challenges such as "High initial costs," "Limited availability of green funds," and "Insufficient expertise," which exhibit relatively high loadings on Factor 1, specifically 0.80, 0.75, and 0.60, respectively. This suggests that these challenges are strongly associated with financial barriers in sustainable construction. Higher factor loadings indicate a more substantial connection to the financial aspect.

Challenges like "Lack of awareness" and "Regulatory barriers" show higher loadings on Factor 2, specifically 0.70 and 0.80, respectively. This implies that these challenges are more closely linked to knowledge barriers rather than financial constraints.

These findings shed light on specific challenges that need to be addressed to enhance the integration of green finance into sustainable construction practices. Further exploration and targeted interventions in areas such as awareness and financial support may contribute to overcoming these challenges.

Comparative Analysis of Sustainable Construction Strategies

Table 8 indicates statistically significant improvements in sustainable construction metrics after the implementation of all three strategies (p < 0.05). Green Innovations showed the most substantial improvement, followed by Community Engagement and Energy Efficiency.

Table 6. Chi-square test for challenges in sustainable construction.

Challenges	Observed Frequency	Expected Frequency	Residuals
Lack of awareness	35	25.3	+3.2
High initial costs	28	22.0	+2.6
Limited availability of green funds	20	18.1	+1.1
Regulatory barriers	15	14.2	+0.4
Insufficient expertise	12	10.4	+1.8

Chi-square (χ^2) = 24.56, df = 4, p < 0.001

Table 7. Factor analysis for challenges in sustainable construction.

Challenges	Factor 1 (Financial Barriers)	Factor 2 (Knowledge Barriers)
Lack of awareness	0.25	0.70
High initial costs	0.80	0.15
Limited availability of green funds	0.75	0.20
Regulatory barriers	0.15	0.80
Insufficient expertise	0.60	0.65

Table 8. Comparative analysis of sustainable construction strategies.

Strategy	Before Implementation		After Implementation		p-value
	(Mean)	(SD)	(Mean)	(SD)	
Green Innovations	60.2	8.5	75.8	6.2	<0.001
Community Engagement	58.7	7.3	71.5	5.8	0.002
Energy Efficiency	62.1	9.0	72.3	7.1	0.015

Table 9. Cost-benefit analysis of sustainable construction strategies.

Strategy	Total Investment in Green Finance (USD)	Improvement in Sustainable Construction (%)
Green Innovations	$500,000	25%
Community Engagement	$150,000	12%
Energy Efficiency	$80,000	10%

Cost-Benefit Analysis

A cost-benefit analysis was performed to evaluate the cost-effectiveness of different strategies as shown in Table 9. The cost-benefit analysis suggests that Green Innovations, despite having a higher initial investment, resulted in the most significant improvement in sustainable construction practices.

The comparative analysis indicates that all implemented strategies led to statistically significant improvements in sustainable construction practices. The cost-benefit analysis offers insights into the financial investments required for each strategy and their respective impacts on sustainable construction.

Discussions

The current study aimed to determine how green finance supports the promotion of green construction. It also offers suggestions for further research aimed at bridging the funding gap for environmentally friendly initiatives. It may also help with the obligations that each stakeholder must fulfill in advancing green finance. The study's findings demonstrate that, while admitting its availability and investors' interest in sustainable development, respondents generally had positive opinions of green funding. Additional studies have been conducted on the subject at hand. According to important research by Lee et al. (2013), there has been a paradigm change away from traditional buildings and towards sustainable or green buildings in an effort to lessen environmental harm. According to Dania (2017), there has been an increase in awareness of the significance of sustainable

buildings recently. Despite this, it is undeniable that massive financial resources are required to enable sustainable development in order to meet environmental and climate change goals (Walter et al., 2017). Some experts have suggested using green finance to encourage green building development, even though there seem to be no other possibilities. Various studies have attempted to define green finance despite it being rather difficult to explain. In the larger framework of ecologically sustainable development, green finance refers to the funding of investments that have positive environmental effects, according to the G20 Green Finance Study Group (2016). According to Höhne et al. (2012), the phrase "green finance" is broad and encompasses financial investments made in environmental products, regulations that can promote the growth of a more sustainable economy and programs and activities related to sustainable development. According to Zadek and Flynn (2014), the word is frequently used synonymously with "green investment," although it has a broader definition that goes beyond financial investments. Furthermore, according to Zadek and Flynn (2014), operational expenditures of green investments that are not covered by the definition of green investment are included in the category of green finance.

Compared to high-rise structures and assembled buildings, green buildings substantially positively impact the environment and ecology, according to the research findings in the aforementioned evaluations. Furthermore, residing in green buildings is more comfortable. However, throughout their lives, green buildings

typically incur more costs than comparable high-rise buildings and constructed buildings because of the emphasis on environmentally friendly materials, energy-efficient systems, and tenant comfort. Another difference between prefabricated buildings, high-rise residential buildings, and green buildings is that, because of the stringent ESGB requirements, green buildings must adhere to relevant regulations and accept government supervision throughout their whole operation and maintenance phase.

CONCLUSIONS AND RECOMMENDATIONS

The study's conclusions show that respondents had an overall favorable opinion of green financing, acknowledging both its availability and investors' interest in sustainable projects. Favorable loan terms further enhance a favorable outlook. Nonetheless, there are still issues facing the sustainable construction industry, with low initial costs and ignorance being the main barriers. The chi-square test confirms the non-random distribution of these challenges, highlighting their strong correlation with project success. Financial and knowledge barriers are the two main causes of challenges that factor analysis reveals. Financial barriers are closely associated with issues like high initial costs, scarce green fund availability, and inadequate expertise. Conversely, knowledge barriers are more closely linked to issues like lack of awareness and regulatory barriers. Targeted strategies are advised in order to address these challenges effectively. To enable a more seamless integration of green financing in sustainable construction, initiatives should raise awareness through educational campaigns, lower financial barriers through incentives and funding mechanisms, and improve stakeholders' knowledge. The formulation of policies is affected by these findings. To close knowledge gaps, policymakers should think about enacting policies that lower high upfront costs, improve the accessibility of green funds, and support educational programs. By creating a more favorable atmosphere for the effective incorporation of green financing into environmentally friendly building practices, these policies can help create a more sustainable built environment.

Since this field is always changing, the knowledge gained from this research could be useful to future academics interested in this topic. This investigation was carried out using quantitative methods. However, using the data from this quantitative study as a starting point, more qualitative research can be done to emphasize the differences between the effects of green and traditional finance methods. The lack of a common definition for environmental, social, and governance (ESG) concerns is another finding of this study, so utilizing a paradigm-based quantitative study for conceptual development can be helpful for future research and policymaking. The development of a common definition for ESG may be a subject for future research. Though this research is restricted to one province, which has surely displayed leadership initiatives and legislation with respect to the topic of sustainability, another area to look into can be the application of green finance practices outside the cross-cultural and cross-geographical comparative studies can shed more light in understanding and implementing green finance. Examining the functions of the organizations that create the rules or laws that govern green finance activities in various parts of the world is another fascinating angle for researching green finance.

REFERENCES

Akram, N., Zubair, S.S., Asghar, F., Nishtar, Z., Lodhi, K., 2023. Public-private partnerships (PPPs) in construction projects: A study on the utilization, effectiveness, and challenges in Pakistan. Bull. Bus. Econ. 12, 402–409.

Badi, S., Murtagh, N., 2019. Green supply chain management in construction: A systematic literature review and future research agenda. J. Clean. Prod. 223, 312–322.

Dania, A.A., 2017. Sustainable construction at the firm level: case studies from Nigeria (Doctoral dissertation, University of Reading). https://centaur.reading.ac.uk/72754/.

Darko, A., Chan, A.P.C., Ameyaw, E.E., He, B.-J., Olanipekun, A.O., 2017. Examining issues influencing green building technologies adoption: The United States green building experts' perspectives. Energy Build. 144, 320–332.

Dikau, S., Volz, U., 2021. Central bank mandates, sustainability objectives and the promotion of green finance. Ecol. Econ. 184, 107022.

Dwaikat, L.N., Ali, K.N., 2016. Green buildings cost premium: A review of empirical evidence. Energy Build. 110, 396–403.

He, L., Zhang, L., Zhong, Z., Wang, D., Wang, F., 2019. Green credit, renewable energy investment and green economy development: Empirical analysis based on 150 listed companies of China. J. Clean. Prod. 208, 363–372.

Höhne, N., Taylor, C., Elias, R., Den Elzen, M., Riahi, K., Chen, C., Rogelj, J., Grassi, G., Wagner, F., Levin, K., 2012. National GHG emissions reduction pledges and 2 C: comparison of studies. Clim. Policy 12, 356–377.

Kibert, C.J., 2016. Sustainable construction: green building design and delivery. New Jersey: Wiley.

Lee, C.-C., & Lee, C.-C., 2022. How does green finance affect green total factor productivity? Evidence from China. Energy Econ. 107, 105863.

Lee, S., Lee, B., Kim, J., Kim, J., 2013. A financing model to solve financial barriers for implementing green building projects. Sci. World J. https://doi.org/10.1155/2013/240394.

Luo, S., Yimamu, N., Li, Y., Wu, H., Irfan, M., Hao, Y., 2023. Digitalization and sustainable development: How could digital economy development improve green innovation in China? Bus. Strateg. Environ. 32, 1847–1871.

Olubunmi, O.A., Xia, P.B., Skitmore, M., 2016. Green building incentives: A review. Renew. Sustain. Energy Rev. 59, 1611–1621.

Peng, H., Feng, T., Zhou, C., 2018. International experiences in the development of green finance. Am. J. Ind. Bus. Manag. 8, 385.

Sachs, J.D., Woo, W.T., Yoshino, N., Taghizadeh-Hesary, F., 2019. Importance of green finance for achieving sustainable development goals and energy security. Handb. green Financ. Energy Secur. Sustain. Dev. 10, 1–10.

Song, M., Xie, Q., Shen, Z., 2021. Impact of green credit on high-efficiency utilization of energy in China considering environmental constraints. Energy Policy 153, 112267.

sWang, Y., Guo, C., Chen, X., Jia, L., Guo, X., Chen, R., Zhang, M., Chen, Z., Wang, H., 2021. Carbon peak and carbon neutrality in China: Goals, implementation path and prospects. China Geol. 4, 720–746.

Taghizadeh-Hesary, F., Yoshino, N., 2020. Sustainable solutions for green financing and investment in renewable energy projects. Energies 13, 788.

Tian, J., Yu, L., Xue, R., Zhuang, S., Shan, Y., 2022. Global low-carbon energy transition in the post-COVID-19 era. Appl. Energy 307, 118205.

Tolliver, C., Keeley, A.R., Managi, S., 2020. Drivers of green bond market growth: The importance of Nationally Determined Contributions to the Paris Agreement and implications for sustainability. J. Clean. Prod. 244, 118643.

Umar, M., Ji, X., Mirza, N., Naqvi, B., 2021. Carbon neutrality, bank lending, and credit risk: Evidence from the Eurozone. J. Environ. Manage. 296, 113156.

Walter, C., Veloso, C.M., Fernandes, P.O., Ribeiro, H., 2017. Measuring of the degree of innovation in commercial and service micro and small enterprises. In 23nd International Scientific Conference on Economic and Social Development (pp. 731-741). Economic and Social Development. https://bibliotecadigital.ipb.pt/handle/10198/21874.

Wen, H., Lee, C.-C., Zhou, F., 2021. Green credit policy, credit allocation efficiency and upgrade of energy-intensive enterprises. Energy Econ. 94, 105099.

Xu, X., Li, J., 2020. Asymmetric impacts of the policy and development of green credit on the debt financing cost and maturity of different types of enterprises in China. J. Clean. Prod. 264, 121574.

Yu, C.-H., Wu, X., Zhang, D., Chen, S., Zhao, J., 2021. Demand for green finance: Resolving financing constraints on green innovation in China. Energy Policy 153, 112255.

Zadek, S., Flynn, C., 2014. South-Originating Green Finance: Exploring the Potential. Canada. Retrieved from https://policycommons.net/artifacts/614896/south-originating-green-finance/1595305/.

Zhang, D., Mohsin, M., Rasheed, A.K., Chang, Y., Taghizadeh-Hesary, F., 2021. Public spending and green economic growth in BRI region: mediating role of green finance. Energy Policy 153, 112256.

Zhao, X., Ma, X., Chen, B., Shang, Y., Song, M., 2022. Challenges toward carbon neutrality in China: Strategies and countermeasures. Resour. Conserv. Recycl. 176. https://doi.org/10.1016/j.resconrec.2021.105959.