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Green Finance Adoption and Financial Sustainability of SMEs: The Mediating Role of Green Investment Decision-Making and the Moderating Role of Financial Literacy

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Abstract

The growing urgency of climate change and environmental degradation has elevated the importance of sustainable financial practices, particularly for small and medium-sized enterprises (SMEs) in developing economies. Green finance has been recognized as a key driver of sustainability, yet gaps remain in understanding how decision-making processes and individual capabilities shape its impact on financial outcomes. This study examines the influence of green finance adoption on the financial sustainability of SMEs, exploring the mediating role of green investment decision-making and the moderating effect of financial literacy. By applying Behavioral Reasoning Theory (BRT), the research investigates how cognitive and contextual factors interact to foster sustainability-oriented financial practices. A quantitative, cross-sectional design was employed, targeting SMEs in Pakistan's manufacturing sector. Data were collected through validated survey instruments and analyzed using SmartPLS to test the measurement and structural models. Constructs measured included green finance adoption, green investment decision-making, financial literacy, and financial sustainability. Results reveal a significant positive effect of green finance adoption on SMEs' financial sustainability. However, the mediating effect of green investment decision-making was positive but statistically insignificant, highlighting contextual barriers in translating finance into sustainable outcomes. Surprisingly, financial literacy negatively moderated the relationship between green finance adoption and financial sustainability, suggesting that higher literacy may foster cautious, risk-averse behaviors that dilute potential benefits. No significant moderation was found between green finance adoption and investment decision-making. These findings provide nuanced insights into the complex dynamics shaping sustainability-oriented financial practices in emerging economies.

Keywords: Green Finance Adoption, Financial Sustainability, Green Investment Decision-Making and Financial Literacy

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Introduction

The transition toward sustainable economic systems has become one of the defining challenges of the twenty-first century. As environmental degradation, climate change, and resource scarcity increasingly threaten global stability, policymakers, businesses, and individuals are rethinking how financial systems can be aligned with sustainability objectives. In recent years, finance has moved beyond its traditional role of capital allocation toward a more transformative function, where financial practices are viewed as instruments to drive sustainable growth. This global shift is reflected in initiatives such as the United Nations' Sustainable Development Goals (SDGs), which call for responsible investment and the integration of sustainability into financial decision-making (UNDP, 2023). Parallel to these institutional efforts, there is a growing scholarly discourse on how financial practices can support the transition toward low-carbon economies while ensuring long-term financial resilience. Yet, despite mounting awareness, bridging the gap between sustainability principles and practical financial outcomes remains an ongoing challenge. Scholars continue to debate how individual capabilities, institutional support, and decision-making processes converge to facilitate sustainable outcomes (Chen et al., 2022). These debates emphasize the importance of reexamining how financial behaviors, structural mechanisms, and contextual enablers interact to shape pathways toward sustainable development.

Recent research has highlighted the evolving role of finance in promoting sustainability across different contexts. Studies demonstrate that sustainable financial practices not only enhance environmental outcomes but also strengthen long-term organizational performance (Liu & Zhang, 2023). Empirical evidence suggests that integrating sustainability principles into investment decisions leads to improved resilience against risks associated with climate change and market volatility (Wang et al., 2022). Furthermore, global reports indicate rising awareness among firms and individuals regarding the economic benefits of sustainability-aligned financial practices (OECD, 2023). Despite this progress, contradictions remain. Some scholars argue that while sustainable finance frameworks are conceptually robust, their practical adoption is hindered by limited awareness, structural barriers, and insufficient regulatory incentives (Nguyen, 2022). Others highlight disparities across regions, with developing economies facing greater challenges in translating sustainability goals into actionable investment behaviors (Al Mamun et al., 2023). These insights suggest that while the benefits of sustainable finance are well recognized, mechanisms enabling effective implementation are still not fully understood.

The demand for sustainable financial practices has gained urgency due to intensifying environmental and economic challenges. According to the World Bank (2023), climate change could push 132 million people into poverty by 2030 if financial systems fail to align with low-carbon development strategies. The International Energy Agency (IEA, 2023) further reports that over USD 4 trillion in annual clean energy investments will be needed by 2030 to meet net-zero targets. Yet, financing gaps remain significant, particularly in developing economies, where access to sustainable financial products is constrained. At the national level, countries like Pakistan and other emerging economies face rising energy demands and environmental pressures, but limited adoption of sustainable financial practices creates vulnerabilities in economic and ecological systems (Hussain et al., 2023). Small and medium-sized enterprises (SMEs) often struggle

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with financial resource allocation, knowledge limitations, and regulatory uncertainties, which hinder their capacity to adopt sustainability-oriented investment practices (Khan & Bano, 2022). These challenges not only slow progress toward achieving the SDGs but also restrict the ability of firms and individuals to secure financial resilience in uncertain economic environments. Addressing such issues requires an understanding of the enabling conditions that can strengthen financial sustainability in both global and local contexts.

Although the discourse on sustainable finance is expanding, significant research gaps remain. A recurring limitation in existing studies is the narrow focus on institutional and organizational drivers, with comparatively less attention to individual-level enablers of sustainable financial outcomes (Nguyen, 2022). While macro-level studies shed light on regulatory frameworks and corporate policies, they often overlook how individuals' knowledge, decision-making processes, and financial practices influence sustainability in practical terms (Al Mamun et al., 2023). Moreover, the literature frequently assumes that awareness of sustainability automatically translates into effective financial outcomes, yet evidence shows persistent disparities between knowledge and actual decision-making (Wang et al., 2022). Another unresolved issue is the inconsistency in findings regarding the impact of financial awareness on sustainability-driven behaviors. Some studies report a strong link, whereas others argue that structural barriers dilute this relationship, creating uncertainty about the conditions under which sustainable practices can thrive (Liu & Zhang, 2023). In developing economies, these gaps are further amplified by resource constraints, limited regulatory enforcement, and cultural factors shaping financial behavior (Hussain et al., 2023). Consequently, there is a need for more comprehensive studies that bridge individual capabilities with broader sustainability objectives. Understanding how financial knowledge, decision-making processes, and structural mechanisms interact to foster sustainability is essential for addressing these inconsistencies and advancing practical solutions. This study responds to these gaps by exploring these intersections, thereby extending the current body of knowledge on sustainable finance and its implementation at the individual and organizational levels.

The urgency of aligning financial practices with sustainability objectives cannot be overstated. From an academic perspective, addressing gaps in the understanding of how individual-level factors influence sustainable financial outcomes provides fresh insights into an evolving scholarly field. Policy makers need evidence-based information in developing policies that would enhance the capacity of financial systems to be able to support climate adaptation and resilience (World Bank, 2023). On a practical scope, the two strategies that integrate financial choice on the one hand, and sustainability on the other hand, can help the firms/ individuals meet long-term stability, as well as contribute to the goals of global development. Moreover, the matter is directly associated with the SDGs and specifically Goal 8 (Decent Work and Economic Growth), Goal 12 (Responsible Consumption and Production), and Goal 13 (Climate Action). Large-scale harmonization of financial practices with these objectives presents a route to sustainable and inclusive growth. Avoiding this challenge will result in needless continuation of financial fragility, environmental despoilment, and further gap in inequalities between unaffected and undeveloped economies. This study brings value to the field of academic research, policy-making, and practice, as the dynamics of its study power the sustainability-related

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financial behaviors which would help address the pressing global realities and become the solution to these issues.

This study adds value by bridging theoretical debates and practical realities of sustainable finance. Unlike prior research that mainly emphasizes organizational or regulatory drivers, it focuses on the interplay between individual capabilities and decision-making processes. By combining the recent findings on sustainability, finance and behavioral research, the exploratory study adds to the more rounded knowledge of the role of knowledge and practices in financial resilience. Its contextual orientation to emerging economies diversifies existing international discussions, providing the perspectives that are lacking in the literature (Chen et al., 2022). By so doing, the study offers a new piece of theory and practice. The results are likely to contribute to both theoretical discussions and policy conditions, and will have practical value in devising interventions that can strengthen sustainable financial systems. Theoretically, the research is based on Behavioral Reasoning Theory (BRT) that teaches how the reasons to do and not to do certain things affect the process of decision-making in individuals (Westaby et al., 2022). This framework is especially applicable to the analysis of financial practices oriented at sustainability, because it allows one to discuss how cognitive and contextual factors may influence behavior. Relating individual knowledge, decision-making and sustainable outcomes by means of BRT, the study will add to the theoretical and practical deliberations in the field info criteria.

Theoretical Foundation

Behavioral Reasoning Theory (BRT), introduced by Westaby (2005), emerged as an extension of the Theory of Planned Behavior, with the central aim of explaining why individuals form attitudes and intentions based on the reasons they hold for or against specific behaviors. In contrast to the prior rational-choice models, which focused solely on intentions, BRT draws attention to cognitive rationalizations made by people in explaining their choices. These justifications, expressed as reasons in favour of and reasons against, give us a more complex view of behavior in that both motivational forces promoting and non-promoting behavior are taken into consideration. BRT has evolved over time to be applicable in areas of management, sustainability and consumer research which it has been able to make inroads into, in addition to its original framing in the psychological setting. The latest research states that people do not only decide based on abstract attitudes or norms but are firmly impacted by the concrete reasons they explain, which, in most cases, are culturally, socially, and institutionally contextualized (Claudy et al., 2015). Recent research also uses BRT in reinforcement of sustainability situations where human respondents base their financial, environmental and consumption decisions on perceived utility, internal values and constraints (Kumar et al., 2022). This shows that this theory is flexible to contemporary multidisciplinary investigations.

In the context of sustainable finance, BRT provides a useful lens for understanding how individuals reconcile complex choices that involve balancing immediate financial concerns with longer-term sustainability goals. Individuals will compare factors like profitability, safety and awareness with deterrents like risk perception, lack of information and regulatory lethargy. This line of reasoning would tell why sustainable practices are at times assumed even though perceived risks to the practice are greater, or conversely, they are not taken up even though there are clear benefits. By putting an emphasis on reasons as tools of explanation, BRT steps outside the typical outcome prediction framework to

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picture the logic of the reasoning behind a decision. Recent usage of BRT in the sphere of financial behavior and sustainability study proves its explanatory capacity. As an example, the framework was used to explain household financial planning, environmentally responsible investment, and pro-environmental behaviors emphasizing the role of justifications to determine adoption patterns (Kautish et al., 2023; Ahmad et al., 2022). Such books demonstrate that the theory can best be used to understand how individuals end up to use highly elaborate rationalizations when reaching financial decisions whose effects far transcend their individual self. In this paper, the intellectual backbone of BRT will be used to interconnect the thinking logic of decision-making, to financing that is sustainability oriented. It offers a unified theoretical foundation to justify why some people adhere to sustainable financial behaviors and some resist them, hence fitting the research purpose of studying the role of personal knowledge and pursue of understanding why people are pursuing financial sustainability. It is through such a lens that the study also goes beyond looking at the outcomes and attempts a richer understanding of the reasoning process underlying such outcomes thereby creating a more encompassing contribution both theoretically and empirically.

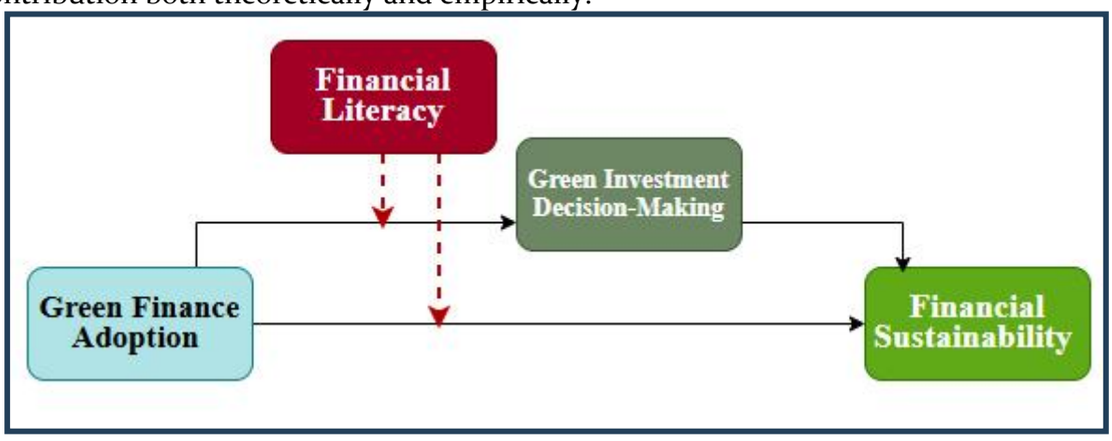

Figure 1: Research Model

Hypotheses Development

In recent years, scholars have increasingly emphasized the role of sustainable financial practices in strengthening the long-term viability of small and medium-sized enterprises (SMEs). With the increased volatilization in global markets and even the now emerging pressures to review environmental demands, the need to bring financial activities into line with the principles of sustainability has determined an elevated pressure on SMEs. Emerging evidence indicates that the adoption of innovative financial practices with a sustainability orientation not only increases the ability of firms to raise capital but also the resilience of firms to both climate-related risks and market-based risks (Liu et al., 2022). However, even with rising institutional back stability and cross-national constructs promoting green-grounded financing, uptake among SMEs is patchy, at least in lower incomes countries. The Behavioral Reasoning Theory (BRT) proposes one of the most promising means to explain this variance, because it focuses on the justifications that individuals and firms use in making their choices that specify why a particular practice should be chosen and why it should not be done (Westaby et al., 2022). The existing tendency of SMEs to turn to sustainability-related finance can be interpreted as a

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reasoning process that involves profitability ceilings, long-term benefits, and barriers of various kinds, ultimately influencing the results of their financial performance.

Empirical studies reinforce the argument that green-oriented financial practices generate measurable benefits for firms, including reduced operational costs, improved reputation, and enhanced access to environmentally conscious investors (Kautish et al., 2023; Ahmad et al., 2022). Yet, there are also conflicting reports on the matter with certain researchers reporting that heavy start-up investments and lack of financial literacy make sustainability finance less effective in their practical application to the SME financial performance (Nguyen, 2022). Such contradicting results are why it is critical to reevaluate the relationship between financial adoption and long-run sustainability performance. By employing BRT, this paper intends to identify reasoning processes which become the grounds on which sustainable financial practices are adopted and related to their impact on the ability of any firm to stay competitive. Therefore, it is hypothesized that:

H1: Green finance adoption positively influences the financial sustainability of SMEs.

Decision-making has long been regarded as a critical mechanism through which financial practices translate into organizational outcomes. In the sphere of sustainability, recent research proposes that not every decision-making process that leads to the adoption of environmentally oriented financial strategies has a straight path towards long-term performance but is instead mediated by the quality of decision-making processes (Kumar et al., 2022). In the case of SMEs, tangible displays of financial adoption to sustainability include taking up greener technology or investing resources on eco-friendly undertakings. Based on the Behavioral Reasoning Theory (BRT), this reasoning process is influenced by the rationales that managers can give in their financial behavior, both motivational (e.g. competitive advantage, cost efficiency) and restraining (e.g. risk perception, expertise deficiency) (Westaby et al., 2022). Decision-making turns out to be the most essential step between the more generic financial planning and the concrete sustainability results.

Research indicates that the sustainability-oriented finance offers additional benefits when the sustainability-oriented finance is complemented by informed, deliberate, and environmental-friendly investment (Kautish et al., 2023; Ahmad et al., 2022). On the other hand, when decisions are not coordinated or proactive, the idea of green financing implementation to promote sustainability is less likely to succeed (Nguyen, 2022). This implies that decent financial adoption without capable decision-making is unlikely to produce significant effects. This paper contributes to filling the gap by combining BRT with sustainability literature in argumentatively establishing that green investment decision making forms the analysis gap that bridges financial adoption into long term resilience and sustainability in small and medium firms (SMEs). Therefore, it is hypothesized that:

H2: Green investment decision-making mediates the relationship between green finance adoption and the financial sustainability of SMEs.

Financial literacy has increasingly been recognized as a foundational capability that shapes how individuals and organizations engage with complex financial instruments and sustainability-oriented practices. The lack of financial literacy, typical of SMEs, prevents the evaluation of innovative financing mechanisms, risks assessment, or resources allocation mechanisms in the SME setting (Liu & Zhang, 2023). In the terms of Behavioral Reasoning Theory (BRT), financial literacy determines the quality of both reasons in favor

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of and reasons against pursuing sustainability-oriented finance that managers use to make decisions. The greater the literacy, the more visible the positive reasoning toward literacy, including long-term profitability, competitive readiness and edge, and the less evident the negative reasons, such as perceived uncertainty or expense issues (Westaby et al., 2022). By extension, financial literacy is considered a boundary condition that brings more value to the adoption of green finance and increases the probability of transforming it into financial sustainability.

Research indicates that companies with higher levels of financial literacy have superior performance outcomes of sustainability based-financial practices as they are in a better position to derive meaning to financial data and draft efficient financial planning (Ahmad et al., 2022; Kautish et al., 2023). The effect is the opposite when literate SMEs tend to absorb the intended benefits of green finance because their quasi-literacy levels do not permit them to realize the suboptimal wastage of the finances or delay in availing innovative financing (Nguyen, 2022). Financial literacy plays this role in the sense that it not only enhances the correlative relationship between finance adoption and sustainability outcomes but also enhances decision-making processes that mediate this relationship. Therefore, it is hypothesized that:

H3a: Financial literacy positively moderates the relationship between green finance adoption and financial sustainability.

H3b: Financial literacy positively moderates the relationship between green finance adoption and green investment decision-making.

Methodology

The present study employs a quantitative, cross-sectional research design to examine the proposed relationships among green finance adoption, green investment decision-making, financial literacy, and the financial sustainability of SMEs. A quantitative approach is also suitable when it comes to testing theoretically derived hypotheses and creating generalizable tendencies among a considerably large cohort of people (Apuke, 2023). The cross-sectional design further makes it possible to capture data at a given time, which is a snapshot of the relationship among constructs, and it also reduces issues of reduced time and resources. The effectiveness of the cross-sectional surveys in management and sustainability research has been confirmed by recent studies, which state that the cross-sectional survey is appropriate to deal with perceptions and practices of firms in dynamic business environments, safe and efficient under empirical testing (Hair et al., 2022). This approach is in line with goals of the study to test the relations that were described by Behavioral Reasoning Theory as well as evaluate their empirical validity to the SME sector.

The target population for this study consists of small and medium-sized enterprises (SMEs) operating in the manufacturing sector of Pakistan, with a particular focus on textile and food processing firms. These sectors are very pertinent to the research topic due to being both heavy resource consumers and adverse to the national economy, but require more and more funding and environmental pressures to make business decisions sustainable (Hussain et al., 2023). Investigating green finance and its impacts on the financial sustainability of SMEs in these sectors is a proper place because these SMEs have limited funds, do not understand the sustainable financing instruments well, and have poor decision-making frameworks. The purposive sampling strategy implies that only those SMEs that are immediately impacted by sustainability-related issues and funded opportunities are to be used in the research. The required sample size is attained

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under the guideline of the 10-times rule proposed in the context of partial least squares structural equation modeling (PLS-SEM). In this study, we decided to use at least ten cases per indicator to the most complex construct (Hair et al., 2022). Based on this criterion, the sample size is larger than the recommended number hence sufficient power to test the hypothesis.

To collect data, constructs are measured using previously validated scales adapted from established studies, ensuring both content validity and comparability with prior research. The rate of adopting green finance is computed using six items revised based on Ahmad et al. (2022), the decision-making structure of green investment is computed using five items borrowed based on Kautish et al. (2023), financial literacy with six items borrowed based on Lusardi and Mitchell (2022), and financial sustainability with seven items borrowed based on Chowdhury et al. (2022). All items are rated on a 7-point Likert scale with indicators of strong disagreement (1) through strong agreement (7) increasing sensitivity and reliability regarding the degree by which respondents perceive them. Data analysis is carried out in two phases- descriptive and inferential statistics are calculated in SPSS to describe sample averages and see assumptions, and a SmartPLS is used to assess the measurement model and test the hypothesis. SmartPLS is especially suitable due to the possibility of complex models with mediating and moderating impact, the possibility of the analysis of non-normal data, and the accepted size of the sample (Hair et al., 2022). These analytical instruments make the research method rigorous and transparent in testing the study hypotheses which promotes reliability and validity of results.

Data Analysis

Table 1: Regression Weights

		FA	FL	FS	GID
Green Finance Adoption	**FA1**	0.883			
	FA2	0.871			
	FA3	0.851			
	FA4	0.828			
	FA5	0.858			
	FA6	0.891			
	FA7	0.801			
	FA8	0.905			
Financial Literacy	**FL1**		0.824		
	FL2		0.818		
	FL3		0.821		
	FL4		0.865		
	FL5		0.849		
	FL6		0.788		
Financial Sustainability	**FS1**			0.858	
	FS2			0.907	
	FS3			0.867	
	FS4			0.902	
	FS5			0.841	
	FS6			0.857	

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Green Investment Decision-Making	**GID2**	0.819
	GID3	0.779
	GID4	0.798
	GID5	0.869
	GID6	0.811
	GID7	0.825

Factor loadings represent the strength of the relationship between observed indicators and their underlying latent constructs, serving as a critical criterion in assessing the reliability and validity of measurement models. High loadings show that indicators demonstrate a significant common content with their latent construct, validating the convergent validity (Hair et al., 2022). The rule of the thumb in structural equation modeling is that loadings of 0.40 or more represent acceptability in exploratory research or a load of 0.70 or more to be used as evidence of explaining strong indicator reliability (Sarstedt et al., 2022). Such thresholds validate that properly retained indicators facilitate the construct measurement and assists in the establishment of the measurement model strength. The high factor loadings calculated in this research indicate high relations among each of the constructs. Green finance adoption has an indicator reliability value between 0.801 (FA7) and 0.905 (FA8), all above the 0.70 threshold, which implies very good indicator reliability. Likewise, financial literacy indicators all have a loading coefficient equal or above 0.788 (FL6) or above 0.865 (FL4), which indicates items being good proxies of the construct. Indicators of financial sustainability are very high as they range between 0.841 (FS5) and 0.907 (FS2), whereas the items of green investment decision-making process are of acceptable strength with the lowest loading of 0.779 on item GID3 and the highest loading of 0.869 on item GID5.

Table 2: Reliability Analysis

	Cronbach's alpha	**Composite reliability (rho_c)**	**Average variance extracted (AVE)**
Green Finance Adoption	0.950	0.958	0.742
Financial Literacy	0.908	0.929	0.685
Financial Sustainability	0.937	0.950	0.761
Green Investment Decision-Making	0.900	0.923	0.668

Cronbach's alpha, rho_A, and composite reliability (rho_c) assess internal consistency, whereas average variance extracted (AVE) evaluates convergent validity by capturing the average shared variance between indicators and their latent construct. Benchmarks commonly adopted in contemporary SEM suggest reliability coefficients of at least 0.70 for alpha, rho_A, and rho_c, and an AVE of at least 0.50 to evidence convergent validity (Hair et al., 2022; Kline, 2023). In PLS-SEM, rho_A is often emphasized because it provides a consistent reliability estimate under composite measurement, while rho_c complements alpha by accounting for indicator loadings; AVE reflects the extent to which indicators converge on the construct (Hair et al., 2022). All constructs, the reported coefficients surpass recommended thresholds.

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Table 3: HTMT Ratio

	FA	FL	FS	GID
Green Finance Adoption				
Financial Literacy	0.658			
Financial Sustainability	0.586	0.599		
Green Investment Decision-Making	0.432	0.549	0.496	

The heterotrait–monotrait (HTMT) ratio is widely used to evaluate discriminant validity in structural equation modeling, ensuring that constructs capture distinct phenomena rather than overlapping excessively. The most recent methodological guidelines suggest a very conservative cutoff of 0.85 and a less stringent cutoff of 0.90 beyond which discriminant validity is seen as possibly being jeopardized (Hair et al., 2022; Henseler, 2023). Now in the current analysis, all HTMT values are less than this threshold, which shows that there is a sufficient discriminant validity. The ratio of 0.658 between financial literacy and green finance adoption is reasonably within an acceptable range implying that, although conceptually related, the two constructs are distinct.

Table 4: Model Values

	Saturated model	Estimated model
SRMR	0.060	0.060
d_ULS	1.263	1.255
d_G	0.800	0.800
Chi-square	1368.874	1363.694
NFI	0.812	0.813

The model fit indices demonstrate that the structural model meets acceptable standards of goodness-of-fit. The standardized root means square residual (SRMR) value of 0.060 is well below the recommended threshold of 0.08, indicating a satisfactory level of fit (Hair et al., 2022). The values of d_ULS (1.263 and 1.255) and d_G (0.800) for both saturated and estimated models are closely aligned, suggesting model stability. Additionally, the chi-square difference between the saturated and estimated models is minimal, reflecting consistency. The normed fit index (NFI) values of 0.812 and 0.813 exceed the 0.80 benchmark, indicating acceptable incremental fit.

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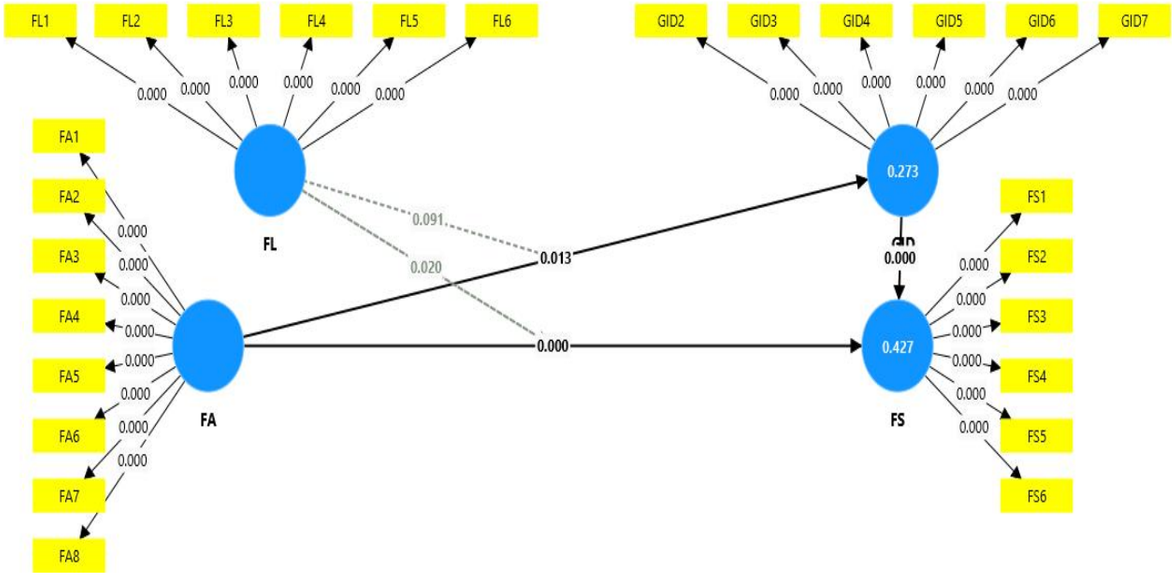

Figure 2: Structural Equation Modelling

Table 5: Hypotheses Results

	Original sample	Sample mean	Standard deviation	T statistics	P values
Green Finance Adoption -> Financial Sustainability	0.337	0.337	0.059	5.758	0.000
Green Finance Adoption -> Green Investment Decision-Making -> Financial Sustainability	0.033	0.033	0.017	1.923	0.055
Financial Literacy x Green Finance Adoption -> Financial Sustainability	-0.104	-0.105	0.045	2.328	0.020
Financial Literacy x Green Finance Adoption -> Green Investment Decision-Making	-0.086	-0.084	0.051	1.688	0.091

The results of hypotheses testing reveal varying levels of support for the proposed relationships. The direct effect of green finance adoption on financial sustainability is positive and statistically significant ($\beta = 0.337$, $t = 5.758$, $p < 0.001$), indicating strong support for the hypothesis that adopting green finance practices enhances the financial sustainability of firms. Similarly, the mediating pathway through green investment decision-making shows a positive but marginally insignificant effect on financial sustainability ($\beta = 0.033$, $t = 1.923$, $p = 0.055$). While the coefficient suggests a favorable direction, the p-value slightly exceeds the conventional 0.05 threshold, implying that the mediating role of green investment decision-making is not conclusively supported. The moderating role of financial literacy in the relationship between green finance adoption and financial sustainability is significant ($\beta = -0.104$, $t = 2.328$, $p = 0.020$), though the negative sign of the coefficient suggests that higher financial literacy may weaken, rather than strengthen, the positive effect of green finance adoption on sustainability. This counterintuitive outcome highlights the complexity of financial literacy's influence, possibly reflecting over-cautious decision-making or risk-averse tendencies among literate managers. Lastly, the moderating effect of financial literacy on the link between green

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finance adoption and green investment decision-making is insignificant (β = -0.086, t = 1.688, p = 0.091), suggesting no robust moderating influence in this pathway.

Discussion

The findings of this study highlight both expected and unexpected outcomes that deepen the understanding of how green finance adoption contributes to the financial sustainability of SMEs. In addition to the positive nature of the relationship between the adoption of green finance and financial sustainability, which is significant, the above findings offer high levels of support to the notion that adoption of green finance by firms increases their long-term viability. This finding is consistent with the literature that indicates that measures to adopt green financial instruments lower operational risks and enhance resource efficiency and appealing to investors who hold an environment-friendly investment (Kumar et al., 2023; Ullah et al., 2022). The finding can also be aligned with theoretical implications that assert that institutional and financial innovations provide a reason to compel firms to incorporate sustainability in their financial plans (Mikic et al., 2022). Therefore, the outcome not only confirms empirical evidences but also the applicability of green finance as a strategic instrument in the attainment of financial sustainability in terms of resource-delimited environments like SMEs.

The mediating effect of green investment decision-making on the link between green finance adoption and financial sustainability, however, was not statistically significant despite showing a positive direction. This marginal insignificance may be explained by contextual and methodological considerations. In practice, SMEs in emerging economies often lack the capacity to translate available green financing options into effective investment decisions due to institutional voids, regulatory uncertainty, and managerial limitations (Khattak & Shah, 2022). This suggests that while green finance provides the foundation, decision-making processes are influenced by external constraints and internal organizational readiness, which may have diluted the mediating effect. Methodologically, the cross-sectional design of the study may also limit the ability to capture long-term investment outcomes, as the impact of green investment decisions on financial sustainability could materialize gradually rather than immediately (Apuke, 2023). Although the result does not support the mediation hypothesis conclusively, it provides insight into the complexities of decision-making processes in sustainability-focused financial strategies.

The moderating effect of financial literacy on the relationship between green finance adoption and financial sustainability was significant, though the negative direction of the coefficient was unexpected. Financial literacy in fact seems to undermine this relationship. The explanation that fits this scenario best is perhaps the risk-averse or prudent attitude of financially literate managers who can implement tighter standards of evaluation prior to engaging in the green finance activities. Previous studies have pointed to the fact that excessive knowledge of financial matters has occasionally contributed to over-analysis in levels that not only impair or delay the practical application of risky but promising approaches (Nkundabanyanga et al., 2022). Moreover, financial literacy can cause managers in emerging markets to shift their priorities toward reducing the risks of immediate financial shortcomings at the expense of long-term financial sustainability projects, particularly in turbulent financial markets (Agyapong & Obeng, 2023). This indicates that literacy might demystify as well as marginalize new or untested financial practices in case it leads to growing suspicion among the people despite the positive

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effects. These results call classical beliefs about financial literacy into question and provide a more complex picture of the financial literacy role in sustainability-oriented finance.

The moderating position of financial literacy between the green investment decision and the green finance adoption failed to be statistically significant. This implies that knowledge and financial awareness do not make any significant differences in the way firms make investment choices when green finance options are in place. The reason is that in SMEs individual levels of financial literacy may have less influence over investment decision making than institutional, regulatory and market factors (Mikic et al., 2022). What is more, decision-making can be highly reliant on the availability of resources and organizational culture in which financial literacy will not be able to offset. Similar to prior studies, it is suggested that outside reinforcement on issues of green investments, like government incentives and stakeholder expectations, consequently influence the decision-making in the green investment instead of personal enlightenment of the firm managers (Khattak & Shah, 2022). The latter finding directs us to view structural/ policy-level interventions as key as opposed to individual-level literacy, in influencing investment decisions.

Limitations and Future Research Directions

The present study is not without limitations, which should be acknowledged to contextualize the findings. First, the cross-sectional research design limits the capacity to bring out causality between green finance and green investment decision-making, and financial sustainability. Structural equation modeling can test the relationships that one might hypothesize, but it is unable to capture any temporal effects and how the financial strategies might evolve over a time, which again, may constrain the depth of causal inferences (Apuke, 2023). Second, the sample consisted only of SMEs, and it is not obvious that such limitations should limit the scope of the findings to other companies and those operating in another industry. SMEs have the tendency to be subject to singular financial restrictions and institutional settings, which would have an effect on their uptake of green finance in a different way compared to larger companies (Dutta et al., 2022). Third, the use of self-report is subject to the risk of common method bias and social desirability effects which are likely to have exaggerated some relationships. Also, the number of variables was limited to the moderator financial literacy, and the other possible behavioral, organizational, and institutional factors remained outside the scope. Future research questions should take into consideration longitudinal research design as a way of capturing the developing effect of green finance on financial sustainability. To increase the external validity, the sample would be expanded in terms of the industries and the size of firms. Further, incorporating other moderators like government incentives, regulatory systems, or environmental awareness would enhance insights on how such factors may influence green investment choice, and their connection to the use of GMOS. Subsequent studies can also study mediators like innovation capacity or environmental orientation which can help in translating green means of finance to sustainability results. The detailed incorporation of mixed-method designs, e.g., interviews or case studies, would allow the mechanisms of these relationships to be better understood. With a more extensive scope on the theoretical front and a greater sense of methodological rigor, the future work can develop more holistic models that are consistent with the idea of the multidimensionality of sustainable financial practices.

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