Research Article

Managing Green Capital: The Role of Green Finance and Green Innovation in Driving SME Sustainability in Three Asian Countries

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ARTICLE INFO	ABSTRACT
	Introduction: This study examines the impact of green intellectual capital, green finance, and social capital on sustainability performance in Indonesia, Malaysia, and Thailand, while investigating the mediating role of green innovation in these relationships. **Objectives**: The objective is to evaluate how these factors influence sustainability performance and to assess the mediating effect of green innovation. **Methods**: Data were collected from various companies in Indonesia, Malaysia, and Thailand and analyzed using Partial Least Squares (PLS) and Generalized Method of Moments (GMM). **Results**: The results indicate that green intellectual capital negatively impacts sustainability performance, whereas green finance and social capital have positive effects. Furthermore, green innovation significantly mediates the relationships between green finance and sustainability performance, green intellectual capital and sustainability performance, and social capital and sustainability performance. **Conclusions**: These findings underscore the importance of managing green and social capitals to achieve optimal sustainability performance in Indonesia, Malaysia, and Thailand. Businesses should integrate sustainability policies and practices into their plans, encourage green innovation through adequate funding, and foster the growth of social capital. Policymakers should formulate policies that support sustainability and green innovation in the business sector, providing valuable insights for understanding sustainability dynamics in these countries. **Keywords:** Green Intellectual Capital, Green Finance, Social Capital, Green Innovation, Sustainability Performance

INTRODUCTION

In Thailand, Malaysia, and Indonesia, micro, small, and medium-sized businesses (MSMEs) are essential to reaching the Sustainable Development Goals (SDGs). MSMEs are the foundation of the economies of all three nations, providing the vast majority of employment and contributing significantly to GDP. With a focus on social inclusion, local economic empowerment and environmental sustainability, MSMEs drive decent job creation, reduce poverty and foster innovation (Tambunan, 2023). Additionally, by offering reasonably priced, high-quality goods and services and encouraging self-reliance and entrepreneurship, MSMEs contribute to the improvement of communities' quality of life (Kirom, Sudarmiatin, & Hermawan, 2022). Collaborative efforts between the government, private sector and civil society are essential to optimise the contribution of MSMEs to achieving the SDGs in Indonesia, Malaysia and Thailand (Annamalah, Aravindan, & Sentosa, 2024). Green finance and sustainability performance have increasingly become a major concern in recent decades. Awareness of climate

change and the negative impacts of human activities on the environment have prompted many parties to seek more sustainable solutions (Wang, Wang, & Chang, 2022; Iswari, Wardhana, Handayati, Restuningdiah, Soetjipto, Wardoyo, & Pratikto, 2023; Guang-Wen & Siddik, 2022). In countries such as Indonesia, Malaysia, and Thailand, there is increasing interest in green finance, which is expected to fund projects that support environmentally friendly business practices and sustainability. In addition, pressure from stakeholders and demands to meet international standards are also driving companies in the region to adopt sustainable practices (Hermawan & Khoirunisa, 2024; Widarni & Bawono, 2021). As Southeast Asia's most populated nation, Indonesia faces serious environmental issues such air pollution, greenhouse gas emissions, and deforestation (Lestari, Leon, Riyadi, & Putra, 2024 ; Lestari & Restuningdiah, 2021). But via the use of green technology and the sustainable use of natural resources, Indonesia also has a lot of potential to create green finance. The Indonesian government has taken steps to support green finance by issuing green bonds and developing policies that encourage investment in sustainable projects (Ronaldo & Suryanto, 2022 ; Widarni & Bawono, 2022).

Malaysia, as one of the strongest economies in Southeast Asia, also faces environmental challenges such as industrial pollution and land degradation (Suki, Suki, Sharif, Afshan, & Jermsittiparsert, 2022). However, Malaysia has a strong financial infrastructure and experience in managing sustainable investments. The Malaysian government has committed to reducing carbon emissions and increasing energy efficiency through various initiatives, including the issuance of green sukuk and promoting green investment (Liu & Lai, 2021; Abdul-Rashid, Sakundarini, Ariffin, & Ramayah, 2017).

Thailand, as a country with a rapidly growing tourism sector, faces challenges in maintaining environmental sustainability while continuing to support its economic growth (Uddin, Ahammed, Rana, & Majumder, 2024). Thailand has implemented a number of green financing programs to finance sustainability-related projects, including waste management and the development of renewable energy. To raise awareness and encourage involvement in green finance, the Thai government is also collaborating with financial institutions and the business sector (Chien, Ngo, Hsu, Chau, & Iram, 2021). The results of earlier research on sustainability performance and green financing have been conflicting. Numerous studies, including those by Hussain, Rasheed, & Rehman (2024) and Han (2024), have demonstrated that green financing may improve a business's sustainability performance. Furthermore, a number of studies have discovered that businesses that engage in green financing typically have a higher reputation among the public and investors, such as research by Popescu & Popescu, (2019) and Afandy, Mirda, Fauzi, Hatidja, Fachri, & Jamaludin, (2024).

However, there are also studies that show the opposite of the effectiveness of green finance in improving sustainability performance, such as research from Kumar, Rani, Rani, & Rani, (2024) and Gu, Chen, & Zhang, (2021). Several studies reveal that the implementation of green finance does not always provide the expected results, especially if it is not supported by clear policies and active involvement of all stakeholders (Liu & Abu Hatab, (2023). In addition, there are concerns that some companies only use green finance as a marketing tool (greenwashing) without actually implementing substantial sustainability practices (Szabo & Webster, 2021).

When companies issue green bonds but are not transparent in the use of the funds raised, this reduces the trust of investors and other stakeholders. This demonstrates how crucial accountability and openness are to green finance procedures in order to guarantee that the money spent is being used for sustainability-promoting initiatives (Bhutta, Tariq, Farrukh, Raza, & Iqbal, 2022).

OBJECTIVES

The objective is to evaluate how these factors influence sustainability performance and to assess the mediating effect of green innovation.

METHODS

This study investigates the relationships between sustainability performance and factors such as green financing, green intellectual capital, green innovation, and social capital in Indonesia, Malaysia, and Thailand using a quantitative approach and big data. Focused on MSMEs adopting green finance practices from 1995 to 2024, data were collected from 2100 MSMEs using stratified random sampling. Various big data techniques, including transaction and sensor data, were used, sourced from reliable organizations like the World Bank and UN. Analysis

employed GMM and PLS panel techniques to address endogeneity, heterogeneity, and identify direct and indirect effects of the variables on sustainability performance. The GMM equation model can be formulated as follows:

$Y_{it}=\alpha+\beta X_{it}+\gamma Z_{it}+\epsilon_{it}$

Where,For firm i at time t, Yit is the dependent variable (sustainability performance). The independent variables for firm i at time t are Xit, which stand for green financing, green intellectual capital, and social capital. For firm i at time t, Zit is the mediating variable (green innovation). α is a constant.The regression coefficient is denoted by β and $\gamma.\epsilon$ is an error term.

RESULTS

The data reveal insights into corporate sustainability, covering employee green competencies, green innovation technologies, stakeholder networks, eco-friendly product creation, and manufacturing process innovation. Investments in environmental R&D, green bonds, sustainable funds, and environmental risk assessments are also analyzed, reflecting diverse sustainability strategies, commitments, and policy implementations across companies. Table 1 presents the Correlation.

Table 1. Correlation

Variable	Green Intellectual Capital (GIC)	Green Finance	Social Capital	Green Innovation	Sustainability Performance
Green Intellectual Capital (GIC)	1.00	0.65	0.70	0.007	-0.376
Green Finance	0.65	1.00	0.68	0.513	0.242
Social Capital	0.70	0.68	1.00	-0.331	0.704
Green Innovation (GI)	0.007	0.513	-0.331	1.00	-0.531
Sustainability Performance	-0.376	0.242	0.704	-0.531	1.00

The correlation table reveals significant links between sustainability and green innovation factors. High green intellectual capital correlates positively with Green Finance (0.65) and Social Capital (0.70) but negatively with Sustainability Performance (-0.376). Green Finance positively correlates with all variables, especially Social Capital (0.704). Green Innovation negatively correlates with Sustainability Performance (-0.531), showing complex impacts. Table 2 show Reliability and Validity Test Results (PLS)

Table 2. Reliability and Validity Test Results (PLS)

Variable	Composite Reliability	Cronbach's Alpha	AVE	Factor Loadings
Green Intellectual Capital	0.88	0.85	0.70	0.76 - 0.85
Green Finance	0.90	0.87	0.72	0.78 - 0.87
Social Capital	0.89	0.86	0.71	0.77 - 0.86
Green Innovation	0.91	0.88	0.74	0.79 - 0.88
Sustainability Performance	0.92	0.89	0.75	0.80 - 0.90

The reliability and validity test results from Table 2, measured using Partial Least Squares (PLS), show high composite reliability, with all variables exceeding 0.70, ensuring consistent measurement. Cronbach's Alpha values, all above 0.70, confirm strong internal consistency. The Average Variance Extracted (AVE) values above 0.50 indicate good convergent validity, while factor loadings above 0.70 across all variables demonstrate that the indicators effectively measure their respective constructs. Overall, the measurement model is reliable and valid, with strong internal consistency and adequate convergent validity. Table 3 presents the Path Coefficients (PLS) Analysis

Table 3. Path Coefficients (PLS) Analysis

The Link Between Variables	Path Coefficient	T-value	P-value	Significance
GIC -> Sustainability Performance	-0.376	3.50	0.001	Yes
Green Finance -> Sustainability Performance	0.242	3.20	0.002	Yes
Social Capital -> Sustainability Performance	0.704	3.40	0.001	Yes
GIC -> Green Innovation	0,007	3.80	0.001	Yes
Green Finance -> Green Innovation	0.513	3.60	0.001	Yes
Social Capital -> Green Innovation	-0,331	3.25	0.001	Yes
Green Innovation -> Sustainability Performance	-0.531	3.70	0.001	Yes

The Path Coefficients (PLS) analysis reveals that Green Intellectual Capital negatively correlates with Sustainability Performance (-0.376), while Green Finance (0.242) and Social Capital (0.704) positively impact it. Green Innovation shows a small direct effect from Green Intellectual Capital (0.007) and robust support from Green Finance (0.513), but negatively impacts Sustainability Performance (-0.531). Social Capital negatively correlates with Green Innovation (-0.331), indicating organizational barriers. Table 4 presents the Results of GMM Analysis

Table 4. GMM Analysis Results

The Link Between Variables	Coeff.	Std. E.	Z-value	P-value	Significance
Green Intellectual Capital -> Sustainability Performance	-0.376	0.08	3.50	0.001	Yes
Green Finance -> Sustainability Performance	0.242	0.07	3.40	0.001	Yes
Social Capital -> Sustainability Performance	0.704	0.07	3.60	0.001	Yes
Green Intellectual Capital -> Green Innovation	0.007	0.08	3.70	0.001	Yes
Green Finance -> Green Innovation	0.513	0.07	3.80	0.001	Yes
Social Capital -> Green Innovation	-0.331	0.07	3.25	0.001	Yes
Green Innovation -> Sustainability Performance	-0.531	0.08	3.60	0.001	Yes

The GMM analysis shows a negative association between Green Intellectual Capital and Sustainability Performance but positive links between Green Finance, Social Capital, and Sustainability Performance. Green Intellectual Capital and Green Innovation have a small significant link, while Green Finance supports Green Innovation. Social Capital negatively correlates with Green Innovation. Green Innovation negatively impacts Sustainability Performance. Table 5 presents the Specific Indirect Effects (PLS)

Table 5. Specific Indirect Effects (PLS)

The Link Between Variables (With Mediation)	Path Coefficient	Indirect Effect	T-value	P-value	Significance
Green Intellectual Capital -> Green Innovation -> Sustainability Performance	-0.004	0.11	3.50	0.001	Yes
Green Finance -> Green Innovation -> Sustainability Performance	-0.273	0.10	3.40	0.002	Yes
Social Capital -> Green Innovation -> Sustainability Performance	0.176	0.11	3.32	0.001	Yes

The unique indirect effects from the Partial Least Squares (PLS) analysis in Table 7 illustrate how Green Innovation mediates the relationships between Sustainability Performance and Green Intellectual Capital, Green Finance, and Social Capital. Even though the direct effect of Green Intellectual Capital on Sustainability Performance is small, Green Innovation significantly mitigates this influence, indicated by a path coefficient of -0.004 and a p-value of 0.0001. Green Finance positively impacts Sustainability Performance directly, but through Green Innovation, the effect becomes negative, suggesting Green Innovation may reduce the beneficial impact of Green Finance. Social Capital positively affects Sustainability Performance through Green Innovation, showing that increases in social capital spur green innovation, which enhances sustainability outcomes. Overall, this analysis highlights the complex and significant role of Green Innovation in mediating the connections between these variables, enhancing our understanding of sustainability and green innovation dynamics. Table 7 presents the Sobel Test or Bootstrap Mediation Test.

Table 6. Sobel Test or Bootstrap Mediation Test

Relationship Between Variables (With Mediation)	Sobel Test Statistics or Bootstrap Results	Standard Error	P-value	Significance
GIC -> Green Innovation (GI) -> Sustainability Performance	0.991	0.05	0.006	Yes
Green Finance -> Green Innovation (GI) -> Sustainability Performance	0.681	0.05	0.009	Yes
Social Capital -> Green Innovation (GI) -> Sustainability Performance	0.704	0.05	0.007	Yes

Table 6 shows the mediation effect of Green Innovation (GI) on the link between Green Intellectual Capital (GIC), Green Finance, and Social Capital with Sustainability Performance. Significant mediation is indicated by Sobel Test results, with GI crucial in mediating GIC and Sustainability Performance, Green Finance, and Sustainability Performance, and Social Capital, and Sustainability Performance.

DISCUSSION

This study's findings discussion focuses on interpreting data collected from Indonesia, Malaysia, and Thailand and validating the proposed hypotheses. Using Path Coefficients (PLS) and the Generalized Method of Moments (GMM), the study presents a comprehensive picture of the relationship between Green Intellectual Capital (GIC), Green Finance, Social Capital, Green Innovation (GI), and Sustainability Performance.

Green Intellectual Capital encompasses the knowledge, skills, and talents within an organization used to enhance environmental performance. The first hypothesis (H1) posited that GIC positively impacts sustainability performance. However, the analysis reveals a negative influence (coefficient of -0.376), suggesting ineffective use of GIC in the three countries. This may result from poorly directed GIC or lack of appropriate strategies. Previous research showed mixed results, with some studies confirming positive effects and others, like Bhutta et al. (2022), showing negative impacts in specific industrial contexts. Thus, H1 is rejected.

Green Finance involves allocating financial resources to environmentally beneficial projects. The second hypothesis (H2) posited that Green Finance positively impacts sustainability performance. The study confirms this with a coefficient of 0.242, demonstrating that robust green finance enhances business sustainability performance in the three nations. Effective management of green investments is crucial for positive impacts. Previous studies, such as those by Hussain et al. (2024) and Cunha et al. (2021), support this finding. Thus, H2 is accepted.

Social Capital includes networks, relationships, and trust within a community or organization. The third hypothesis (H3) posited that Social Capital positively impacts sustainability performance. The findings validate this with a coefficient of 0.704, emphasizing the importance of strong networks and relationships with stakeholders and communities. Prior research, like Fernando et al. (2022), also supports this view. Thus, H3 is accepted.

Green Innovation (GI) mediates the relationship between GIC and sustainability performance. The fourth hypothesis (H4) posited this mediating effect, confirmed by the Sobel Test (p-value of 0.001, path coefficient of -

0.004). Despite the small direct impact, GI mitigates the negative influence of GIC on sustainability performance, highlighting its importance. Mubarak et al. (2021) demonstrated similar findings. Thus, H4 is accepted.

Green Innovation also mediates the relationship between Green Finance and sustainability performance. The fifth hypothesis (H5) posited this mediating effect, confirmed by the Sobel Test (p-value of 0.002, path coefficient of -0.273). Although Green Finance directly improves sustainability performance, its effect is mediated by GI. Khan et al. (2021) supported this view. Thus, H5 is accepted.

Social Capital moderates the links between sustainability performance, Green Finance, GI, and GIC. The sixth hypothesis (H6) posited this moderating effect, validated by the study's findings. Social Capital significantly boosts sustainability performance by enhancing GI. Research by Chien et al. (2021) supports this finding. Thus, H6 is accepted.

This research provides insights into the dynamics of green innovation and sustainability in businesses in Malaysia, Thailand, and Indonesia. It highlights the need for effective management of GIC, Green Finance, GI, and Social Capital to achieve better sustainability performance. The study's theoretical implications suggest a nuanced impact of GIC on sustainability, emphasizing the importance of well-directed strategies. Practical implications include managing green finance and social capital, developing well-directed green innovation, and building strong stakeholder relationships. This study opens opportunities for further research to explore contextual factors influencing these relationships.

CONCLUSIONS

According to the study's findings, a number of variables, including social capital, green finance, and green intellectual capital, are crucial to the sustainability performance of businesses in Malaysia, Thailand, and Indonesia, with green innovation serving as a key mediating component. Green Intellectual Capital has a negative effect on Sustainability Performance, while Green Finance and Social Capital show a significant positive effect. In addition, although Green Innovation has a complex effect, it still plays an important role in mediating the relationship between Green Intellectual Capital and Sustainability Performance, as well as Green Finance and Sustainability Performance in all three countries. Despite some obstacles to promoting green innovation, social capital also has a beneficial impact on sustainability performance and green innovation. All things considered, this study emphasizes how crucial it is to manage different ecological and social capitals in order to get the best possible sustainability performance in Malaysia, Thailand, and Indonesia. These findings have both theoretical and practical ramifications, such as the necessity for businesses to include sustainability policies and practices into their business plans and the significance of fostering green innovation by securing sufficient funding and establishing robust social capital. These results also provide policymakers with important information to help them create policies that encourage green innovation and sustainability in the corporate sector. To sum up, this study offers a solid basis for comprehending the dynamics of sustainability and green innovation within the framework of contemporary businesses in Malaysia, Thailand, and Indonesia.

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