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***Research article***

# Sustainable performance in coastal MSMEs: The role of green innovation and leadership

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**ABSTRACT**

The integration of Green Human Resource Management plays a critical role in advancing the sustainability of micro, small, and medium enterprises. This study investigates the strategic influence of Green Human Resource Management on sustainable performance among micro, small, and medium enterprises in the coastal community of Tanjung Balai, Indonesia. It further examines the mediating role of Green Innovation and the contribution of Green Leadership in addressing resource constraints and environmental challenges faced by coastal enterprises. Data were collected from 280 coastal micro, small, and medium enterprises through a hybrid survey approach and analyzed using Partial Least Squares Structural Equation Modeling. The findings indicate that Green Human Resource Management significantly enhances both Green Innovation and Green Leadership, while Green Leadership further promotes Green Innovation. Green Innovation emerges as the primary mechanism through which Green Human Resource Management contributes to sustainable performance, suggesting that innovation capability, rather than managerial practices alone, is the principal driver of sustainability in coastal micro, small, and medium enterprises. These findings underscore the importance of policies that strengthen Green Human Resource Management, promote locally embedded Green Innovation, and foster adaptive Green Leadership to improve the long-term environmental, social, and economic sustainability of coastal micro, small, and medium enterprises.

**KEYWORDS**

Green leadership;
green human resource management;
green innovation;
micro, small, and medium enterprises;
sustainable performance

## Introduction

Green Human Resource Management (GHRM) practices have been widely adopted as a strategic approach to improving organizational performance in large-scale enterprises. However, their application remains limited among micro, small, and medium enterprises due to the distinct challenges these businesses face compared with larger organizations. One of the most critical challenges is their limited access to financial, technological, and managerial resources. Consequently, micro, small, and medium enterprises exhibit unique business characteristics and encounter different operational constraints, as illustrated by the case of Tanjung Balai, a coastal city located on the eastern coast of North Sumatra, Indonesia. Micro, small, and medium enterprises in coastal regions play a vital role in supporting local economic development and sustaining the social well-being of coastal communities, including those in Tanjung Balai, Indonesia (Pangarso et al., 2022; R Reniati, 2024). The economic activities of these enterprises depend heavily on the availability and quality of coastal natural resources, making them particularly vulnerable to increasing environmental pressures (Fabinyi et al., 2022). Ecosystem degradation, climate change, and environmental pollution not only threaten the sustainability of natural resources but also directly affect business continuity (Hassan et al., 2025). Consequently, the performance orientation of coastal micro, small, and medium enterprises must extend

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beyond short-term economic objectives toward the broader concept of sustainable performance (Ansar & Syamsu, 2025). Amid escalating sustainability challenges, the internal capabilities of micro, small, and medium enterprises have become a key determinant of their ability to respond effectively to environmental pressures (Gao et al., 2025). However, coastal enterprises are often constrained by limited financial resources, inadequate technological capacity, and underdeveloped managerial systems, which hinder the adoption of sustainable business practices (Endris & Kassegn, 2022). These challenges require a managerial approach that optimizes available resources through the development of environmentally oriented organizational capabilities and behaviors (Nawir et al., 2024). In this regard, strengthening internal management practices is essential for facilitating the transition of coastal micro, small, and medium enterprises toward more adaptive and sustainable business models.

Human resource management has evolved into a strategic management approach that integrates economic and environmental objectives (Ayman & Thaher, 2026). GHRM incorporates sustainability principles into key human resource functions, including recruitment, employee development, performance evaluation, and compensation systems. This approach encourages environmentally responsible behavior at both the individual and organizational levels (Guo et al., 2025). Numerous empirical studies have shown that the implementation of GHRM significantly improves environmental performance and organizational sustainability in large corporations (Zihan & Makhbul, 2024). Nevertheless, most existing studies have focused on large organizations that possess relatively sufficient financial, technological, and institutional resources. In contrast, micro, small, and medium enterprises, which constitute the backbone of emerging economies, have received considerably less attention in GHRM research. Approximately 89% of previous studies have focused on large enterprises (Kanan et al., 2023). This imbalance represents an important research gap, particularly in the context of coastal micro, small, and medium enterprises, which face not only internal resource limitations but also significant environmental pressures resulting from the vulnerability of coastal ecosystems. Moreover, the effectiveness of GHRM in these enterprises is likely to depend on the presence of Green Leadership and the organization's capacity to stimulate Green Innovation as the primary mechanism for achieving sustainable performance. Therefore, this study aims to examine empirically how Green Human Resource Management, supported by Green Leadership, promotes Green Innovation and ultimately enhances sustainable performance among coastal micro, small, and medium enterprises in Indonesia. By focusing on enterprises operating under resource-constrained and environmentally vulnerable conditions, this study seeks to contribute to a better understanding of sustainable business development in coastal regions and to provide practical insights for strengthening the long-term resilience and competitiveness of coastal enterprises.

## Literature review

### *GHRM*

The concept of human resource management reflects a shift from traditional personnel management practices toward strategic approaches that integrate environmental sustainability into organizational (Gupta & jao, 2024; Mousa & Othman, 2020). Recent studies in the hospitality and tourism sector further demonstrate that sustainable human resource management has become a strategic capability for strengthening organizational sustainability and long-term competitiveness (Sao Joao et al., 2025). In the context of micro, small, and medium enterprises, GHRM exhibits distinctive characteristics compared with large organizations and is reflected in three interrelated dimensions: green recruitment, green training, and green incentives. Green recruitment incorporates candidates' environmental awareness into employee selection criteria (Bolaji et al., 2024). Green training enhances employees' capabilities to adopt environmentally responsible practices (Maheshwari et al., 2024), while green incentives align reward systems with the achievement of organizational sustainability objectives (Xu et al., 2024). Collectively, these three dimensions embed environmental responsibility into employees' day-to-day work activities and encourage the development of a sustainability-oriented organizational culture. Despite its potential benefits, the implementation of GHRM in micro, small, and medium enterprises remains challenging and requires further investigation. One of the most significant barriers is limited financial capacity, as many enterprises struggle to allocate adequate resources for human resource initiatives that support sustainability (Shen et al., 2020). Another major challenge is employees' resistance to adopting new practices, particularly among those accustomed to conventional work routines, which constrains organizational innovation (Y. Zhang et al., 2024). Furthermore, limited managerial awareness often prevents business owners from recognizing the strategic value of GHRM for long-term business sustainability (Mousa & Othman, 2020). These constraints are closely interconnected and collectively create substantial barriers to the effective implementation of GHRM in micro, small, and medium enterprises.

Recent studies suggest that these challenges can be mitigated through appropriate managerial and policy interventions. Aloqaily et al. (2024) recommend implementing GHRM gradually, beginning with low-cost initiatives that generate measurable outcomes. They further emphasize the importance of cultivating an organizational culture that supports sustainability through clear communication of the benefits of GHRM to all relevant stakeholders (Gupta & Jangra, 2024; Montalvo-Falcón et al., 2023). Similarly, Mousa & Othman. (2020) advocate targeted sustainability training programs for owners and managers of micro, small, and medium enterprises to strengthen their awareness and managerial capabilities. From a broader perspective, the adoption of GHRM generates benefits that extend beyond organizational performance. In addition to strengthening business competitiveness and long-term sustainability, GHRM contributes to the achievement of the Sustainable Development Goals, particularly Goal 8 (Decent Work and Economic Growth), Goal 12 (Responsible Consumption and Production), and Goal 13 (Climate Action). Recent evidence in the hospitality sector also suggests that organizational green capabilities, particularly Green Intellectual Capital, play a critical role in fostering Green Innovation and improving sustainable organizational outcomes, highlighting the importance of integrating human resource practices with innovation-oriented sustainability strategies (Qoyyimah et al., 2025). Consequently, policy support and targeted initiatives from governments and relevant institutions are essential to facilitate the adoption of GHRM among micro, small, and medium enterprises. Building upon these arguments, this study proposes that GHRM positively influences Green Innovation (H1), Green Leadership (H2), and Sustainable Performance (H3).

***Green innovation in the domain of MSMEs***

Green innovation is widely recognized as a key driver of the long term sustainability of micro, small, and medium enterprises, achieved through the development of products, processes, and organizational systems that reduce environmental impacts while optimizing resource utilization (Xing et al., 2024). Within the context of micro, small, and medium enterprises, Green Innovation exhibits distinctive characteristics and can be categorized into three interrelated dimensions: green product innovation, green process innovation, and green organizational innovation. Green product innovation emphasizes the use of environmentally friendly materials and sustainable product design, green process innovation focuses on improving energy efficiency and minimizing waste generation, while green organizational innovation involves adapting organizational structures and management systems to support sustainability initiatives (Harini et al., 2020; Maulidi, 2025; Obuobi et al., 2024; Riaz et al., 2023). These dimensions are mutually reinforcing and are often implemented simultaneously to maximize sustainability performance. Evidence from developing countries suggests several distinctive patterns in the implementation of Green Innovation among micro, small, and medium enterprises. Shen et al. (2020) found that Green Innovation in these enterprises is predominantly incremental rather than radical, reflecting gradual improvements instead of disruptive technological breakthroughs due to limitations in financial resources, technological capabilities, and organizational capacity. In addition, local collaboration networks play a critical role in facilitating Green Innovation, with partnerships involving suppliers, customers, universities, and government institutions serving as important sources of knowledge, resources, and innovation capabilities (Riaz et al., 2023). Government regulations also represent a major driver of Green Innovation adoption through environmental policies, financial incentives, and regulatory requirements that encourage sustainable business practices (Ngoc Huynh et al., 2024).

The adoption of Green Innovation in micro, small, and medium enterprises is further influenced by a range of contextual factors. Limited access to advanced technology and financial resources often compels enterprises to adopt simple, low-cost innovation strategies (Wang et al., 2022). Similarly, weak social and collaborative networks restrict access to external knowledge and strategic resources required for innovation (Harini et al., 2020). Moreover, regulatory environments in many developing countries often fail to provide sufficient institutional support to encourage investment in Green Innovation (Li et al., 2024; Magazzino et al., 2021). Collectively, these interrelated constraints shape a distinctive innovation ecosystem that differs substantially from that of large organizations. These findings have important implications for both public policy and organizational practice. Governments should establish supportive regulatory frameworks that combine environmental standards with financial incentives, technical assistance, and capacity-building programs to accelerate Green Innovation among micro, small, and medium enterprises (Naser & Al-Tit, 2023). At the organizational level, strengthening collaborative partnerships with local stakeholders can help overcome resource limitations and facilitate knowledge exchange (Riaz et al., 2023). Furthermore, prioritizing continuous incremental innovation, rather than pursuing high-risk radical innovations, represents a more feasible and sustainable strategy for resource-constrained enterprises breakthroughs (Y. Zhang., 2020). Based on these theoretical and empirical arguments, this study hypothesizes that Green Innovation has a positive effect on Sustainable Performance (H4).

***Green leadership***

Green Leadership is widely recognized as a leadership approach that promotes environmental sustainability by encouraging environmentally responsible behaviors and initiatives throughout an organization. Theoretically, Green Leadership contributes to the development of organizational visions, values, and norms that are aligned with sustainability, thereby creating an organizational environment that fosters Green Innovation (Kareem & Kummitha, 2025). Beyond establishing strategic direction, Green Leadership facilitates the internalization of environmentally responsible values and innovative practices into employees' daily activities. In this context, organizational culture functions as a critical mechanism through which leadership vision is translated into innovative and sustainable organizational outcomes. A sustainability-oriented organizational culture aligns employees' behaviors with environmental objectives and encourages the development of environmentally responsible innovation (Kareem & Kummitha, 2025) Through leaders' exemplary behaviors and environmentally oriented policies, employees are encouraged to share green knowledge, develop environmentally conscious creativity, and explore innovative sustainability-oriented solutions. These activities represent an essential foundation for the successful implementation of Green Innovation (Al-ghazali & Gelaidan, 2022). This perspective is further supported by organizational capability and motivational theories, which conceptualize Green Leadership as a strategic organizational capability. Green Leadership strengthens environmentally oriented human capital by integrating sustainability into human resource management practices, thereby enhancing the organization's capacity to generate Green Innovation (Singh et al., 2020). Empirical evidence consistently demonstrates that environmentally oriented leadership positively influences Green Innovation. In particular, Green Transformational Leadership has been shown to stimulate Green Innovation through sustainability-oriented human resource practices that strengthen employees' environmental commitment, motivation, and innovation capabilities (Singh et al., 2020). As a result, organizations become better equipped to implement environmentally responsible innovations and improve their environmental performance (Kareem & Kummitha, 2025).

Furthermore, a sustainability-oriented organizational culture reinforces the influence of Green Leadership on Green Innovation. This suggests that the effectiveness of Green Leadership depends largely on its ability to embed environmental values within organizational culture (Montalvo-Falcón et al., 2023). Evidence from both the service and manufacturing sectors indicates that servant leadership grounded in environmental values significantly enhances Green Innovation by empowering employees, creating a supportive organizational climate, and implementing managerial practices that promote sustainability (Widyanty et al., 2025). Ultimately, Green Leadership provides the organizational foundation necessary to strengthen Green Innovation, enabling organizations to enhance their competitiveness and adapt successfully to an increasingly sustainability-driven business environment. Based on these theoretical and empirical arguments, this study proposes that Green Leadership positively influences Green Innovation (H5).

***Green sustainable performance***

Sustainable Performance serves as a key indicator for evaluating the effectiveness of sustainability oriented business operations and refers to an organization's ability to achieve its operational objectives while minimizing negative environmental impacts (Aloqaily et al., 2024). Sustainable Performance is commonly assessed through three interrelated dimensions. The first dimension focuses on energy efficiency, which is achieved through technological optimization, process improvements, and integrated energy management systems (Sheikh et al., 2024). Improvements in energy efficiency can substantially reduce operational costs while enhancing environmental performance. For example, a 10% increase in energy efficiency has been reported to reduce operational costs in micro, small, and medium enterprises by approximately 5–8%. Similarly, waste minimization can be achieved through resource recovery, sustainable production processes, and circular resource utilization practices (Y. Zhang et al., 2020) . Enterprises implementing comprehensive waste management systems have the potential to reduce waste disposal costs by up to 30%, thereby improving both economic and environmental performance. Another important dimension of Sustainable Performance relates to environmental compliance, which reflects the extent to which organizational practices conform to environmental regulations and legal requirements (Yu & Jing, 2025). Previous research has demonstrated that the adoption of green practices and compliance with environmental requirements can contribute to improved organizational sustainability and long-term business competitiveness (Elizabeth, 2024), achieving Sustainable Performance remains particularly challenging for micro, small, and medium enterprises due to limited financial resources, inadequate human capital, and the complexity of obtaining environmental certifications required to support sustainable business operations (Ali et al., 2024). From a theoretical perspective, these dimensions of Sustainable Performance are closely associated with environmentally oriented innovation. Improvements in green product development, production processes, and organizational systems enable firms to enhance resource efficiency, reduce environmental impacts, and

strengthen long-term business sustainability (Harini et al., 2020). Accordingly, organizations that successfully integrate environmentally responsible leadership into their managerial practices are expected to achieve higher levels of Sustainable Performance. Based on these theoretical arguments, this study proposes that Green Leadership positively influences Sustainable Performance (H6).

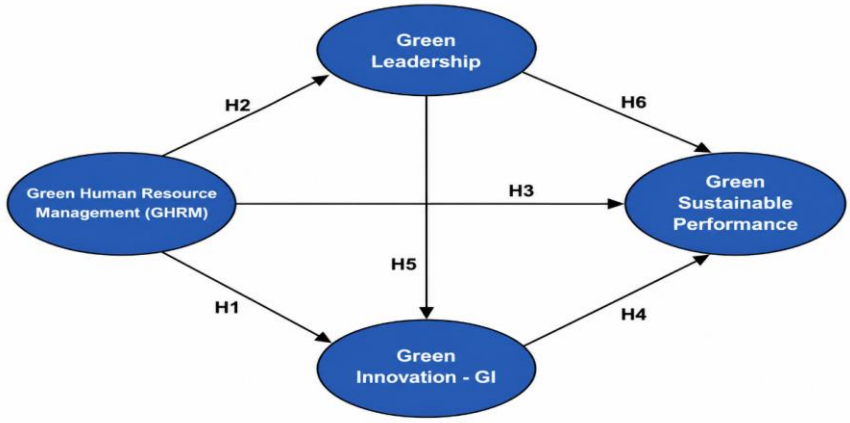


**Figure 1: Conceptual model of GHRM, green leadership, green innovation and green sustainable performance**

## Method

This study employed a quantitative explanatory research design to examine the relationships among Green Human Resource Management, Green Leadership, Green Innovation, and Sustainable Performance in micro, small, and medium enterprises in Tanjung Balai City. The proposed research model was developed based on the integration of the Resource-Based View and the Ability–Motivation–Opportunity Theory (S. Zhang, 2025). Within this framework, GHRM comprises green recruitment, sustainability-oriented training, and green incentives designed to encourage employees' participation in sustainability initiatives (Shahzad et al., 2025). Green Innovation is conceptualized as encompassing green product, process, and organizational innovations aimed at reducing environmental impacts, whereas Green Leadership refers to a leadership approach that integrates environmental values into the organization's vision, culture, and managerial practices. Sustainable Performance is measured through three key dimensions: energy efficiency, waste minimization, and compliance with environmental standards. Data were collected from 280 micro, small, and medium enterprise owners and managers using a structured questionnaire with a five-point Likert scale. The data were analyzed using Partial Least Squares Structural Equation Modeling, which is well suited for estimating complex structural relationships involving latent constructs and exploratory theory development (Otok et al., 2025). The proposed structural model examines six hypothesized relationships: the effects of GHRM on Green Innovation (H1), Green Leadership (H2), and Sustainable Performance (H3); the effect of Green Innovation on Sustainable Performance (H4); the effect of Green Leadership on Green Innovation (H5); and the effect of Green Leadership on Sustainable Performance (H6). The data were analyzed using Partial Least Squares Structural Equation Modeling with the bootstrapping procedure to evaluate both the measurement and structural models (Sathyanarayana & Mohanasundaram, 2025). The measurement model was assessed in terms of internal consistency reliability, convergent validity using the Average Variance Extracted criterion (Average Variance Extracted > 0.50), and discriminant validity using the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio. The structural model was subsequently evaluated based on path coefficients, coefficients of determination, effect sizes, and predictive relevance.

## Results and discussion

The demographic and business characteristics of the respondents are presented in Table 2. Most micro, small, and medium enterprises in Tanjung Balai City operate in the manufacturing sector, accounting for 154 business units (55%), followed by the trade sector with 82 units (29%) and the service sector with 44 units (16%). This distribution indicates that the local economic structure is predominantly oriented toward manufacturing and processing activities, which have the potential to generate significant environmental impacts. With respect to business size, the majority of respondents represent micro-enterprises employing 5–10 workers (43%), followed by small enterprises (37%) and medium-sized enterprises (20%). This profile reflects the resource constraints commonly experienced by micro, small, and medium enterprises while simultaneously highlighting considerable opportunities for business owners and managers to integrate sustainability principles into their managerial practices and organizational decision-making.

**Table 1. Respondent profile in Tanjung Balai City**

| Characteristic | Category | Frequency. (n) | Percentage (%) |
|---|---|---|---|
| **Business Sector** | Manufacturing. | 154 | 55.0 |
| | Trade | 82 | 29.3 |
| | Services | 44 | 15.7 |
| **Business Scale** | Micro-enterprise (5-10 employees) | 120 | 42.9 |
| | Small enterprise | 104 | 37.1 |
| | Medium enterprise | 56 | 20.0 |
| **Operational Tenure** | 5-10 years | 126 | 45.0 |
| | > 5 years | 90 | 32.1 |
| | > 10 years | 64 | 22.9 |

Note: Total number of respondents (N) = 280

**Source: Field data**

In terms of business tenure, most enterprises have been operating for 5–10 years (45%), followed by those operating for less than 5 years (32%) and those with more than 10 years of operation (23%). This distribution indicates that the majority of respondents have reached a relatively stable stage of business development, providing a favorable foundation for the adoption of Green Human Resource Management, Green Leadership, and Green Innovation practices.

### *Model of measurement*

The measurement model was evaluated to assess the reliability and validity of the constructs using a reflective measurement approach, following established guidelines (Sathyanarayana & Mohanasundaram, 2025). Indicator reliability was assessed using outer loadings, internal consistency reliability was evaluated using Cronbach's alpha and Composite Reliability, convergent validity was examined using the Average Variance Extracted, and discriminant validity was assessed using the Heterotrait–Monotrait ratio. All constructs were measured using three reflective indicators adapted from previously validated studies. Responses were collected using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). The results of the reliability and validity assessments are presented in Table 2.

**Table 2. Reliability and validity assessment**

| Construct | Code | Indicator | Loading |
|---|---|---|---|
| Green HRM | | | |
| Cronbach's α = 0.954 | GR1 | The company considers environmental concern in its employee recruitment process. | 0.856 |
| CR = 0.961 | GR2 | The company tends to select individuals who show genuine concern for environmental aspect | 0.871 |
| CR = 0.961 | GR2 | The company tends to select individuals who show genuine concern for environmental aspect | 0.871 |
| | GR3 | Environmental values are explained to employees from the beginning of their employment. | 0.826 |
| AVE = 0.732 | GI1 | The company provides rewards for environmentally friendly work behaviors. | 0.845 |
| | GI2 | Environmental performance is part of employee performance appraisal. | 0.843 |
| | GI3 | Incentives are given to employees who support environmental programs. | 0.866 |
| | GT1 | The company provides training related to environmentally friendly practices. | 0.834 |
| | GT2 | Employees are trained to reduce negative environmental impacts. | 0.868 |
| | GT3 | Environmental training is provided on a sustainable basis. | 0.888 |
| Green Innovation | | | |
| Cronbach's α = 0.945 | GIO1 | The company implements a management system that supports environmental sustainability. | 0.838 |
| CR = 0.954 | GIO2 | The organizational structure supports the development of environmentally friendly innovation. | 0.856 |
| AVE = 0.722 | GPR1 | The company's production process conserves energy usage | 0.840 |
| | GPR2 | The company reduces waste through work process improvements. | 0.854 |
| | GPR3 | Operational processes are designed to be more environmentally efficient. | 0.861 |
| | GIP1 | The company develops products that are more environmentally friendly. | 0.836 |
| | GIP2 | The company's products use more sustainable materials. | 0.853 |
| | GIP3 | The company's products are designed to reduce environmental impact. | 0.859 |
| Green Leadership | | | |
| Cronbach's α = 0.952 | GLC1 | Leaders pay attention to employee needs in implementing environmentally friendly practices. | 0.846 |
| CR = 0.960 | GLC2 | Leaders personally guide employees in activities that support environmental conservation. | 0.874 |
| AVE = 0.750 | GLI1 | Leaders act as exemplars of eco-friendly practices within in the workplace. | 0.861 |
| | GLI2 | Leaders exhibit a deep dedication to promoting sustainable business practices. | 0.859 |
| | GLS1 | Leaders encourage employees to think creatively in solving environmental problems. | 0.877 |
| | GLS2 | Leaders are open to new ideas related to green innovation. | 0.892 |
| | GLV1 | Company leaders have a clear vision regarding environmental sustainability. | 0.860 |
| | GLV2 | Leaders consistently direct the company towards achieving environmentally friendly goals | 0.860 |
| Green Sustainable Performance | | | |
| Cronbach's α = 0.924 | GSPC1 | The company complies with applicable environmental regulations. | 0.830 |
| CR = 0.941 | GSPC2 | The company consistently meets environmental standards. | 0.864 |
| AVE = 0.726 | GSPE1 | The company has successfully reduced energy consumption | 0.869 |
| | GSPE2 | Energy use in the company has become more efficient. | 0.837 |
| | GSPW1 | The company is able to reduce the amount of waste generated. | 0.847 |
| | GSPW2 | Waste is managed in a more environmentally friendly manner. | 0.864 |

Table 2 presents the results of the reliability and validity assessment of the measurement model. The evaluation of indicator reliability, Cronbach's alpha, Composite Reliability, and the Average Variance Extracted confirms the adequacy of the measurement model. All outer loadings exceed the recommended threshold of 0.70, indicating strong indicator reliability. In addition, Cronbach's alpha and Composite Reliability values above 0.90 demonstrate excellent internal consistency reliability, while Average Variance Extracted values exceeding 0.50 confirm adequate convergent validity by indicating that the indicators sufficiently represent their respective latent constructs. All measurement indicators exhibit high factor

loadings (≥ 0.80), further supporting strong indicator reliability. The measurement model also demonstrates excellent internal consistency, with Cronbach's alpha values exceeding 0.92 and Composite Reliability values above 0.94 across all constructs. Furthermore, all Average Variance Extracted values exceed the recommended threshold of 0.50, thereby satisfying the criteria for convergent validity (Sathyanarayana & Mohanasundaram, 2025). Discriminant validity was subsequently evaluated using the Heterotrait–Monotrait ratio. The results confirm that all constructs are empirically distinct, as every Heterotrait–Monotrait ratio falls below the recommended threshold of 0.85 (Sathyanarayana & Mohanasundaram, 2025). The Heterotrait–Monotrait ratio values for each construct pair are presented in Table 3.

**Table 3. Discriminant validity assessment using the Heterotrait–Monotrait ratio**

| | GHRM | Green Innovation (GI) | Green Leadership | Green Sustainable Performance (GSP) |
|---|---|---|---|---|
| Green HRM (GHRM) | | | | |
| Green Innovation (GI) | 0.642 | | | |
| Green Leadership | 0.574 | 0.519 | | |
| Green Sustainable Performance (GSP) | 0.489 | 0.679 | 0.405 | |

Discriminant validity, assessed using the Heterotrait–Monotrait ratio, indicates that all ratio values are below the recommended threshold of 0.85, confirming adequate discriminant validity among the constructs. The highest Heterotrait–Monotrait ratio was observed between Green Innovation and Sustainable Performance (0.679), while all remaining construct pairs exhibited lower values. These results confirm that the measurement model satisfies the recommended criteria for discriminant validity and provides a sound basis for subsequent structural model analysis.

***Structure model evaluation***

After the adequacy of the measurement model had been established, the analysis proceeded to the evaluation of the structural model, focusing on the predictive relationships among the latent constructs. The structural model was assessed based on its explanatory and predictive capabilities using the coefficient of determination and the Stone–Geisser predictive relevance statistic. The coefficient of determination represents the proportion of variance in each endogenous construct explained by its predictor constructs. According to established guidelines, coefficient of determination values of 0.67 indicate substantial explanatory power, values of 0.33 indicate moderate explanatory power, and values of 0.19 indicate weak explanatory power. The results show that the model explains 41.1% of the variance in Green Innovation, 30.1% of the variance in Green Leadership, and 41.6% of the variance in Sustainable Performance. These findings indicate that the model demonstrates a moderate level of explanatory power across all endogenous constructs. Predictive relevance was subsequently evaluated using the Stone–Geisser predictive relevance statistic, calculated through the blindfolding procedure. The predictive relevance values for Green Innovation (0.290), Green Leadership (0.222), and Sustainable Performance (0.297) are all greater than zero, confirming that the model possesses satisfactory predictive relevance and is appropriate for subsequent structural model evaluation.

**Table 4. $R^2$ and $Q^2$**

| Construct | $R^2$ | $Q^2$ |
|---|---|---|
| Green Innovation (GI) | 0.411 | 0.290 |
| Green Leadership | 0.301 | 0.222 |
| Green Sustainable Performance (GSP) | 0.416 | 0.297 |

Hypothesis testing was conducted using the bootstrapping procedure with 4,999 bootstrap subsamples. The results are presented in Table 5 and Figure 1. The findings indicate that not all hypothesized structural relationships are statistically significant. Several structural paths are supported, as they satisfy the significance criteria of $p < 0.05$ and $t > 1.96$. In contrast, the relationships between GHRM and Sustainable Performance, and between Green Leadership and Sustainable Performance, are not statistically significant ($p > 0.05$; $t < 1.96$). Consequently, these two hypotheses are not supported by the empirical evidence.

**Table 5. Summary of hypothesis testing results**

| Path | β | t-statistic | p-value | Supported |
|---|---|---|---|---|
| Green HRM (GHRM) -> Green Innovation (GI) | 0.487 | 9.120 | 0.000 | Yes |
| Green HRM (GHRM) -> Green Leadership | 0.548 | 14.656 | 0.000 | Yes |
| Green HRM (GHRM) -> Green Sustainable Performance (GSP) | 0.089 | 1.388 | 0.166 | No |
| **Green Innovation (GI) -> Green Sustainable Performance** (GSP) | 0.553 | 10.192 | 0.000 | Yes |
| Green Leadership -> Green Innovation (GI) | 0.227 | 3.880 | 0.000 | Yes |
| Green HRM -> Green Innobation -> Green Sustainable Performance (GSP) | 0.270 | 6.533 | 0.000 | Yes |

Based on the results presented in Table 5, several structural relationships exhibit substantial effect sizes. The strongest relationship is the effect of GHRM on Green Leadership ($\beta = 0.548$, $t = 14.656$), highlighting the strategic role of GHRM in fostering sustainability-oriented leadership. In addition, the strong positive effect of Green Innovation on Sustainable Performance ($\beta = 0.553$, $t = 10.192$) confirms that Green Innovation is a critical driver of organizational sustainability performance. The findings further demonstrate that both GHRM ($\beta = 0.487$) and Green Leadership ($\beta = 0.227$) have significant positive effects on Green Innovation,

underscoring their important roles in promoting environmentally oriented innovation. By contrast, the direct effects of GHRM and Green Leadership on Sustainable Performance are not statistically significant, suggesting that sustainability outcomes are primarily achieved through indirect pathways, particularly through the mediating role of Green Innovation. This interpretation is further supported by the significant indirect effect of GHRM on Sustainable Performance (β = 0.270, t = 3.880).

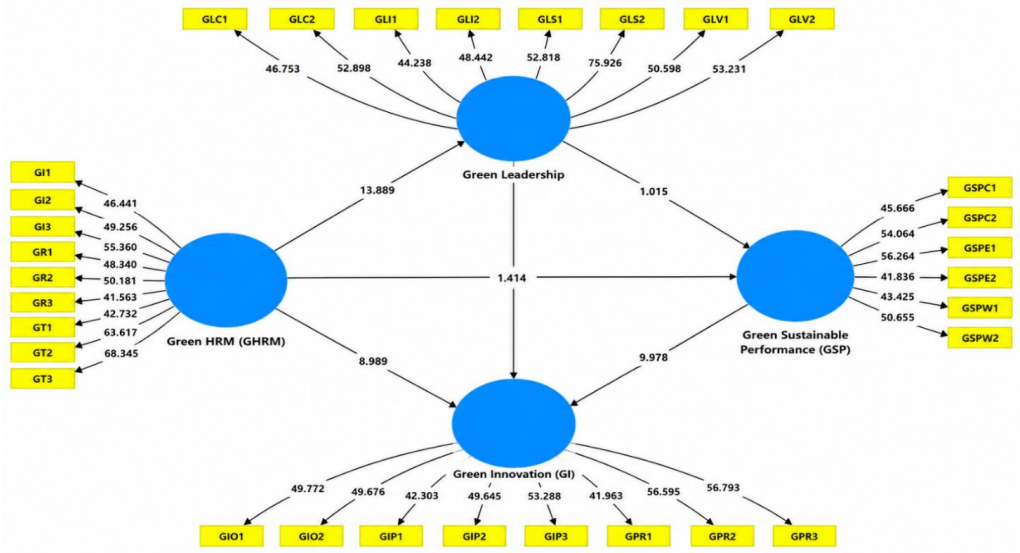


**Figure 2. Structural model**

## Discussion

The findings demonstrate that GHRM serves as a strategic organizational mechanism for developing sustainability-oriented capabilities within micro, small, and medium enterprises. Empirical evidence indicates that GHRM exerts significant positive effects on Green Leadership (β = 0.548, t = 14.656) and Green Innovation (β = 0.487, t = 9.120). These findings suggest that environmentally oriented human resource practices—including green recruitment, sustainability-focused training, and environmentally linked reward systems—not only cultivate leadership committed to sustainability but also strengthen the organization's capacity to generate environmentally responsible innovation. Accordingly, GHRM represents a fundamental managerial capability for supporting the long-term sustainability of micro, small, and medium enterprises. Green Leadership, which is strengthened through GHRM, further contributes to sustainable business development by promoting Green Innovation. The significant positive relationship between Green Leadership and Green Innovation (β = 0.227, t = 3.880) indicates that leaders play a critical role in translating sustainability-oriented human resource policies into environmentally responsible operational practices. This finding reinforces the argument that, within the context of micro, small, and medium enterprises, Green Leadership functions as a strategic mechanism linking human resource management with organizational innovation. From the perspective of the Resource-Based View, leadership represents an intangible organizational capability that facilitates the development of valuable and difficult-to-imitate innovation resources, thereby enhancing organizational competitiveness (Thi et al., 2024; H. Zhang & Wu, 2023). In this context, Green Leadership encourages the adoption of locally embedded sustainable innovations while fostering an organizational culture that supports environmental responsibility and responds to increasing stakeholder expectations for environmentally friendly products and business practices (Megawati et al., 2024; Rahmayanti et al., 2024).

The findings also support the Ability- motivation- opportunity theory. GHRM enhances employees' environmental capabilities through training, strengthens their motivation through sustainability-oriented incentive systems, and creates opportunities for participation in environmentally responsible initiatives. Green Leadership complements these human resource practices by encouraging environmentally responsible decision-making, fostering a sustainability-oriented organizational culture, and creating a work environment that stimulates green creativity and innovation (Al-Swidi et al., 2021; Mustafa et al., 2023). This interpretation is also consistent with recent evidence from the hospitality and tourism literature, which highlights that sustainable human resource management practices and environmentally responsible organizational cultures are essential for strengthening organizational sustainability and long-term competitiveness (Sao Joao et al., 2025). Consequently, the combination of GHRM and Green Leadership establishes favorable organizational conditions for the successful implementation of Green Innovation

(Khaddage-Soboh et al., 2024). Despite these positive relationships, GHRM does not exert a significant direct effect on Sustainable Performance (β = 0.089, t = 1.388). Instead, Green Innovation emerges as the only significant direct predictor of Sustainable Performance (β = 0.553, t = 10.192), indicating that the influence of GHRM is primarily transmitted through organizational innovation. These findings suggest that environmentally oriented human resource practices alone are insufficient to improve sustainability outcomes unless they are translated into tangible innovations in products, production processes, and organizational practices. The significant indirect effect of GHRM on Sustainable Performance further confirms the mediating role of Green Innovation within the proposed research model. The empirical findings can be understood in light of the business characteristics of micro, small, and medium enterprises in Tanjung Balai City. Most enterprises operate in the manufacturing sector and primarily engage in household-scale production, including fish-based culinary products, handicrafts, and other processed goods. Because these products are highly dependent on market acceptance and are particularly vulnerable to quality deterioration and perishability, business owners face strong pressure to continuously improve product quality and environmental attributes. Consequently, Green Innovation becomes an essential strategy for extending product marketability, increasing competitiveness, and reducing business risks associated with the perishability of fishery products. This context explains why Green Innovation plays a more decisive role in enhancing Sustainable Performance than GHRM or Green Leadership alone.

Overall, these findings indicate that improving the Sustainable Performance of micro, small, and medium enterprises requires more than the implementation of environmentally oriented human resource practices or sustainability-focused leadership. Sustainable business performance depends largely on the organization's capability to generate and implement Green Innovation. Green Innovation therefore serves as the primary mechanism through which GHRM and Green Leadership are transformed into superior sustainability outcomes. Theoretically, these findings extend the Resource Based View and the Ability Motivation Opportunity Theory by demonstrating that organizational resources and environmentally oriented human resource practices contribute to Sustainable Performance primarily through the development of innovation capabilities. From a practical perspective, the findings emphasize the importance of strengthening Green Innovation systems, developing sustainability-oriented leadership, and investing in GHRM as complementary strategies for enhancing the long-term sustainability and competitiveness of micro, small, and medium enterprises.

## Conclusions

GHRM significantly strengthens Green Leadership and promotes Green Innovation, while Green Innovation emerges as the primary direct determinant of Sustainable Performance. These findings indicate that the effects of GHRM and Green Leadership on Sustainable Performance are predominantly indirect, operating through the mediating role of Green Innovation. This evidence suggests that Green Innovation is a critical mechanism for achieving Sustainable Performance among micro, small, and medium enterprises in Tanjung Balai. Theoretically, this study extends the literature on sustainability in micro, small, and medium enterprises by demonstrating the importance of a process-based perspective, in which GHRM and Green Leadership contribute to Sustainable Performance primarily through the development of Green Innovation capabilities. Practically, the findings highlight the need for policies and managerial initiatives that strengthen Green Innovation capacity, foster adaptive Green Leadership, and reinforce environmentally oriented human resource practices, particularly for micro, small, and medium enterprises operating under environmental pressures and resource constraints in coastal regions.

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