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The Implementation of Green Human Resource Management (Green HRM) in Supporting Sustainable Construction Projects

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ABSTRACT

The construction sector plays a strategic role in economic development, but also contributes significantly to environmental degradation. The implementation of Green Human Resource Management (Green HRM) has become an essential effort in creating sustainable construction projects through environmentally oriented human resource practices. This study aims to analyze the influence of Green HRM implementation on the performance of sustainable construction projects in Central Java. A descriptive–verificative quantitative approach was employed. Data were collected through questionnaires distributed to 120 respondents, consisting of project managers, site engineers, and HR staff. The data were analyzed using multiple linear regression with the assistance of SPSS 26.0 and SmartPLS 4.0. The findings indicate that four dimensions of Green HRM—Green Recruitment & Selection, Green Training & Development, Green Performance Appraisal, and Green Employee Involvement significantly affect project performance. In contrast, Green Compensation & Reward shows no significant effect. The coefficient of determination of 0.671 indicates that Green HRM explains 67.1% of the variation in project performance. The study concludes that Green HRM plays a crucial role in improving resource efficiency, compliance with environmental standards, and overall construction project effectiveness. Strengthening green work culture and implementing environmentally based reward systems are recommended to enhance the sustainability of Indonesia's construction sector.

Keywords: *Green HRM, sustainable construction, project management, human resources.*

Introduction

Infrastructure development serves as the backbone of national economic growth and as a key indicator of a country's progress. However, the construction sector is also recognized as one of the most significant contributors to carbon emissions, solid waste generation, and environmental degradation due to project activities that heavily rely on energy consumption and natural resources. Although infrastructure development in Indonesia continues to advance, the construction sector still produces adverse environmental impacts, including high resource consumption and excessive waste generation. [1]. In the midst of increasing global awareness of sustainability issues, the concept of sustainable construction has emerged as a new paradigm in civil engineering and project management practices in Indonesia. Sustainable construction not only emphasizes cost and time efficiency but also focuses on balancing economic, social, and environmental dimensions as the foundation of sustainable development. [2].

In this context, the role of human resources (HR) becomes crucial, as the success of sustainable construction implementation is not solely determined by technological innovation but also by the behaviour and work culture of onsite personnel [3]. Enhancing human resource competence is essential, as employees are co-workers.[4]Considered valuable assets of a company, and play a central role in driving operations and production while ensuring business continuity[5],[6]. Human resources act as the dynamic engine within business management, expected to synergize and integrate with the company's vision and mission to achieve organizational goals effectively and efficiently ([7],[8]. Human resource management focuses on transforming ordinary employees into environmentally conscious workers with the aim of fostering organizations committed to green practices and contributing significantly to environmental sustainability.[9], [10]. HRM systems and practices are designed to maximize company performance, serving both as a source of efficiency and as a driver of value creation [11].

The Green Human Resource Management (Green HRM) approach emerges as a strategic framework that integrates environmental principles into HR policies and workforce management practices in the construction sector. Green HRM emphasizes the importance of environmentally oriented training, recruitment, performance appraisal, and reward systems that promote green behavior, energy efficiency, and environmental awareness. [12],[13].

Employees are encouraged to develop awareness and understanding of environmental protection through eco-friendly work practices.[14]. This approach forms a core component of Green Construction Management, which aims to establish a sustainable work ecosystem across the entire project value chain. Green construction, as an effort to actualize sustainable construction, is expected to minimize negative impacts on the environment and enhance user comfort. [15]. Scholars argue that Green HRM is an effective tool for developing green human capital that supports sustainable green performance and enhances competitive advantage.[16].

Previous studies demonstrate that Green HRM contributes significantly to improving environmental performance and organizational efficiency. Environmentally oriented training programs can strengthen employees' organizational commitment, motivating them to support the company's sustainability goals. [17]. For example, [18] Found that building envelope renovations resulted in a notable reduction in energy use of 15.8–27.7% per year. Similarly, [19] Reported that Green HRM implementation improved organizational commitment and workforce productivity in government infrastructure projects. In addition, a study by [20] in the *Journal of Civil and Environmental Engineering* revealed a positive correlation between green HR policies and construction waste management in a bridge development project in Central Java.

Despite its potential, most existing studies have focused on managerial aspects within large construction companies or state-owned enterprises (BUMN). Meanwhile, research on the implementation of Green HRM in small- and medium-scale construction projects remains limited. Challenges such as insufficient worker understanding of green work culture, weak environmental performance evaluation systems, and the absence of standardized Green HRM implementation guidelines in the construction sector hinder progress toward sustainable development [21]. Moreover, many previous studies have influential international literature shows that GHRM is related to green innovation and environmental/operational performance. [22].

Given these conditions, a research gap exists, as limited empirical studies have not comprehensively examined how Green HRM supports sustainable construction project success, particularly within Indonesia's diverse social and work culture. This gap establishes the novelty of the present study, which integrates green HRM perspectives with construction project management practices at the project level, not merely within organizational structures. This research also contributes by developing an adaptive Green HRM implementation model suited to practical field conditions through the identification of key drivers and barriers in sustainable construction projects.

The objective of this study is to analyze the implementation of Green HRM in supporting the effectiveness and sustainability of construction projects in Indonesia. Specifically, the study aims to: (1) identify Green HRM practices implemented in sustainable construction projects; (2) analyze the relationship between green HR policies, environmental performance, and project efficiency; and (3) formulate strategic recommendations for Green HRM implementation relevant to construction companies in Indonesia.

The scientific contribution of this study lies in its support for theoretical and practical advancements in sustainability-oriented construction management while enriching the literature on the integration of Green HRM within civil engineering and the construction sector. From a practical standpoint, the findings are expected to serve as a reference for project managers, consultants, and policymakers in designing environmentally friendly, efficient, and competitive workforce management strategies in the era of sustainable development.

Research Methods

This study employs a descriptive–verificative quantitative approach, using a causal analysis model, to examine the relationship and influence of the independent variable, Green Human Resource Management (Green HRM), on the dependent variable, Sustainable Construction Project Performance. This approach was chosen because it enables the assessment of the extent to which Green HRM contributes to the success of construction projects oriented toward resource efficiency, workplace safety, and reduced environmental impact. [23].

The research design is cross-sectional, meaning that data were collected at a single point in time to obtain an empirical overview of Green HRM practices in the construction sector. This research design is widely used in project management and green HRM studies because it can illustrate causal relationships simultaneously without requiring long-term observation. [23].

The population of this study consists of professional and managerial personnel involved in sustainable construction projects in Central Java, including high-rise buildings, road infrastructure, and bridge construction, implemented by medium- to large-scale construction service companies.

The sampling technique used is purposive sampling, in which respondents are selected based on specific criteria relevant to the research objectives. The criteria include:

1. Having at least two years of work experience in construction projects;
2. Being directly involved in HR management processes or the implementation of environmental policies in projects;
3. Working in companies that apply sustainable construction policies or certifications (green building or ISO 14001).

Based on these criteria, a total of 120 respondents were selected, comprising project managers, site engineers, occupational safety experts, and HR personnel from construction companies. This number is considered adequate for conducting inferential statistical analysis using multiple linear regression. [24].

Primary data were collected through closed-ended questionnaires using a 1–5 Likert scale distributed to respondents. The research instrument was developed based on indicators validated in previous Green HRM studies. [19], [25]. The instrument consists of two main components:

- Variable X (Green HRM): measured through five key dimensions—
  (1) Green Recruitment & Selection,
  (2) Green Training & Development,
  (3) Green Performance Appraisal,
  (4) Green Compensation & Reward, and
  (5) Green Employee Involvement.
- Variable Y (Sustainable Construction Project Performance): measured using four primary indicators
  (1) material and energy efficiency,
  (2) compliance with environmental standards,
  (3) project time and cost effectiveness, and
  (4) stakeholder satisfaction with project outcomes (Sari & Susanti, 2020).

In addition to questionnaires, semi-structured interviews were conducted with several project managers to deepen the contextual understanding of Green HRM implementation in the field. Secondary data were obtained from company reports, project documentation, and relevant academic literature.

Data Analysis

Data analysis was conducted in two stages: descriptive and inferential.

- Descriptive analysis was used to describe the respondent profile and the level of implementation of each Green HRM indicator.
- Inferential analysis employed multiple linear regression to examine the influence of Green HRM on sustainable construction project performance.

The testing process was conducted using SPSS 26.0 and SmartPLS 4.0 software, with the following steps:

1. Validity and reliability testing to ensure the internal consistency of the instrument;
2. Classical assumption testing (normality, multicollinearity, and heteroscedasticity);
3. Testing the coefficient of determination (R^2) and parameter significance through t-tests and F-tests (following [26];
4. Analysis of direct and indirect effects among latent variables using the Partial Least Squares approach.

The results indicate that all measurement indicators meet the criteria of loading factor > 0.7, Composite Reliability > 0.8, and Average Variance Extracted (AVE) > 0.5, confirming that the instrument is valid and reliable. [23].

Regression Model

The research model was developed to describe the causal relationship between the implementation of Green HRM and Sustainable Construction Project Performance. Mathematically, the regression model is expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$$

Where:

- Y = Sustainable Construction Project Performance
- X_1 = Green Recruitment & Selection
- X_2 = Green Training & Development
- X_3 = Green Performance Appraisal
- X_4 = Green Compensation & Reward
- X_5 = Green Employee Involvement
- β_0 = constant
- β_1–β_5 = regression coefficients
- ε = error term

This model assumes that the higher the implementation of Green HRM principles in construction projects, the better the project performance in terms of resource efficiency, environmental sustainability, and team effectiveness (Utami & Wibowo, 2021; Suharyono et al., 2023).

Results and Discussion

This research was conducted from March to June 2025 across several sustainable construction projects located in Surakarta, Boyolali, and Karanganyar. These locations were selected based on the presence of infrastructure projects certified under green building standards and regional government projects that have implemented ISO 14001–based environmental management systems.

Data were collected through questionnaires and interviews with 120 respondents consisting of project managers, site engineers, occupational safety experts, and HR management staff. The data collection process was carried out directly at the project sites with permission from the main contractors and supervising consultants. The collected data were then processed using SPSS 26.0 and SmartPLS 4.0 to identify the relationships among variables and the influence of Green HRM on project performance.

Descriptive analysis was used to provide an overview of the level of implementation of each Green HRM dimension in the construction projects. Table 1 presents the mean values for each indicator.

Table 1. Descriptive Analysis of Green HRM Implementation

No	Green HRM Dimension	Mean	Category
1	Green Recruitment & Selection	4.21	High
2	Green Training & Development	4.08	High
3	Green Performance Appraisal	3.95	Moderately High
4	Green Compensation & Reward	3.87	Moderately High
5	Green Employee Involvement	4.10	High

The results in Table 1 show that Green HRM practices at the research sites have been implemented effectively, particularly in green recruitment and environmental training. This aligns with the findings of [19], who emphasize that the dimensions of recruitment and training serve as the initial foundation for developing a green work culture in the construction industry.

Inferential Analysis

Multiple linear regression was employed to examine the simultaneous and partial effects of the variables. Table 2 presents the hypothesis-testing results at the 5% significance level.

Table 2. Results of Multiple Linear Regression Analysis

Independent Variable	β Coefficient	t-value	Sig.	Description
Green Recruitment & Selection	0.241	3.125	0.002	Significant
Green Training & Development	0.198	2.841	0.005	Significant
Green Performance Appraisal	0.154	2.022	0.046	Significant
Green Compensation & Reward	0.112	1.784	0.078	Not Significant

Independent Variable	β Coefficient	t-value	Sig.	Description
Green Employee Involvement	0.226	3.442	0.001	Significant

$R^2 = 0.671$ F-value = 27.423 Sig. F = 0.000

Based on Table 2, four dimensions of Green HRM significantly influence sustainable construction project performance, except for Green Compensation & Reward, which does not. The coefficient of determination (R^2) of 0.671 indicates that Green HRM explains 67.1% of the variation in project performance, with the remaining 32.9% attributable to external factors such as risk management, project design, and government policy support.

The empirical model shows that the most potent effects originate from Green Recruitment & Selection (β = 0.241) and Green Employee Involvement (β = 0.226). These dimensions play a critical role in embedding sustainability values from the recruitment stage through on-site worker involvement. Thus, project effectiveness is influenced not only by environmentally friendly technologies but also by workers' environmentally conscious behaviors and awareness.

The findings confirm that implementing Green HRM significantly enhances sustainable construction project performance. These results support [27]**,** who argue that green HR practices improve energy efficiency, waste management, and workplace safety. Theoretically, the findings strengthen the Resource-Based View (RBV), which posits that competitive advantage is derived not only from physical assets but also from human resources capable of internalizing sustainability values [23]. Accordingly, Green HRM serves as a strategic link between project management practices and sustainable development goals.

However, the non-significant influence of Green Compensation & Reward suggests that reward systems based on green behavior remain weak in construction companies. This is consistent with [25], who found that many companies in Indonesia have not yet established measurable reward indicators for employee contributions to energy efficiency and waste reduction.

This study expands theoretical insights into the integration of Green HRM within construction management by providing empirical evidence of a direct relationship between green HR practices and project performance. These findings enrich the sustainability management literature within the context of developing countries, where environmental policies and HRM practices are still evolving [24].

Practical Implications

Practically, the results offer several recommendations for construction companies:

1. Integrate environmental considerations into recruitment and training processes;
2. Develop performance appraisal systems based on green indicators;
3. Design compensation and incentive programs that encourage environmentally friendly work behavior;
4. Enhance worker involvement in decision-making regarding environmental project policies.

Implementing these strategies is expected to strengthen sustainable work culture and enhance competitiveness in both national and international green project tenders.

Conclusion

The findings of this study indicate that implementing Green Human Resource Management (Green HRM) significantly enhances the performance of sustainable construction projects. The empirical results suggest that the better the application of Green HRM practices within project organizations, the higher the efficiency of resource utilization, compliance with environmental standards, and effectiveness in project time and cost management. Of the five dimensions analysed—Green Recruitment & Selection, Green Training & Development, Green Performance Appraisal, Green Compensation & Reward, and Green Employee Involvement, four were found to have a significant positive influence on project performance. The most dominant dimensions were Green Recruitment & Selection and Green Employee Involvement, indicating that project sustainability is strongly influenced by environmentally oriented recruitment processes and workers' on-site engagement in green practices.

Meanwhile, the Green Compensation & Reward dimension did not exhibit a significant effect, suggesting the need for improvements in reward systems to consistently stimulate pro-environmental behavior. These findings affirm that human resources are central to achieving sustainable construction projects not only through technological innovations but also through the internalization of sustainability values within organizational culture. Thus, integrating Green HRM policies can be an effective strategy to support the Sustainable Development Goals (SDGs) in Indonesia's construction sector.

This study recommends that construction service companies strengthen their Green HRM policies in a more systematic and integrated manner. The improvements should begin with environmentally oriented recruitment processes, continuous environmental training programs, and performance evaluation systems aligned with sustainability indicators. Additionally, incentive schemes should be designed to reinforce pro-environmental behavior among employees. Regulatory bodies are also encouraged to provide stronger policy support and incentives to ensure consistent implementation of Green HR practices across public and private construction projects. Furthermore, academic institutions and professional organizations may contribute by developing training programs that enhance environmental awareness and green skills among construction workers.

Despite its conceptual and empirical contributions to sustainable construction management, this study has several limitations. First, data were collected only from Central Java, limiting the generalizability of the findings to all construction projects in Indonesia. Second, the study relies on respondents' perceptions, which may not fully capture actual on-site behavioral dimensions. Therefore, future research is recommended to expand the geographic scope and employ mixed-method approaches to obtain a more comprehensive understanding of the relationship between Green HRM and project performance. In addition, future studies may incorporate mediating variables such as organizational culture, environmental commitment, or green technological innovation to enrich the resulting theoretical model further.

Overall, the implementation of Green HRM is proven not merely a conceptual trend but a strategic necessity in addressing sustainable development challenges within the construction sector. Through environmentally oriented human resource practices, Indonesia's construction industry has substantial potential to achieve a balanced synergy between productivity, sustainability, and social responsibility.

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