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## The Green Innovation Engine: How GHRM Practices Influence Sustainable Performance in Manufacturing Industries

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## Abstract

Green HRM, which focuses on environmental sustainability in the context of HRM, is a relatively new term that has seen a dramatic change in recent years. The individuals who work for a company are its most important valuable asset. Wherever HRM is responsible for the company's environmentally conscious initiatives is the focus of this green HRM practice study. This study takes green innovation (GI) into account as a mediator between green HRM practices i.e., green recruitment & selection (GRS), green training & development (GTD), green compensation benefits (GCB), green performance management (GPM), green employee relation (GER) and sustainable performance (SP) in manufacturing industries of Khyber Pakhtunkhwa. In order to accomplish the study objectives, this study collect data from 240 managerial level employees who working in manufacturing industries. This study used analysis tool SPSS V25 for data analyzing. Based on findings, GHRM practices i.e., GRS, GTD, GCB, GPM, and GER has significantly and positively influence sustainable performance. Furthermore, green innovation (GI) partially mediates the relationship GHRM practices i.e., GRS, GTD, GCB, GPM, GER and sustainable performance. The research could prove to be helpful in a number of different ways, including in terms of concept, methodologically, and practically. These interested parties include senior management of companies, researchers, human resource professionals, and the Pakistan security exchange commissions.

**Keywords:** Green HRM, Sustainable Performance, Green Innovation, Manufacturing Industries

## Introduction

Concerns over climate change have increased in recent years. In the twenty-first century, environmental concerns have garnered increased worldwide attention (Liu et al., 2024; Sekhar et al., 2024). The need of international environmentalism to moderate climate change has been acknowledged by particular treaties (Morin et al 2024). To alleviate and depletion of natural resources, numerous rules and regulations are established and endorsed by NGOs and government. These laws and regulations address the detrimental effects of corporations regarding pollution, toxic substances, and other waste materials. Furthermore, these regulations and activities aim to reduce the detrimental impact of environmental challenges on communities, cultures, and living organisms (Onwuka & Adu, 2024). Simultaneously, industries may enhance their trademark recognition and augment market competitiveness via GPDI (Zhu et al., 2024) by using green intellectual capital, since environmental awareness among stakeholders markedly intensifies (Mansoor et al., 2021). Intellectual capital comprises a collection of intangible assets, including resources, talents, and competencies, that enhance a firm's performance and value. Intellectual capital, an intangible asset, encompasses individuals' knowledge, skills, competences, experience, abilities, and customer connections that facilitate organizational competitiveness (Onwuka & Adu, 2024). GHRM has tacit development during the previous three decades. Employment candidates consistently support ecologically responsible enterprises (Koman et al., 2024). The incorporation of sustainability within the jurisdiction of Human Resource Management, namely green HRM, has recently led to considerable transformations in human resources as a vital and esteemed asset of an organization. This study's discourse on "green HRM" centers on the accountability of HRM in relation to the organization's environmental management. To enhance employee self-confidence and satisfaction, Ma et al. (2024) defines green HRM as the policies and practices that allocate resources sustainably in support of environmentalism. Green HRM is defined as the use of HRM policies, procedures, practices, and philosophies to sustainably increase corporate resources and lessen environmental harm inside the organization (John et al. 2024). Achieving environmental objectives and initiatives across the recruitment, selection, training and development, compensation, and employee relations processes, green HRM and its productivity strengthen green culture and green efforts inside the organization (Arda et al., 2023). The HR processes endorse the requisite green HR policies (Vázquez‐Brust et al., 2023). Therefore, the importance of human capital in attaining objectives related to sustainable corporate performance is paramount (Ahmed et al., 2023). The collapse of a company is recognized to inadequate employee engagement, selection, compensation, and recruitment methods (Arda et al., 2023). The HR role may facilitate organizational change. During this phase of rapid expansion, it is essential to recognize emerging domains, particularly the convergence of sustainability and human resource management. To successfully implement organizational strategy, it is important to bring into line HR systems (Agustian et al. 2023). Garai-Fodor, (2013) recognized that prioritizing staff orientation, motivation, recruitment, and incentives influence facilitate the efficient implementation of green initiatives. Research indicates that changes in HRM procedures are essential for recruiting optimal candidates for environmental performance (Shahrulnizam et al., 2024). Integrating green initiatives, employee behavior, and organizational culture, green HRM practices are vital for sustainable business development (Ahmed et al., 2023). In Khyber Pakhtunkhwa, limited research has been conducted on the practical implementation of the study that might assist manufacturing industries in enhancing sustainability via green HRM practices. The contextual aspects of the research received significant attention (Niazi et al., 2024). This study examined the dynamic effect of GHRM practices on of SP. Moreover, very limited study has been conducted of GHRM practices and its dimension within the manufacturing industries context. Despite the extensive literature on green HRM and sustainable performance, uncertainty continues concerning the effective implementation of green HRM and the sustainable performance of firms in achieving ultimate green competitiveness in the business context (Niazi et al., 2024).

Members have an essential role as catalysts for change since green culture has the potential to challenge established ways of thinking inside organizations (Rehman et al. 2023). To find out how companies might make their HR policies more environmentally friendly, this research reviewed the vast and relevant literature that covered many aspects of green HRM. The sustainability conversation is never far from the world's most pressing problems, such as pollution, social exclusion, and the need for new public and private enterprises. In order to provide equal weight to environmental, social, and economic concerns, a development measure is required. In contrast, the evidence of an approach is that companies were not established to serve societal purposes but rather to make a return. Assuming managers should maximize returns to shareholders by increasing firm profitability is the strategy's underlying evidence. In addition, prior studies have shown that GHRM and employee behavior effectively bring about cultural and structural changes that will help firms become more sustainable (Akdeniz, 2023). This study's overarching objective is to determine whether or not green HRM improves long-term business results. A company's HR policies and plans be effective if they are in line with and complementary to its EMS policies and strategies (Wang & Liu, 2023). Many programs, like GHRM, help businesses bring their environmental policies and strategies in line with what their employees want (Al-Swidi et al., 2024). Unfortunately, green HRM is implemented in only a few of nations or areas around the globe, including Europe (Adeyefa et al., 2023) and Australia (Brewster et al., 2024). In the Asian setting, there has been a lack of influential research from some countries, including Pakistan and India (Fuchs et al., 2024), with the exception of Malaysia (Handayani et al., 2024). A thorough, all-encompassing, and integrated approach to GHRM practices has not yet been produced by a huge amount of prior work that focused on a few of green HRM practices.

**Literature review**

**GHRM Practices and sustainable performance**

Green Recruitment & Selection involves hiring individuals who not only possess the necessary skills for the job but also demonstrate a commitment to sustainability. By integrating environmental values into recruitment processes, organizations can ensure that new hires align with the company's green goals and contribute positively to sustainability efforts. Recent studies highlight that green recruitment strategies help attract individuals with the necessary skills to implement sustainable practices, such as energy efficiency and waste reduction (Murino et al., 2023). Green Recruitment & Selection involves the integration of environmental criteria into the hiring process, ensuring that candidates are environmentally conscious and align with the company’s sustainability objectives. Manufacturing organizations that prioritize hiring individuals with sustainability knowledge and eco-friendly values are likely to benefit from employees who contribute to green practices and initiatives (Renwick et al., 2013). These employees can introduce new environmentally responsible practices, improve resource efficiency, and help implement sustainable production processes (Farooq et al., 2023). Green Performance Management involves incorporating environmental sustainability into employee performance evaluations, goal setting, and reward systems. By integrating green Key Performance Indicators (KPIs) into performance management, companies can encourage employees to focus on sustainability objectives such as reducing energy consumption, minimizing waste, or improving resource efficiency (Malarvizhi & Raji, 2024). Research by Jabbour et al. (2020) indicates that companies with robust green performance management systems experience greater environmental improvements because employees are directly motivated to meet environmental goals through regular feedback and recognition. Green Performance Management incorporates environmental criteria into employee performance evaluations, encouraging employees to engage in behaviors that align with sustainability objectives. By setting clear green targets, tracking environmental performance, and offering rewards for sustainable achievements, manufacturing companies can ensure that their workforce is motivated to contribute to sustainability goals (Jabbour et al., 2020). Employees who are rewarded for sustainable performance may focus on waste reduction, energy efficiency, and overall improvements in environmental management. Green Training & Development is critical for enhancing employees’ knowledge and capabilities related to environmental sustainability. Providing training on green technologies, sustainable practices, and environmental regulations enables employees to contribute effectively to the organization’s environmental goals. In manufacturing industries, where technological advancements and operational processes can directly impact environmental performance, green training ensures that employees are equipped to implement energy-saving solutions, reduce waste, and improve resource utilization (Renwick et al., 2013). Green Training & Development focuses on building employees' capabilities to engage in environmental management activities and adopt green technologies. In manufacturing environments, where technical knowledge and the application of eco-friendly practices are essential for sustainability, green training ensures that employees are well-versed in the latest environmental technologies, energy-saving techniques, and regulatory compliance requirements (Li et al., 2024). Research suggests that organizations that invest in green training programs can expect their employees to develop innovative solutions for reducing waste, improving efficiency, and minimizing the environmental footprint (Long et al., 2023). Green Employee Relations refer to the efforts made by organizations to create a work environment that encourages collaboration and engagement around sustainability issues. By fostering positive relationships between employers and employees on environmental matters, organizations can enhance employee buy-in for green initiatives. Research suggests that when employees are involved in decision-making processes related to sustainability, they are more likely to engage in environmentally friendly behaviors (Di Tommaso et al., 2023). Green Employee Relations emphasize building positive, trust-based relationships between employers and employees, with a focus on mutual engagement in sustainability initiatives. When employees feel that their opinions matter and that they are part of a collaborative effort toward sustainability, they are more likely to contribute to green goals and adopt eco-friendly behaviors (Al Falah et al., 2023). This sense of shared responsibility for environmental outcomes leads to better communication, increased participation in green initiatives, and an enhanced organizational commitment to sustainability (Zen, 2023). Green Compensation & Benefits ties employee rewards to sustainability achievements, aligning financial incentives with environmental goals. This can include providing bonuses for achieving green targets, offering sustainable transportation options, or recognizing eco-friendly behaviors (Khalid, 2023). A study by Nasir et al. (2023) found that green compensation practices motivate employees to engage in sustainable behaviors, as they are directly incentivized to meet environmental performance targets.Green Compensation & Benefits link financial rewards, bonuses, and non-financial perks (such as eco-friendly transportation options or subsidies for sustainable commuting) to employees' contributions to sustainability targets. When employees receive tangible rewards for achieving green goals, such as reducing energy consumption or increasing recycling rates, they are more likely to engage in behaviors that improve the company’s environmental footprint (Nasir et al. (2023). This alignment of rewards with sustainability objectives reinforces the organization's commitment to sustainability and drives employees to implement green practices. Hence, this study proposed the following hypotheses,

**H1:** There is positive relationship between green recruitment & selection and sustainable performance.

**H2:** There is positive relationship between green performance management and sustainable performance.

**H3:** There is positive relationship between reen training & development and sustainable performance.

**H4:** There is positive relationship between green employee relation and sustainable performance.

**H5:** There is positive relationship between green compensation & benefits and sustainable performance.

**Green innovation as mediator**

Green Recruitment & Selection (GRS) involves hiring individuals with technical capabilities and an environmental commitment (Das & Dash, 2023). This strategy helps companies hire green-minded personnel who can create new eco-friendly goods or improve production methods (Ogiemwonyi et al., 2023). In resource-intensive sectors like manufacturing, hiring environmentally conscientious workers helps attach the workforce with sustainability objectives (Usman et al., 2023). This consultation between workers' ideals and the company's environmental goals promotes green ideas. Once employed, sustainability-minded individuals are more likely to propose green solutions (Shafiq et al., 2023). These innovations may include waste-reduction technology, energy-efficient industrial techniques, or renewable materials. Green innovation is a natural result of recruiting sustainability-focused employees who can lead or support environmental improvement efforts (Martínez-Falcó et al., 2024). Green recruiting establishes a culture of innovation that reduces operations and product environmental impact (Shahzad et al., 2023). These personnel assist the company fulfill environmental goals including decreasing carbon emissions, energy use, and waste management with their green innovations. Thus, green developments are crucial to industrial enterprises' sustainability. Green recruiting guarantees environmental alignment and catalyzes ideas needed to increase industrial sustainability (Zihan et al., 2024). In order to incentivize employees to be more sustainable, GPM incorporates environmental sustainability into performance evaluation methods (Dalla Valle et al., 2024). Include environmental targets in employee evaluations, such as cutting down on energy use or trash. A results-oriented culture that promotes environmentally conscious actions may be established by linking personal success with organizational sustainability objectives (Ma et al., 2024). GPM motivates individuals to come up with eco-friendly solutions by linking performance with environmental objectives. Mediating Green Innovation: When workers are aware that their environmental efforts are being tracked and compensated, they are more likely to come up with green inventions (Shahzad et al., 2023). These influence in new ways of undertaking things, technologies that save resources or environmentally friendly products that meet consumer demand for sustainability. The performance management system, workers are made to answer for their day-to-day actions as well as their contribution to the company's long-term viability. By fostering an innovation-driven atmosphere, GPM encourages green innovation (Wattoo et al., 2024; Zihan et al., 2024). Workplace "green training and development" (GT&D) programs educate employees how to be more environmentally aware and responsible (Khattak et al., 2023). It includes environmental management, sustainability standards, green technology, and eco-friendly materials (Ejairu et al., 2024). Manufacturing companies may boost sustainability awareness and equip their employees to engage in green innovation efforts by offering personalized training programs (Xu et al., 2023). Environmental innovation requires specialized skills, and GT&D is essential for knowledge transfer (Asad et al., 2023). The correct training empowers employees to creatively tackle environmental sustainability issues. A worker familiar with sustainable production may offer energy- or trash-saving process adjustments. Green training may assist sustainable product development by encouraging more efficient designs and eco-friendly materials (Zihan et al., 2024). By offering employees the tools to make the firm and environment more sustainable, GT&D promotes green innovation. Green Employee Relations (GER) promotes a collaborative, participative culture where workers are interested in sustainability (Fernandez & Ganesan, 2023). Encourage workers to engage in environmental, sustainability, and green innovation decision-making (Kumar et al., 2023). A friendly workplace that encourages open communication and cooperation is more likely to provide different ideas and solutions (Durrah, 2023). Employees are more likely to recommend creative sustainability ideas when they feel valued (Palmié et al., 2023). Green employee relations inspire collaboration and innovative thinking on how to decrease environmental effects in everyday work (Abbas & Khan, 2023). When management supports employees, they are more likely to share creative ideas, which may lead to green advancements including process optimizations, energy-saving technology, and sustainable product designs (Makhloufi et al., 2023). The innovations that result from employee input on sustainability programs increase environmental performance (Kumar et al., 2023). Green Compensation & Benefits (GCB) is financial incentives, bonuses, or other benefits to sustainability objectives (Klindžić, 2024). By compensating workers for sustainability efforts like trash reduction, energy efficiency, and eco-friendly technologies, firms may connect financial interests with environmental goals. Incentivization encourages workers to produce green innovation ideas, promoting a performance-driven sustainability strategy. These incentives encourage workers to be innovative and own environmental ideas. Financial and non-financial prizes for sustainability performance may motivate staff to create and execute environmental innovations. Employees may be incentivized to create resource-efficient goods, improve industrial processes to cut emissions, or install energy-saving technology (Mehrajunnisa et al., 2023). Green remuneration directly relates green innovation to personal and organizational success, boosting the creation and implementation of sustainable performance-impacting technologies (Owusu et al., 2023). Thus, we proposed these hypotheses,

**H6:** Green innovation mediates the relationship between Green Recruitment & Selection and sustainable performance.

**H7:** Green Performance Management and sustainable performance.

**H8:** Green innovation mediates the relationship between Green Training & Development and sustainable performance.

**H9:** Green innovation mediates the relationship between Green Employee Relation and sustainable performance.

**H10:** Green innovation mediates the relationship between Green Compensation & Benefits and sustainable performance.

**Conceptual framework**

|  |  |
| --- | --- |
| **Figure 1** | **Mediation Model** |
|  Green Recruitment & Selection Green Performance Management Green Training & Development Green Employee RelationGreen Compensation & Benefits **Source: Conceptual Framework** |

**Methodology**

**Population and sample size**

This study population is the managerial level employees at manufacturing industries from Khyber Pakhtunkhwa, Pakistan. In order to get primary data from the intended participants, the present research employed modified questionnaires. To ensure a satisfactory response rate, survey questionnaires were sent in three different ways. Participants that was select for the study given a total of 500 questionnaires. The response rate was 48%, with just 240 authentic responses received. Research in the same area as this one has shown that the sample size is sufficient (Rahman, 2023; Sobaih, 2020), thus can say that this study's sample size is appropriate. Employees at the managerial level selected for them because of their reputation for expertise in incorporating Green HRM practices. In the KP manufacturing sector, data was collected from 240 managerial level personnel using a survey questionnaire approach. Not only that, but this research empirically investigates the role of GHRM practices on sustainable performance. Further, this study also examined the intervening effect of green innovation. The respondent profile consisted of 240 individuals, including upper level, middle level, and lower level managers from manufacturing industries. The sample comprises 204 male participants, representing an 85% of the total. The respondents' ages indicate that the majority are in-between 31-38, with a valid percentage of 44.6%. Education levels indicate that a considerable percentage of employees in manufacturing sectors, a majority respondents have qualifications of Master degree (42.5%). Additionally, majority of individuals, that they have more experience are 91 individuals with a valid percentage of 37.9%. The employment status indicates that a majority of employees are middle level managers having a valid of 45.8%.

**Table 1 *Participants Profile***

|  |  |  |
| --- | --- | --- |
| Male  | 204 (85.0%) | **Gender** |
| Female  | 36 (15.0%) |  |
| 22-30 years | 82 (34.2%) | **Ages** |
| 31-38 | 107 (44.6%) |  |
| Above 38 | 51 (21.3%) |  |
| Bachelor degree | 48 (20%) | **Qualification** |
| Master degree | 102 (42.5%) |  |
| MS/MPhil degree | 59 (24.6%) |  |
| Above  | 31 (12.9%) |  |
| 1-5 years | 43 (17.9%) | **Experience**  |
| 6-10 | 91 (37.9%) |  |
| 11-15 | 74 (30.8%) |  |
| Above 15 | 32 (13.3%) |  |
| Upper level | 70 (29.6%) | **Employee status** |
| Middle level | 110 (45.8%) |  |
| Lower level | 59 (24.6%) |  |

Note: Coding Scheme: {“{Gender” (“Male = 1, Female = 2”)} {“{Ages” (“22-30 = 1, 31-38 = 2, above 38”)} {“{Experience” (“1-5 years = 1”, “6-10 years = 2”, “11-15 years = 3”, “above 15 = 4”}{“{Employee status” (“Upper level = 1, Middle level = 2, Upper level= 3”)}.

**Measurement**

A Likert scale with five points was used to investigate the responses of the participants. A score of 1 indicated a (strong disagree), while a score of 5 indicate a (strong agree). **(See table 2).**

**Table 2** Scale developed from the following articles

|  |  |  |
| --- | --- | --- |
|  **Variables** | **Scale items** | **References** |
|  |  |  |  |
| **Independent variable** | ***GHRM Practices***Green recruitment & selection | **05** | (Shah, 2019; Tang et al. 2018; Yong et al. 2019) |
|  | Green training & development | **05** |  |
|  | Green compensation & benefits  | **05** |  |
|  | Green performance management  | **05** |  |
|  | Green employee relation | **05** |  |
| **Dependent variable** | Sustainable performance | **07** | (Tom, 2015; Yong et al. 2019) |
| **Mediator** | Green innovation | **07** | (El-kassar and Kumar, 2018) |
|  **Total items 39** |

**Table 3 Reliability Statistics**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr.** | **Variables** | **Items** | **Alpha value** |
| **1** | GHRM Practices**(Independent variables)**Green recruitment & selection (GRS) | **05** | **.812** |
|  | Green training & development (GTD) | **05** | **.781** |
|  | Green compensation & benefits (GCB) | **05** | **.854** |
|  | Green performance management (GPM) | **05** | **.901** |
|  | Green employee relation (GER) | **05** | **.773** |
| **2** | Sustainable Performance (SP)**(Dependent variable)** | **05** | **.865** |
| **3** | Green Innovation (GI)**(Mediator)** | **05** | **.846** |

To validate the reliability of each component, Cronbach's alpha must be greater than 0.70. Green recruitment & selection **(GRS=.812),** Green training & development **(GTD=.781),** Green compensation & benefits **(GCB=.854),** Green performance management **(GPM=.901),** Green employee relation **(GER=.773),** Green Innovation **(GI=.846),** and sustainable performance **(SP=.865);** values higher than 0.7, proving that the scale used in the current research is reliable. The evidence supports this conclusion. **(See table 3)**.

**Table 4**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Variables** | **KMO** | **BTS** |
| **Independent variables** | **GHRM Practices**Green recruitment & selection (GRS) | **.884** | Chi square (845.061)P =.000 (< .05) |
|  | Green training & development (GTD) | **.839** | Chi square (617.790)P =.000 (< .05) |
|  | Green compensation & benefits (GCB) | **.610** | Chi square (762.506)P =.000 (< .05) |
|  | Green performance management (GPM) | **.698** | Chi square (224.482)P =.000 (< .05) |
|  | Green employee relation (GER) | **.774** | Chi square (924.548)P =.000 (< .05) |
| Dependent variable | Sustainable Performance (SP) | **.725** | Chi square (492.563)P =.000 (< .05) |
| Mediator | Green Innovation (GI) | **.825** | Chi square (623.824)P =.000 (< .05) |

The sample meets the criteria for adequacy, as shown by the table presented above. The KMO values above 0.50, consistent with the previously established standards. Consequently, it is evident that the values of the variables in BTS are acceptable; this study found support for the alternative hypotheses. **(See Table 4)**

**Hypotheses Testing**

**Table 5 Coefficient summary of *GHRM practices on SP***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Path** | **Beta value** | **T value** | **P value** | **Supported** |
| **H1:** GRS -> SP | .663 | 16.076 | .000 | **(Yes)** |
| **H2:** GTD -> SP | .682 | 10.540 | .000 | **(Yes)** |
| **H3:** GCB -> SP | .153 | 2.32 | .021 | **(Yes)** |
| **H4:** GPM -> SP | .799 | 19.675 | .000 | **(Yes)** |
| **H5:** GER -> SP | .174 | 2.52 | .001 | **(Yes)** |
| **Dependent variable: SP** |  |  |  |  |

The hypotheses were evaluated with the use of SPSS version 24.0, which was utilized to perform regression analysis on the dataset. Based on study findings, shows that (GRS) has positive and significant impact on sustainable performance **(*B* =.663, *t* = 16.076, *p* =.000).** Similarly, green training & development on sustainable performance **(*B* =.682, *t* = 10.540, *p* =.000),** green compensation & benefits has positive and significant on sustainable **(*B* =.153, *t* = 2.32, *p* =.000),** green performance management has positive and significant on sustainable **(*B* =.799, *t* = 19.675, *p* =.000),** and green employee relation has positive and significant on sustainable **(*B* =.174, *t* = 2.52, *p* =.000),** respectively. Therefore, this study identified support for H1, H2, H3, H4, and H5 hypotheses. **(See table 5)**

**Table 6 Mediation analysis**

|  |  |
| --- | --- |
|  **Green recruitment & selection -> Green innovation -> sustainable performance** |  |
| GRS -> GI.7285 | GI -> SP.3373 | Direct effect.5849 | Indirect effect.2457 | Total effect.8306 | Sobel test3.97 | SupportH6**(Yes)** |
| **Green training & development -> Green innovation -> sustainable performance** |  |
| GTD -> GI.7455 | GI -> SP.3642 | Direct effect.3766 | Indirect effect.2715 | Total effect.6481 | Sobel test4.81 | SupportH7**(Yes)** |
| **Green compensation & benefits -> Green innovation -> sustainable performance** |  |
| GCB -> GI.6426 | GI -> SP.5140 | Direct effect.3178 | Indirect effect.3321 | Total effect.6499 | Sobel test2.96 | SupportH8**(Yes)** |
| **Green performance management -> Green innovation -> sustainable performance** |  |
| GPM -> GI.5875 | GI -> SP.3661 | Direct effect.3466 | Indirect effect.2151 | Total effect.5617 | Sobel test3.11 | SupportH9**(Yes)** |
| **Green employee relation -> Green innovation -> sustainable performance** |  |
| GER -> GI.3404 | GI -> SP.6411 | Direct effect.4547 | Indirect effect.2182 | Total effect.6729 | Sobel test4.28 | SupportH10**(Yes)** |

The current study examined green innovation (GI) as mediator between GHRM practices i.e., green recruitment & selection (GRS), Green training & development (GTD), Green compensation & benefits (GCB), Green performance management (GPM), Green employee relation (GER) on sustainable performance(PS). According to results, GI partially mediates the relationship GRS and SP (Z=3.97, p=.000). Similarly, GI mediates the relationship GTD and SP (Z=4.81, P=.000), GI mediates the relationship between GCB and SP (Z=2.81, P=.000), GI mediates the relationship GPM and SP Z=3.11, P=.000), and GI mediates the relationship GER and SP Z=2.28, P=.000), Hence, this study identified support for hypotheses H6, H7, H8, H9, and H10.

**Discussion**

The research investigates the dynamic effect of green HRM practices on sustainable performance in Pakistan's Khyber Pakhtunkhwa manufacturing industry. The literature was used to build a model, which was then tested for reliability and validity. The result of the present study shows green recruitment & selection has positive and significant effect on sustainable performance. Similarly, green training & development has positive and significant effect on sustainable performance. Green compensation benefits have positive and significant effect on sustainable performance. Green performance management has positive and significant effect on sustainable performance. Green employee relation has positive and significant effect on sustainable performance. Additionally, Green innovation partially mediates the relationship between GHRM practices i.e., green training & development, green compensation benefits, Green performance management, Green employee and sustainable performance. This technique helps to cultivate a sustainable workforce by confirming that new workers share the organization's environmental principles. Shahzad et al. (2023) found that companies that recruit with a concentrate on the environment tend to have staff members who are more invested in sustainability efforts. Green ideas and environmentally friendly business practices are more likely to come from a staff that shares these ideals. Employees are more inclined to act sustainably if sustainability measures are a part of performance management systems. Research has shown that including sustainability objectives into performance assessment systems may increase workers' dedication to environmentally friendly activities (Adeoye et al., 2023). Companies may encourage energy efficiency, waste reduction, and better environmental compliance among workers by connecting employee performance with sustainability results. Staff members may better support the company's green efforts when they get training that emphasizes environmental sustainability. Employees exhibit more environmental consciousness and pro-environmental activities subsequent to green training, as previously shown in study (Shah et al., 2023). In order to innovate continuously and improve sustainability practices in industrial processes, this body of knowledge is essential. Employees are more likely to work together towards shared environmental objectives in an organization with strong green employee relations. Employees are more inclined to participate in environmentally friendly practices when they believe their company is really dedicated to sustainability, according to the literature (Qi et al., 2024). Employee happiness and overall sustainability performance are both enhanced in collaborative workplaces characterized by trust and shared ideals. There is a clear incentive for green behavior when staff is rewarded for implementing sustainable methods. Employees are more motivated to achieve environmental goals when their income is green or when incentives are tied to sustainability performance, according to research (Min et al., 2024). Such incentives make sure that staff is rewarded for their efforts toward green objectives and that sustainability is part of the company's culture. Importance of Previous Results for Ongoing Studies Research has shown time and time again that GHRM practices lead to better sustainability results. For example, according to Shah et al. (2023), GHRM practices are critical for incorporating sustainability into the culture of organizations. Furthermore, in industrial environments, green performance management improves environmental performance (Qi et al., 2024). The significance of integrating HRM strategies with sustainability objectives to boost manufacturing companies' financial and environmental performance is highlighted by the present study, which is in line with these results. Green employee relations and pay systems that acknowledge and reward sustainable activities lead to increased levels of involvement and performance in sustainability programs, as shown in studies by Adeoye et al. (2023). Organizations with robust sustainability practices are in a better position to fulfill regulatory requirements and market demands for eco-friendly products and processes, which in turn improves the manufacturing industries' environmental footprint and promotes long-term competitive advantages.

**Practical implications**

During the hiring process, manufacturing companies should give sustainability ideals first priority. To do this, it may be necessary to gauge potential employees' level of environmental consciousness, their interest in and capacity to implement green projects, and how well their values mesh with those of the company. Companies may foster long-term sustainability by hiring people who are enthusiastic about environmental problems. This will lead to a staff that is more dedicated to green practices. Interviews and performance reviews conducted by human resources experts should include questions and criteria centered on candidates' environmental commitment. Performance management systems should include sustainability-related key performance indicators (KPIs). For example, you may encourage your staff to cut down on energy use, trash production, or inefficient use of resources by outlining concrete green goals for them to achieve. Making sustainability an inherent aspect of individual and team ambitions, these environmental goals should be included in regular assessments of staff performance. An effective way to motivate workers and encourage their increased participation in green projects is to provide them with clear feedback and assistance on their sustainability performance. Businesses in the manufacturing sector would do well to institute ongoing education and training programs that emphasize sustainable practices like recycling more, using less energy, and reducing their environmental impact. Everyone from operators to upper management should have their own specialized program. Employees may be more prepared to contribute to the company's green goals if they get training on cutting-edge green technology, environmental legislation, and creative sustainable practices. In addition, keeping the workforce flexible in the face of ever-changing environmental issues is achieved via encouraging a culture of sustainability learning. When it comes to sustainability efforts, manufacturing organizations should prioritize creating strong, open lines of communication between management and staff. Encouraging employees to work together and share ideas for how to improve environmental performance is crucial. By forming green teams or sustainability committees, employees can feel more invested in green projects and be more motivated to come up with innovative solutions. Employees are given an opportunity to make a difference and the company's dedication to environmental principles is strengthened via frequent discussions on sustainability objectives. To encourage workers to take part in environmental efforts, businesses should link pay and incentives with sustainability results. Employees are more likely to engage in environmentally conscious practices when they are financially rewarded for going above and above in areas such as waste reduction, energy efficiency, and participation in green projects. Companies could think about providing incentives like discounted green items, additional time off, or incentives for environmentally friendly transportation to workers who contribute significantly to sustainability initiatives. That environmental sustainability is an important component of employee compensation is further supported by research.

## Theoretical implications

Existing theories in the fields of sustainability, organizational behavior, motivation, and human resource management are enriched and expanded by the theoretical implications of green HRM practices in manufacturing companies. Scholars could gain a better grasp of how HRM practices impact corporate competitiveness in an environmentally concerned market by including sustainability into HRM. In addition, by creating new theoretical frameworks, we may better understand how human capital, sustainability objectives, and corporate performance are interdependent. This will improve our understanding of how Green HRM can be used to drive sustainable results.

**Limitations and Future study**

This study has few limitations that future researchers must overcome for benefits to the environment. This study was conducted in a confined Khyber Pakhtunkhwa region. Environmental deterioration is not limited to Khyber Pakhtunkhwa; other Pakistani provinces may also be explored. Second, the study specially included manufacturing industries in KPK, Pakistan. Our results cannot be generalized due to this limitation. More research may be done in services, construction, agriculture, transportation, textiles, and pharmaceutical to extend the study's scope. The study data was collected by questionnaire, which may have persuaded incorrect responses. This conceptual model should be studied using different analytical methods, such as open-ended participant answers. Sustainable management should also be assessed in the company's environmental performance. To expand the study, further factors may be included. This research explored few variables. To fill this gap, future study should include employee green trust, pro-environmental behavior, harmonious environmental passion, as mediators and moderators. It provides an essential green innovation management framework. The study solely investigates how green human resource management practices on sustainable performance. The dynamics of recommended green organizations should be studied using more reliable measures.

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